Ca' Foscari
University
of Venice

Master's Degree programme

in Language and Management to China

Final Thesis

Blockchain Technology in China and Its Application in the Chinese Accounting Sector

Supervisor
Ch. Prof. Michela Cordazzo

Assistant supervisor
Ch. Prof. Franco Gatti

Graduand
Paolo Radice
Matriculation Number 885350

Academic Year
2021 / 2022

前言

近年来，区块链已成为中国最著名的新兴技术之一。最初，区块链技术开发和应用被谨慎观察。然而，中国中央政府越来越将其视作一个机会。

本论文的目的是了解区块链技术在中国和中国会计行业的发展和应用的发展趋势，以及政府对新一代信息技术的态度。鉴于中国及其会计行业区块链技术开发和采用的政策框架以及现有的相关文献，有关中国区块链生态系统的二级数据被分析和解释了。主要结果如下。

中国政府于 2016 年开始积极支持其开发和采用，作为中国信息化战略的一部分。区块链技术的大力推广源于政府对信息化过程的促进，尤其是在工业，作为中国经济和社会发展的重要手段。2016年，政府如何致力于在全球区块链行业中占据主导地位，并利用这一前沿技术加速大数据行业的研发，这一点变得显而易见。自 2021 以来，区块链技术被视作实施国家发展战略的关键新兴产业，旨在将国家发展成为“制造强国”和区块链等关键新行业的全球领导者。就与区块链在会计行业中有关的政策框架而言，中国会计行业和会计职业的扩张总体上受到了信息技术的显著推动，以达到国际同行水平。在一些大型会计企业开始采用区块链之后，该技术于 2021 首次被纳入中国注册会计师协会的信息化战略。中注协确定，将区块链技术应用于大型企业审计系统的现代化，并在会计行业进一步采用。

文献综述表明，中国的区块链技术开发和应用仍处于比较初级的阶段。然而，由于政府的积极推动，区块链产业正在扩大。大多数作者同意区块链技术正在重塑根深蒂固的工业体系，以利于透明、共享和协作。区块链的使用始于加密货币，并迅速扩展到广泛的领域，包括会计。在会计领域，区块链有着广阔的前景。虽然区块链技术在这一领域的质量和效率方面带来了显著的好处，但它也可能改变会计和审计的传统角色。一方面，它导致了这些活动的重大进展，但另一方面，也带来了一些问题，如技术安全风险、有会计和 IT 复合知识的人才的缺乏以及会计准则不一致，这些问题必须得到解决，区块链技术才能在会计行业蓬勃发展。

对政府机构和私有机构发布的数据的分析表明，中国区块链行业正在发展，但也必须应对一些挑战。由于中国在区块链企业和行业联盟中的份额极大，因此在全球区块链行业中具有强大的影响。在中央和地方政策的推动下，区块链企业在最发达地区（即北京、上海、浙江和广东）的数量和集群不断增加，但也在向中国中西部扩张。然而，只有一小部分企业实际推出了区块链业务，而该行业的监管大多在北京和上海取得了进展。大多数企业只进行下游经营过程，由注册资本在一百万至一亿元之间的小型初创企业组成，受益于外商投资和特殊政策推动的国内融资的增加。企业投资从工业转向金融行业，又转向技术研发。越来越多

区块链企业也在海外投资。区块链产业主要关注应用和解决方案，其场景正在扩展，但主要针对金融服务。与其他国家相比，中央政府的项目相对较少，但省级项目有九十多个，主要是政府服务项目。创新产出也相对较大且不断增长，因为中国在区块链相关专利申请和研究论文数量上都排名第一，但专利的创造性、竞争力和质量可能相对较低。大多数专利申请都是阿里巴巴提出的，主要在安全和智能合约的领域。研发投资和工业园也在增长。从这一分析中，出现了四个问题：人才短缺、技术不成熟、采用受限和监管不力。在会计方面，定量数据的短缺表明，“区块链加会计”的应用探索和试验、研究、创新和投资目前仍然受到限制。然而，区块链预计在未来几年将在会计领域变得更加重要。

Table of Contents

List of Exhibits

List of Tables

Introduction

A blockchain, or Distributed Ledger Technology (DLT), is a decentralized, distributed and public digital ledger, which is jointly maintained by multiple parties, or nodes, using cryptography to ensure the security of data transmission, storage, and access.[1]

Blockchain was conceptualized by Satoshi Nakamoto in October 2008 as the underlying technology of cryptocurrencies. In its publication, "Bitcoin: A Peer-to-Peer Electronic Cash System", he recognizes the need for an electronic payment system that relies on cryptographic verification rather than trust. Therefore, he proposes

> "a peer-to-peer network using proof-of-work to record a public history of transactions that quickly becomes computationally impractical for an attacker to change if honest nodes control a majority of CPU[2] power."[3]

In recent years, blockchain has been one of China's best-known emerging technologies. Initially, its development and application were observed with concern. The Chinese government actually placed a stringent prohibition on Initial Coin Offerings (ICOs)[4] and strict regulations on cryptocurrency trading in September 2017 to manage and minimize the possible financial risks brought on by speculative bubbles in cryptocurrency markets. Nevertheless, China's central government has increasingly seen it as an opportunity and in October 2019 Xi Jinping emphasized the significance of blockchain technology in the current wave of technical innovation and industrial transformation and called for further efforts to advance the sector's development.[5] Subsequently, Chinese regulators have been quite enthusiastic and interested in the cutting-edge blockchain technology that was generated from Bitcoin. On this note, the objective of this work is to understand the development and deployment of blockchain technology in China in connection to the Government's stance on this frontier information technology and how it informs the domestic and international strategies. Since blockchain was born as a distributed record of transactions, this study also investigates the role of this technology in the

[1] China Academy of Information and Communications Technology, 2018.

[2] Central Processing Unit, i.e. the component of a computer that manages all other components. (Cambridge Advanced Learner's Dictionary & Thesaurus, 2020).

[3] Nakamoto, S., 2008.

[4] "The first public sale of a cryptocurrency", roughly equivalent to an Initial Public Offering (IPO) in the traditional investment world. (Cambridge Advanced Learner's Dictionary & Thesaurus, 2020).

[5] Hua X., 2019.

Chinese accounting sector, how it can transform accountancy in China, and the extent of its application in this sector. Through the analysis of the main policies related to blockchain in China and the review of the existing literature on the matter, secondary empirical data will be presented and interpreted maintaining a double perspective: a macroeconomic one, which considers the whole blockchain industry ecosystem, and a microeconomic one, which focuses on the combination of blockchain and accounting in China.

This work is divided in three chapters. The first chapter introduces to the institutional norms published by the major bodies regulating the blockchain technology in China in the first paragraph. The policies are presented following a chronological order to highlight the evolution of Chinese institutions' attitude towards the blockchain technology, which is marked by two key turning points: the inclusion of blockchain in the national informatization strategy, and the elevation of blockchain to the level of key strategic industry for the attainment of national socioeconomic development. The second paragraph of this chapter focuses on the blockchain-related policy framework in the accounting sector, which is articulated according to the Informatization Strategy of the Chinese Institute of Certified Public Accountants (CICPA).

The second chapter presents a review of the existing literature on the matter of blockchain technology in China and Chinese accountancy. It is also divided in two paragraphs: the literature about blockchain in China is examined and summarized in the first paragraph, which describes the ecosystem of the blockchain industry in China from the perspective of several authors and presents the challenges to blockchain development and corresponding countermeasures signaled and suggested by them; while the second paragraph explains the potential of blockchain technology to transform the Chinese accounting sector compared to its actual status, and summarizes the challenges affecting it and possible solutions.

The last chapter explains the research method employed to collect and analyze empirical data and presents the results in light of the regulatory framework and the publications reviewed, delineating the trends in China's blockchain industry, the current challenges, and how blockchain is seen as a leading accounting technology in the future.

Chapter 1. Regulatory framework of the blockchain technology in China

This chapter introduces to the institutional norms of the major bodies regulating the blockchain technology in the People's Republic of China from both a macro- and microeconomic perspective.

The sources of norms include plans, white papers, opinions, guiding opinions, provisions and measures.

The major entities involved in the regulation of the blockchain technology in China are: the State Council, the Ministry of Industry and Information Technology (MIIT), the Cyberspace administration of China (CAC), the National Development and Reform Commission (NDRC), the China Academy of Information and Communications Technology (CAICT), the Blockchain-based Service Network Development Association (BSN Development Association), the Ministry of Finance (MOF), and the Chinese Institute of Certified Public Accountants (CICPA). Some other bodies are not majorly involved in the regulation of blockchain but still collaborated in the preparation of some norms and they are: the Ministry of Education (MOE) and the Shanghai Higher People's Court.

The macroeconomic perspective is intended as the general regulatory and political framework regarding blockchain technology on the national level, while the microeconomic perspective focuses on the application of blockchain technology to the accounting field. For the macroeconomic part, this work presents the norms mentioned in a publication of the European Union Institute for Security Studies (EUISS)[6] and on the website of the Seconded European Standardization Expert for China (SESEC) project;[7] while for the microeconomic part the CICPA's Strategy for Informatization[8] was taken as a reference for the selection of relevant norms. In addition, new research was conducted to complement the list in both sections.

The institutional norms are presented below following a chronological order to highlight the evolution of Chinese institutions' attitude towards the blockchain technology.

[6] Ekman, A., 2021.

[7] SESEC, 2020.

[8] Chinese Institute of Certified Public Accountants, 2022.

Table 1: Timeline of China's regulations related to the informatization process and the blockchain technology

2006	Mar	**State Council** *11th Five-Year Plan for National Economic and Social Development* Informatization, as a major driver of national development, is strictly linked to industrialization and must be promoted.
2009	Oct	**MOF** *Opinions on Accelerating Development of Chinese Accountancy Profession* The Chinese accountancy profession must be informatized to measure up to international counterparts.
2011	Mar	**State Council** *12th Five-Year Plan for National Economic and Social Development* Informatization must develop sustainably and comprehensively and its application is promoted.
2012	May	**CICPA** *Overall Plan for Informatization of Chinese Accountancy Profession* By 2015, big accounting firms will have world-class IT infrastructures.
2014	Sep	**CICPA** *Incentive Measures for Informatization of Accounting Firms* A monetary reward is given to accounting firms for outstanding efforts in informatization.
2016	Mar	**State Council** *13th Five-Year Plan for National Economic and Social Development* Breakthroughs in and adoption of IT is promoted further.
	Oct	**MIIT** *White Paper on Blockchain Technology and Application Development* First white paper on blockchain. It proposes a roadmap for blockchain development and standardization.
	Nov	**CICPA** *Development Plan of Accounting Sector in China (2016-2020)* Modern IT should be fully used in the accounting sector to improve professional services.
	Dec	**CICPA** *Development Plan for Informatization of Accounting Sector in China (2016-2020)* By 2020, the accounting sector will be highly equipped with IT.
		CAC *13th Five-Year Plan for National Informatization* Blockchain is mentioned for the first time in a Five-Year Plan. China aims at dominating in the field of new generation IT on the international level.
		MIIT *Software and Information Technology Service Industry Development Plan (2016-2020)* Blockchain will reach the international advanced level of innovation by 2020.
		MIIT *Big Data Industry Development Plan (2016-2020)* Blockchain support is needed to accelerate R&D in big data.
2017	Nov	**State Council** *Guiding Opinions of the State Council on Deepening the "Internet + Advanced Manufacturing" and Developing the Industrial Internet* Additional exploration of and research on blockchain application is needed.
2018	May	**MIIT** *Blockchain Industry White Paper* The blockchain industry is developing at full speed and by 2021 it will be widely integrated in the real economy.
	Sep	**NDRC**, **MIIT**, **MOE** *Guiding Opinions on Developing the Digital Economy to Stabilize and Increase Employment* Digital talent training is required to develop the digital economy.

2019	Jan	**CAC** *Provisions on the Administration of Blockchain Information Services* The activities of blockchain information service providers and users are regulated. The former are required to register with the CAC.
	Jun	**CAICT**, **Shanghai Higher People's Court** *White Paper on Blockchain Technology Application in Judicial Evidence Storage* The range of blockchain application scenarios expand from the financial economy towards the real economy.
2020	Feb	**BSN Development Association** *Blockchain-based Service Network (BSN) Introductory White Paper* Blockchain infrastructure construction goes global.
2021	Mar	**State Council** *14th Five-Year Plan for National Economic and Social Development* Blockchain will contribute to the implementation of the "Digital China" national strategy.
	Apr	**CICPA** *Development Plan of Accounting Sector in China (2021-2025)* The focus is on digitalization and quality improvement through the "3456" informatization project.
		CICPA *Development Plan for Informatization of Accounting Sector in China (2021-2025)* Blockchain is mentioned for the first time in the Informatization Strategy of the accounting sector. Some big accounting firms already use blockchain, but overall it should still be used to upgrade the audit system and further applied in the accounting sector.
	Jun	**MIIT**, **CAC** *Guiding Opinions on Accelerating and Promoting Blockchain Technology Applications and Industrial Development* By 2025, Blockchain will reach the world's most advanced level. By 2030, it will be further strengthened, its application scenarios will also expand further and blockchain technology will be further integrated with other new IT.
	Dec	**CAC** *14th Five-Year Plan for National Informatization* China is the world's first source of blockchain patent applications but the blockchain industry must improve further.

1.1. Macroeconomic perspective: blockchain regulations on the national level

As summarized in Table 1, blockchain is mentioned for the first time by the State Council in the 13th Five-Year Plan for National Informatization, where it is regarded as a key frontier technology. The innovation, testing and application thereof should be reinforced for China to dominate in the field of new generation IT. Despite the blockchain technology was first invented in 2008, before this Plan, blockchain itself was never part of national strategies. However, when information technologies as a whole are considered it is useful to analyze also the Government's attitude towards them in the previous years in order to better understand the way blockchain has gained importance over time. Since the 11th National Five-Year Plan, the process of informatization has always been of great importance

for the national economic and social development. That Plan highlights the link between informatization and industrialization and promotes the improvement of and investments in informatization. The 12th National Five-Year Plan promotes the application and the sustainable and comprehensive development of informatization, and the 13th National Five-Year Plan further promotes the adoption of and breakthroughs in IT. Before becoming a crucial element of the national informatization strategy, blockchain is dedicated a comprehensive white paper by the MIIT, according to which, blockchain development should undergo the four stages of technical research, platform construction, technology optimization and application trials, and can be promoted by establishing a system of standards. It is only with the 13th Five-Year Plan for National Informatization that the interest of the Chinese government to dominate in the blockchain industry becomes clear. Subsequently, blockchain is also mentioned in other plans such as the Software and Information Technology Service Industry Development Plan (2016-2020) and the Big Data Industry Development Plan (2016-2020). The former aims at reaching the international advanced level of innovation in blockchain by 2020, while the latter requires to support blockchain to accelerate big data research and development. Also the Guiding Opinions of the State Council on Deepening the "Internet + Advanced Manufacturing" and Developing the Industrial Internet stress the importance of further exploring and researching on blockchain application. According to the 2018 Blockchain Industry White Paper, the blockchain industry is developing rapidly and will be widely integrated in the real economy by 2021, but it requires the improvement of worker's digital skills, as specified in the Guiding Opinions on Developing the Digital Economy to Stabilize and Increase Employment. In 2019 the activities of blockchain information services are standardized in the Provisions on the Administration of Blockchain Information Services and the shift of its application scenarios from the financial economy to the real economy is exemplified by the White Paper on Blockchain Technology Application in Judicial Evidence Storage. In 2020 the progress in blockchain infrastructure construction becomes evident with the Blockchain-based Service Network (BSN) Introductory White Paper. Subsequently, in the 14th National Five-Year Plan, blockchain further gains of importance and is integrated in the national development strategy. The Guiding Opinions on Accelerating and Promoting Blockchain Technology Applications and Industrial Development set that blockchain will reach the world's most advanced level by 2025 and will be further strengthened, expanded and integrated by 2030. For now, as stated in the 14th Five-Year Plan for National Informatization, China has become the world's first blockchain patent application source, but it still needs better governance and standardization, further research, deeper application and improved infrastructure in the blockchain field.

In synthesis, the evolution of the Government's attitude towards blockchain technology is marked by two key turning points: the inclusion of blockchain in the national informatization strategy with the

13th Five-Year Plan for National Informatization, and the elevation of blockchain to the level of key strategic industry to attain national socioeconomic development in the 14th Five-Year Plan. This chronological division offers a proper criteria for the organization of this paragraph into three parts: the first part will analyze the sources of law issued before the 13th Five-Year Plan for National Informatization; the second part will consider the plans, guiding opinions, white papers and provisions issued in the 13th five-year period (2016-2020); the third part will focus on the legislative output produced up to date in the 14th five-year period (2021-2025).

1.1.1. Informatization of the industrial sector and blockchain technology development

Before blockchain technology was first mentioned in a national plan, namely the 13th Five-Year Plan for National Informatization, the Government had attached a great deal of attention to the informatization of the industrial sector to attain national economic and social development, promoting its sustainable and comprehensive development and application, and breakthroughs in information technology. At the same time, the Government had recognized the importance of Nakamoto's technology and started focusing on its development and standardization. This subparagraph studies the role of informatization in the 11th, 12th, and 13th Five-Year Plans for National Economic and Social Development and analyzes the White Paper on Blockchain Technology and Application Development of the Ministry of Industry and Information Technology.

In the 11th National Five-Year Plan informatization is presented as a crucial driver of national economic and social development, strictly integrated with industrialization and applicable to a rather vast array of fields. The informatization process must be improved and is financially supported by the government. According to the second chapter "Fully implement the scientific outlook on development", pushing the informatization of national economy and society is a way of accelerating the change of economic growth mode, which is necessary for China to adhere to the principle of maintaining a stable and fast economic development, in order to implement national development in general. In Chapter 15, "Actively promote informatization", this process is seen as strictly linked to industrialization in the sense that these two processes mutually reinforce each other; informatization should be a driver of industrialization and industrialization should be a promoter of informatization with the objective of improving economic and social informatization. This chapter focuses on the informatization of the manufacturing industry, the development of information resources, the improvement of information infrastructure and the reinforcement of information security protection. According to Chapter 45, informatization should be further applied to the military. The informatization of the army is necessary to improve defense combat capabilities, and in order to strengthen military construction, informatization must be developed together with mechanization. Therefore,

informatization can strengthen national defense mobilization. In Chapter 47, informatization and information security infrastructure are listed amongst the key areas supported by government investment.

In the 12th five-year period, the importance of informatization increases in the sense that it must be more widely applied, more sustainable, and more comprehensive. As from Chapter 1, China keeps considering the informatization process a key driver of domestic development. As a matter of fact, the range of areas that should further undergo such process has widened; according to Chapters 5, 9, 11, 12, 15, 20, 34, 38, and 60 it includes the following areas: agriculture, construction industry, R&D design, production, logistics, distribution, enterprise management, energy transmission channels, transportation, digital cities, healthcare, community governance, and the military. From Chapter 10 it is clear that China's development is turning towards sustainability. As stated in the text, new generation information technology should be developed attaching great attention to energy saving and the environment in general. Moreover, in Chapter 13 it is evident how China wants to increase the informatization level in an all-around manner. Therefore, new-generation information infrastructure and socioeconomic information technology must be built. In order to implement the construction of socioeconomic IT, it is necessary to promote information sharing, enhance auditing systems, and strengthen network and information security by improving laws, regulations, and standards.

The 13th National Plan aims at further developing information technology adoption and making significant breakthroughs in core technologies in key sectors such as next generation information and communications. Therefore, China plans to encourage more foreign capital investment in new technology.

The White Paper on Blockchain Technology and Application Development analyzes the situation of blockchain development both abroad and in China and provides a framework for the future development of blockchain technology and standardization. For the purposes of this research, only the parts concerning China are taken into consideration.

The need for this white paper originates from the fact that several Chinese companies in the fields of finance, Internet, IT, and manufacturing are actively investing in the research and development of blockchain technology and the promotion of blockchain applications. Therefore, this white paper aims at actively guiding the development of blockchain technology and applications in China, which is already advancing rapidly.

The white paper is divided into five sections: 1) current situation of blockchain development in China and abroad; 2) blockchain typical application scenarios; 3) blueprint of blockchain technology development in China; 4) blueprint of blockchain standardization in China; 5) suggestions on the promotion of blockchain development.

The first section analyzes the evolution and ecological structure of blockchain development, presents the types of participants in blockchain development, and discusses the attitudes of relevant institutions in different countries, and the relationship of blockchain with other new generation IT. The Chinese companies that participate in blockchain development are key Internet and IT enterprises such as Wanxiang Group, Ant Financial, Wanda Network Technology, and WeBank, which have entered the blockchain industry, developing or launching infrastructures and applications; some startups in the blockchain field have also sprung up, applying blockchain technology to financial and non-financial fields, and some technology-based companies that provide development platforms for blockchain developers have also emerged. Since blockchain technology is still in its early stage, investments mainly come from venture capital institutions, but traditional financial institutions (e.g. Goldman Sachs) are also important. Before 2015, investments were mainly directed to bitcoin-related enterprises, while with the development of blockchain technology, funds have been increasingly invested in blockchain technology R&D and industrial applications. Since 2015, mainstream financial institutions around the world have begun to deploy blockchain. In China, the Shanghai Stock Exchange has also conducted in-depth exploration of blockchain technology. The main regulatory authority in China is the China Internet Finance Association (Zhongguo hulianwang jinrong xiehui 中国互联网金融协会), which established a blockchain research working group to conduct in-depth research on the application and impact of blockchain technology in the financial field. Both government and banking institutions have adopted positive attitudes to blockchain; the Chinese government deems necessary to actively discuss the promotion of blockchain technology and applications development; in February 2016, Zhou Xiaochuan, president of the People's Bank of China stated that the bank had deployed an important force to study and discuss blockchain application technology. He believed that blockchain technology at that time had the problem of occupying so many computing and storage resources that it could not cope with the volume of transactions; in September 2016, Fan Yifei, vice president of the People's Bank of China, proposed in the 2015 Bank Science and Technology Development Award Review Leading Group Meeting that all institutions should actively explore the transformation of the system infrastructure, and actively study the establishment of a flexible, strongly scalable, safe and controllable distributed one, and at the same time, continuously pay attention to emerging technologies such as blockchain, innovate services and products, and promote inclusive finance.

Blockchain and other new generation information technologies (IT) mutually reinforce; the development of blockchain technology and applications requires new generation IT as infrastructure support: cloud computing provides the deployment infrastructure, big data provides storage infrastructure, cryptography provides encryption infrastructure, IoT provides devices network infrastructure,

AI improves the application, and next generation network provides the communication infrastructure; at the same time, blockchain technology and applications development plays an important role in promoting the development of new generation IT industry.

The second section discusses the typical application scenarios of blockchain technology. Until 2016, the application of blockchain had already extended from a single digital currency application, such as Bitcoin, to various fields of the economy and society, including financial services, supply chain management, culture and entertainment, intelligent manufacturing, social welfare, education and employment. In addition, besides the relatively mature applications in the financial services industry, applications in other industries were still in the initial stage of exploration.

The third section discusses the technical requirements of blockchain, key programs, protocols, and algorithms, blockchain governance rules, security issues and development trends, before suggesting a blueprint for the development of blockchain technology in China. Besides general technical requirements such as having distributed systems, cryptographic algorithms, and member management, blockchain technology and application should meet seven specific technical requirements: 1) core functions should be modularized, configurable and extensible to easily build upper-layer applications; 2) higher performance than mainstream transaction networks; 3) consistency of data; 4) interoperability; 5) economical and reasonable, with low energy consumption; 6) ensure the security and privacy protection of data; 7) safe and reliable. Based on these technical requirements, a blockchain technology architecture is proposed, including core technical and application components and supporting facilities, and key and core technologies such as consensus mechanism, data storage, network protocol, cryptography, privacy protection, and smart contracts are explained. Blockchain governance rules are set by blockchain participants and are divided into technical rules and regulatory rules; the first ones refer to technical elements (e.g. software, protocols, programs, algorithms, and supporting facilities), while the second ones consist in regulatory frameworks, articles, and industry policies. Governance models vary according to the type of blockchain (public, proprietary, and alliance). About blockchain security, the risks faced by blockchain systems can originate from external entities' attacks or internal actors and component failures. Therefore, before the implementation of blockchain systems, it is necessary to develop a risk model and identify special security needs. Blockchain technology is also characterized by unique security features: 1) written data authenticity is recognized only when most of the nodes (or multiple key nodes) in the whole network simultaneously believe that a record is correct; 2) the reading of data is controlled through cryptography and complex consensus protocols ensure that anyone in the system sees the same ledger, which prevents double spending; 3) Distributed Denial of Service (DDOS) attack resistance ensures that in case one node fails, other nodes are not affected, and users connected to the failed node generally cannot connect to the

system. Blockchain technology faces a number of security challenges, therefore countermeasures are necessary. For instance, to tackle the network's openness and lack of protection, greater privacy and careful control of network connections is needed. The responses to a lack of legal privacy protection are not recording user data and personal behavior, limiting transaction data transmission to relevant nodes, encrypting data, and using algorithms such as the "zero-knowledge proof". The means to cope with the risk of an organization controlling the majority of the computing power are asset mortgages, and legal and regulatory constraints. To improve the blockchain security system, the physical environment should be protected, for instance, by VPN private network, firewall, and physical isolation; data should be transmitted using encryption algorithms, or even desensitized, and the encryption key should not be stored on the same node and should undergo a short life cycle; the relevant personnel, transaction nodes, and transaction data involved in the application should be controlled and auditable; an effective risk control mechanism is also necessary. The development trends of blockchain technology are introduced by focusing first on key and core technologies (e.g. distributed data storage, point-to-point transmission, consensus mechanism, encryption algorithm, etc.) and then on general development platforms. New and higher requirements will continue to be imposed on key and core technologies. It is important to achieve new research results in consensus mechanisms, security algorithms, and privacy protection, and pursue continuous innovation of these technologies. Consensus mechanisms have low performance and high energy consumption in public chains, while they reduce efficiency, constraints, and fault tolerance in alliance chains, therefore universal and better consensus algorithms will probably continue to emerge. Most of the traditional security algorithms need to be gradually replaced, strengthened, and upgraded; however, it is also necessary to prevent new technologies, such as quantum computing, from impacting and even subverting them. Privacy protection, which is still relatively weak in blockchain, should be balanced with compliance regulations. Information privacy protection technologies, such as zero-knowledge proof and homomorphic encryption, are also an important direction for subsequent development. At present, many IT companies, consulting companies, communities and technology alliances have invested in applied research in blockchain, and established a general development platform, which is composed of an infrastructure support layer, a blockchain core component service layer, and a corresponding development test suite. It provides a one-stop, low-cost technical service for building and deploying blockchain applications. Such platforms are going to develop in the direction of service coverage, R&D convenience, operation and maintenance intelligence, high stability, large capacity, and low costs. In order to promote and provide direction for the development of China's blockchain technology, a development blueprint of blockchain technology is proposed, and its tasks are grouped into four stages:

1) Demand analysis and technical system research:

1. study the requirements and use cases of typical application scenarios;
2. research and propose a general blockchain technology architecture;
3. tackle and solve key and core blockchain technologies;
4. improve the governance scheme and security mechanism of blockchain technology;
5. form a safe and reliable blockchain technology and product system.

2) Key technology solutions selection and platform construction:
    1. assess the applicability and maturity of various key blockchain technologies;
    2. carry out technology solution selection and feasibility verification;
    3. form a blockchain technology solution;
    4. build a blockchain underlying technology platform that meets common needs.
3) Technology open source and optimization:
    1. promote the open sharing of the underlying technology platform;
    2. promote open source code for technical solutions;
    3. establish an open source community and collaborate to optimize the underlying technology platform and technical solutions.
4) Application pilot:
    1. promote the testing and trial operation of typical application scenarios on the blockchain open source underlying technology platform;
    2. according to the needs and problems of trial operation of application scenarios, continue to iteratively update the technical platform and technical solutions;
    3. select qualified industries to carry out application pilots and continue to improve the maturity of applications.

The fourth section analyzes blockchain standardization requirements and suggests a standard system framework comprising five types of standards and standards implementation plans. In 2016, there was no general standard in the field of blockchain in China yet. Blockchain applications face a series of practical problems such as poor compatibility and interoperability of various DAPPs in the market, a lack of standardized guidance for blockchain development and deployment, security issues in blockchain applications, and usage of blockchain by economic criminal activities. Blockchain standardization can solve blockchain development problems and promote blockchain applications. For enterprises standards contribute to: cost reduction, by unifying the underlying development platform and API and promoting interoperability; higher customer satisfaction, due to improved security and service quality; market expansion, by improving the versatility of blockchain-related products and services. For users, products and services that meet the standards are safe, reliable and high quality. For

the government, standards are the basis for policies and a strong market supervision. The blockchain standard system mainly addresses the following issues:

- building a standardized language for blockchain and unify the understanding of blockchain;
- unifying the underlying development platform and API of the blockchain to provide support for the development, porting and interoperability of the blockchain;
- unifying the links between different blockchains, implementing standards for trust and exchanging data, and establishing the basis for interoperability between blockchains;
- building a secure and trusted environment, standardizing blockchain-based services, and creating a good application environment.

The standard system framework proposed in the white paper groups twenty-one standards into five categories:

1. Basic standards: used to unify blockchain terms, related concepts and models, and guide the formulation of other standards. It includes four key directions: terminology and overview, reference architecture, ledger coding and identification, and standard integration application guide.
2. Business and application standards: used to regulate the design, deployment, delivery of blockchain application development and services, and transactions based on distributed ledgers. It mainly includes three directions: application maturity model, distributed ledger-based transaction specification, BaaS and transaction service quality evaluation.
3. Process and method standards: used to regulate the update and maintenance of the blockchain, and to guide the realization of communication and data exchange between different blockchains. It mainly includes four directions: cross-chain communication mechanism, cross-chain communication message specification, ledger management specification and consensus mechanism.
4. Trustworthiness and interoperability standards: used to guide the design, construction and use of blockchain development platforms, to standardize and guide the development of blockchain-related software, and to achieve interoperability, portability and compatibility. It mainly includes six directions: hybrid message protocol, block data format specification, development platform reference architecture, application programming interface (API), interoperability guidelines, and distributed database requirements.
5. Information security standards: used to guide the realization of blockchain privacy and security, as well as identity authentication. It mainly includes four directions: information security guidelines, identity authentication mechanism, certificate storage specifications and KYC standards.

The implementation plan of blockchain standardization consists in four steps: standard system pre-research to achieve the “Research report on blockchain standard system”; development of key standards which produce specific criteria; pilot project launch and promotion to achieve the “Standard verification pilot report”; standard system improvement. considering that blockchain technology and applications are still in the development stage, and the international standardization work is only in its infancy, the strategy for the development of blockchain standards will give priority to relying on the blockchain technology and industry development forum, formulate and promote group standards, and simultaneously promote international standardization work. When the conditions are ripe, it will be transformed into national standards or industry standards in time, so as to establish a blockchain standard system with coordinated development of standards led by the government and independently formulated by the market. The international standardization of blockchain is still in the early stage of research. Whether China can play an important role in the process of international standardization and whether it can increase its participation and influence largely depends on whether it can respond quickly and rationally in the early stage. To this end, we propose the following strategic recommendations:

- Track the new progress and achievements of international standardization, study the international standard system, and identify new trends, new demands and new opportunities for blockchain standardization.
- Actively participate in the work of international standardization authoritative organizations in the blockchain field and strive for more right to speak.
- Accelerate the formulation of basic standards such as reference architecture and block data format, lead or substantially participate in the formulation and revision of international blockchain standards, and promote the transformation of my country's advantageous technologies into international standards.
- Intensify efforts to build a blockchain standard system with an international advanced level and promote it internationally.

Finally, relevant suggestions for promoting the development of blockchain in China and cultivate a globally competitive blockchain industry are proposed to government authorities at all levels and concern (1) support policies, (2) technical research and platform construction, (3) application demonstrations, (4) talent training, and (5) international exchanges and cooperation. Support policies should be inspired by advanced practices of developed countries, focus on research and platform construction, combine decentralization and regulation, and encourage key enterprises and investments. Cooperation in research should be strengthened. National strategies should be combined with the development of the Internet and blockchain application demonstrations should be carried out in selected

regions and industries. A talent training system should be established and the promotion of blockchain professional training should be accelerated. On the international level, Chinese enterprises should be more influential and global and cooperate with US and EU enterprises.

1.1.2. Blockchain strategy in the 13th five-year period (2016-2020)

With the 13th Five-Year Plan for National Informatization, blockchain technology is mentioned for the first time in a national plan, epitomizing the Government's commitment to dominate in the new generation IT on the international level. In this period, China aims at reaching the international advanced level of blockchain innovation by 2020 and using it to accelerate research and development in big data. Additional exploration of Nakamoto's technology application is needed and by 2021 it will be fully integrated in the real economy. However, digital talent training must be improved, including in the field of blockchain. Subsequently, the activities of blockchain information service providers and users are regulated and the construction of a global blockchain infrastructure begins. This subparagraph analyzes the 13th Five-Year Plan for National Informatization, the Software and Information Technology Service Industry Development Plan (2016-2020), the Big Data Industry Development Plan (2016-2020), the Guiding Opinions of the State Council on Deepening the "Internet + Advanced Manufacturing" and Developing the Industrial Internet, the 2018 Blockchain Industry White Paper of the Ministry of Industry and Information Technology, the Guiding Opinions of the National Development and Reform Commission on Developing the Digital Economy to Stabilize and Increase Employment, the Provisions of the Cyberspace Administration of China on the Administration of Blockchain Information Services, the 2019 White Paper on Blockchain Technology Application in Judicial Evidence Storage by the China Academy of Information and Communications Technology, and the Blockchain-based Service Network (BSN) Introductory White Paper.

Although the corresponding National Plan does not explicitly mention blockchain and only makes reference to informatization and information technology in general, the 13th Five-Year Plan for National Informatization specifically brings up blockchain. This is the first time that blockchain is included in a Five-year Plan. It is therein referred to as one of the new technologies that are driving the evolution of cyberspace from a virtual environment where everyone is interconnected to one where everything is interconnected. It is also deemed necessary to reinforce the R&D of blockchain and other new technologies in order to build a modern IT and industrial ecosystem and leverage the first-mover advantage in this field.

The Software and IT Service Industry Development Plan was prepared by the Ministry of Industry and Information Technology to implement the overarching 13th Five-Year Plan, accelerate the construction of a manufacturing and cyber superpower, and promote the transformation of the Chinese

software and IT service industry from great to strong. It is divided in five chapters, respectively dealing with: 1) software and IT service industry development retrospection; 2) current development situation; 3) guiding ideology and development objectives; 4) main tasks and major projects; 5) safeguard measures. The plan mentions blockchain in the third and fourth chapters. In Chapter 3, one of the development objectives is to reach the international advanced level of innovation in several fields, including blockchain, by 2020. One of the main tasks presented in Chapter 4 provides for comprehensively improving the ability of innovation and development of the software and IT service industry, by strengthening basic technology research, advancing the layout of research and development of cutting-edge technologies, building a core technology system, accelerating the innovation of information technology services, and improving the industrial innovation system. The layout of research and development of cutting-edge technologies should be implemented by carrying out research on big data theory and methods, computing systems and analysis, key application technologies and models, and arranging the development of cloud computing and big data frontier technologies. In particular, technological research and innovation in several areas, including blockchain, will be accelerated. Blockchain is also mentioned in two major projects: the software "soul casting" project and the information technology service capacity leap project. The first one consists in the goals of accelerating breakthroughs in basic general software, strengthening the competitive advantage of networked software, taking the lead in layout and development of intelligent software, and building an open source and open technology product innovation and application ecology. Focusing on the strategic goal of seizing the leading position in the design and development of intelligent software, breakthroughs in cloud computing and big data technologies such as blockchain will be made. The second project provides for strengthening the construction of basic service capabilities, developing new service models and new formats, and promoting the transformation and development of service-oriented enterprises. In order to develop new service models and new formats, it is necessary to improve the key technology service capabilities in blockchain.

The Big Data Industry Development Plan was also published to implement the overarching 13th National Five-Year Plan, accelerate the implementation of the national big data strategy, and promote the healthy and rapid development of the big data industry. It is divided into five chapters: 1) foundation of big data industry development in China; 2) situation in the 13th Five-Year Plan period; 3) guiding ideology and development objectives; 4) key tasks and major projects; 5) safeguard measures. The mentioning of blockchain occurs only in the first key task presented in Chapter 4, which regards the reinforcement of research and development of big data technology products. It should be oriented towards application and consists in making progress in big data key technologies, promoting the R&D and industrialization of products and solutions, innovating the technology service model, and form a

technologically advanced, ecologically complete, safe and controllable system of big data technology products. Blockchain is therein considered as a cutting-edge technological innovation and as such it should be supported, in order to contribute to the acceleration of big data key technologies R&D.

In 2017, The State Council proposed the Guiding Opinions on Deepening the “Internet + Advanced Manufacturing” and Developing the Industrial Internet to deepen the supply side structural reform, further promote the "Internet + Advanced Manufacturing Industry" strategy, and standardize and guide the development of China's industrial Internet. The document is divided into four chapters, which respectively deal with the basic situation, general requirements, main tasks, and support pledge. Under the main task of strengthening industrial support by intensifying efforts to tackle common key technologies, building the industrial Internet standard system, and improving the supply capacity of products and solutions, blockchain is listed among the emerging frontier technologies in the industrial Internet that should undergo application research and exploration.

The 2018 Blockchain Industry White Paper was prepared by the MIIT with the purpose of accelerating the technological innovation and application of the blockchain industry and promote the healthy and standardized development of the industry. Field research on nearly one hundred blockchain industry and application enterprises in Beijing, Hangzhou, Shenzhen, Guiyang and other Chinese cities was led in order to prepare this white paper, which is divided into five main chapters: first, it analyzes the current development situation and general characteristics of the blockchain industry in China; second, it focuses on the ecological composition of the industry; third, it conducts in-depth research on the application of blockchain technology in the financial field; then it studies blockchain application exploration and trial in the real economy; finally, important development trends of the industry are forecast.

The first chapter describes the overall characteristics of the development of the blockchain industry in China by focusing on industry ecology, geographical distribution, applications, informatization of collaborative links, risks related to technology abuse, and policy system.

China's blockchain industry ecology has initially taken shape and is in the ascendant. The industry is developing rapidly, since 2014 the number of enterprises has been increasing at full speed and investments have been growing. The blockchain industry chain overall context is gradually becoming clear, from equipment manufacturing to industrial application services, to industrial investment and financing, media and talent services, and industrial application companies provide services for both the financial industry and the real economy. Moreover, the development of the industry is promoted, besides start-ups, also by Internet giants such as Tencent, Alibaba, Baidu, JD, etc.

The regional distribution is relatively concentrated, causing an evident industrial agglomeration effect. 80% of Chinese blockchain companies are situated in Beijing, Shanghai, Guangdong and Zhejiang.

78% of blockchain entrepreneurial activity concentrates in Beijing, Shanghai, Shenzhen and Hangzhou. In the future, blockchain will also extend to traditional industries, making geographical distribution more extensive.

Blockchain applications are diversified, extending from finance to physical fields. Blockchain has been applied in payment clearing, credit financing, financial transactions, securities, insurance and leasing, because it is distributed, tamper-proof, highly transparent and traceable, which is very consistent with the business needs of the entire financial system. From the perspective of application scope, the blockchain technology can be applied in almost all industrial scenarios. The reason is that almost all industrial scenarios involve transactions, and there is a need to reduce costs, improve efficiency and optimize the industrial integrity environment. The main battlefield for the application of blockchain technology is the real economy industry. At present, the physical flow in traditional industries has not been widely transformed into information flow, mainly because small, medium and micro enterprises have to bear a series of risks such as information leakage. However, with the use of blockchain technology a large amount of transaction information has begun to shift from offline to on-the-chain.

The realization of "cooperation links informatization" will help the real economy reduce costs and improve efficiency. The cooperation between enterprises is not covered by information systems in many cases, while the blockchain technology can enable multiple business entities to communicate equally, share information, and check data consistency in real time. These blockchain based systems effectively realize multilateral information sharing and effective cooperation in a "low trust" environment, and greatly reduce the cost of mutual trust among multiple entities. Furthermore, blockchain will improve the synergy efficiency of the industrial chain. Based on the blockchain technology, through the commodity circulation information of various countries, the whole process of international trade commodity circulation can be traced, and even mutual trust can realize rapid customs clearance, thus greatly simplifying relevant procedures and improving efficiency.

Technology abuse leads to certain risks in industrial development, such as risks of compliance nature and technical risks, which cannot be ignored. Compliance-related risks include illegal fund-raising, pyramid selling, fraud through ICO, excessive speculation and false propaganda in the capital market. Technical risks include 51% attacks, selfish mining, private key and terminal security, consensus mechanism security, network congestion and bifurcation. Other risks are related to the division of responsibilities of the network participants, the final ownership of the ledger data, the high cost, and the selectivity of the transaction blocks.

The industrial policy system has been gradually established and the industrial development environment has been continuously optimized. The policy system for the development of the blockchain

industry has been gradually improved. Since 2016, when blockchain technology was mentioned for the first time in the notice of the State Council on publishing the 13th Five-Year Plan for National Informatization, it has risen to the level of national science and technology strategy. Subsequently, local governments timely issued support policies for blockchain technology and industrial development, which ushered in a new explosion of the blockchain industry. At present, local governments are actively positioning the blockchain technology from the industrial perspective and grasping the new opportunities for industrial upgrading brought by technological upgrading. In addition, one of the priorities of China's economic agenda is preventing and resolving major risks. Therefore, it is necessary to actively strengthen industry supervision and effectively prevent and control financial risks. For this reason, the financing of ICOs and cryptocurrencies, which bear very high risks, has been made illegal and has had to be stopped. Finally, blockchain-based regulatory systems have emerged to solve regulatory compliance problems and reduce compliance costs.

Chapter 2 discusses the development of blockchain industry segmentation by focusing on platform construction, hardware manufacturing and infrastructure, security protection, and industry service organization. As a matter of fact, various sub-sectors of blockchain are flourishing and a complete industrial ecological chain has been initially formed.

Platform construction involves underlying platforms, digital asset storage, and blockchain technology solutions. Public chain, alliance chain and BaaS are currently the three main platform models. The public chain is open to everyone and consensus is reached combining the incentive mechanism and encrypted digital verification. It has many advantages such as users' independence, information disclosure, high accessibility and trustworthiness. However, it has the disadvantages of low efficiency, high transaction costs, long confirmation time, poor scalability, and difficult application implementation. In the alliance chain several institutions participate in bookkeeping and reach consensus through mutual trust. Therefore, it is more suitable for transactions and settlement between organizations. Its advantages are high availability, high performance, programmability, privacy protection, high efficiency and low cost. Applications are also easily implemented. Node access is controlled, and the platform meets regulatory requirements. BaaS is usually an enterprise level blockchain open platform based on cloud services. It is easily accessible, has a decentralized trust mechanism, private deployment and rich operation and maintenance management. It can be used in a wide range of industries to reshape the business model and enhance the influence of customers. Large companies are currently more active in BaaS, because they all have their own cloud services, and the business scenarios in the ecosystem are rich, which is suitable for trial and error. In addition, BaaS balances credibility and efficiency.

The development of the blockchain industry requires a new type of digital asset storage, which has led to the birth of digital wallets. For digital wallets, security requirements always rank first.

A secure digital wallet should be able to always protect the user's private key. Therefore, encrypted digital wallet should be designed with basic security system (storage security, network security, memory security, installation package security), key management security system, development process security system and user behavior security system. At present, digital wallets are mainly divided into cold (or offline) wallets and hot (or online) wallets. As of the end of March 2018, there were about 15 companies developing digital wallets (mainly hot wallets) in China. Digital wallets can also be classified in decentralized and centralized wallets. In the former, the user is responsible for the custody of the private key; the assets are stored on the blockchain rather than hosted on a centralized server; operations such as “account freezing” and “transaction rollback” cannot be realized. Therefore, decentralized wallets are difficult to be attacked by hackers. However, with the increasing number of hacker attacks around the world, wallet companies need to continuously update their products and technologies.

Blockchain technology solutions are the expansion of the underlying platform in terms of products, applications and services for specific business scenarios.

Blockchain hardware manufacturing and infrastructure originated from one of the consensus mechanisms of blockchain - POW (Proof of Work), i.e. computing nodes in the whole network compete in terms of hash rate for the right to keep accounts aiming at obtaining economic rewards. In addition, distributed accounting is one of the core features of the blockchain, and the blockchain hardware device acts as an accounting node. As an increasing number of people participate in the competitive bookkeeping, an exponential increase in the difficulty of the whole network's computing power occurs. This has put forward higher requirements for the output and performance of the blockchain hardware equipment, has promoted the continuous innovation and development of the industry, transformation and upgrading, and has achieved a leading position in the world. At the same time, the improvement of computing power has also promoted the development of other fields. For example, the artificial intelligence field is very dependent on computing power.

In the field of blockchain hardware, Chinese companies have absolute advantages, because they produce most of the blockchain hardware in the world. The design and R&D capability of chips is the decisive factor in the conquest of market share. Therefore, China has strongly promoted the innovation and development of the chip design industry. Furthermore, the blockchain computing center has become mainstream, and the shared computing mode has been applied. Due to the increasing difficulty of computing power in the whole network, the era of individuals acting as bookkeeping nodes has long ended in the increasingly fierce competition of computing power. A blockchain computing

center provides computing power resources for the development of the whole blockchain industry. Its most basic function is to gather personal computing power to participate in competitive bookkeeping. After experiencing fierce competition, the monopoly effect is becoming more and more obvious. In addition, shared computing is a kind of intelligent scheduling technology based on blockchain technology, which records and gathers individual users' idle bandwidth, storage, computing and other resources into high-quality resources that can be used by enterprises, connecting enterprises and individuals, and making the resources of individual users available to enterprises.

Blockchain faces security problems related to the underlying code, cryptographic algorithm, consensus mechanism, smart contract, and digital wallet. Since blockchain underlying code is open source, it is easily attacked. Therefore, it is necessary to use professional code audit services and understand the security coding specifications. Cryptographic algorithms must be protected against hash algorithm collision and quantum attacks. Therefore, it is necessary to adopt a secure cryptographic algorithm (e.g. lattice based cryptographic algorithm) in the design, while paying attention to the progress of cryptographic research against quantum attacks and giving priority to its use when it is mature. It is also necessary to reduce the potential risks caused by public key disclosure by storing the balance after each transaction in a new address to ensure that the public key of the address is not leaked. Current consensus mechanisms include Proof of Work (POW), Proof of Stake (POS), Delegated Proof of Stake (DPOS), Practical Byzantine Fault Tolerance (PBFT), etc. POW can be subject to 51% attacks. POW has the ability to cancel the transactions that have occurred, and the attacker can only modify his own transaction and cannot modify the transactions of other users. In POS, an attack is successful only when more than 51% of the tokens are held. In PBFT, the system is safe when the malicious nodes are less than one third of the total nodes. In general, any consensus mechanism has its own conditions. As an attacker, it is also necessary to consider that once the attack is successful, the value of the system will return to zero. At this time, the attacker will not get any other valuable reward except destruction. If there is a problem in the design of smart contracts, it may cause great losses. One countermeasure is to conduct security audit on smart contracts, and the other is to follow the security development principles of smart contracts, which include: being prepared for possible errors to ensure that the code can correctly handle the bugs and vulnerabilities; carefully releasing smart contracts, doing well in functional and security tests, and fully considering boundaries; keeping smart contracts simple; paying attention to blockchain threat intelligence and check and update it from time to time; understanding the characteristics of the blockchain, such as carefully calling external contracts.

Digital wallets entail three major security risks: design defects, malicious code, and the loss of assets caused by the loss or damage of computers and mobile phones. Countermeasures include ensuring

the randomness of the private key; carrying out hash value verification before software installation; using cold wallets; backing up the private key. There are also some companies providing security services in this field, which mainly help customers solve various blockchain security problems through technical means and code audit. Quantum technology computing power is much stronger compared to traditional computers. Quantum technology development has brought great security challenges to the current cryptosystem. In order to deal with the security threat brought by quantum computer to the password, we can mainly adopt anti-quantum computing password and quantum key. Blockchain industry service organizations include media communities, investments institutions, industry organizations and industry research institutions.

With the popularity of blockchain and the initial formation of the industrial scale, a number of media communities have emerged in the industry. The blockchain media community has also become a hot investment direction, because investors want to understand the information of the whole industry. In addition, in 2018, many professional traditional media people successively entered the blockchain field to start businesses. At the time, blockchain media community revolves around industry news, newsletters, in-depth reports, quotes, data, communities, and there is no essential difference with other media forms. Advertising is the main form of revenue. With the increasing number of entrants, the demand will soon exceed the supply. The blockchain media communities that can survive in the market must be those companies that spread the positive energy of the blockchain, truly create value for users, and have unique advantages.

Traditional mainstream investment institutions began to lay out the blockchain in 2012, but their professional capabilities are still highly competitive in the market. Bitmain and One Connect Financial Technology are unicorn companies. At the same time, there are also a number of newly established token investment institutions, which mainly focus on blockchain investment in overseas markets.

The development and application of the blockchain industry cannot be separated from the support of industry organizations, which provide a professional communication and cooperation platform for people in the industry, and play a great role in promoting the healthy development of China's blockchain industry and accelerating the application implementation. The most important blockchain industry organizations are Zhongguancun Blockchain Industry Alliance, the Trusted Blockchain Initiatives, and FISCO-BCOS.

As for blockchain industry research institutions, Chain Lab must be mentioned. It is China's first scientific research and practice institution focusing on the legal research and business practice exploration of financial science and technology policies represented by big data, blockchain and regulatory technology. In addition, the rapid development of the blockchain industry has led to a serious shortage

of talents. Therefore, relevant colleges and universities in China are offering blockchain-related courses.

This white paper dedicates the whole third chapter to the application and development of blockchain in the financial field, while other areas of application are all dealt with in the following chapter. The blockchain has the potential to change the financial infrastructure.

Various financial assets (e.g. equity, bonds, bills, warehouse receipts, fund shares, etc.) can be integrated into the blockchain ledger, become digital assets that are stored, transferred and traded on the blockchain. Financial transactions are made more convenient, intuitive and safe thanks to the disintermediation of blockchain technology. With the improvement of blockchain technology and its combination with other financial technologies, it will gradually be applied in large-scale financial scenarios, such as supply chain finance, trade finance (letter of credit, letter of guarantee, forfaiting, factoring, bills), credit investigation, transaction clearing, point sharing, insurance, securities, etc.

It is difficult to verify the authenticity of the transactions of the supply chain finance platform and the core enterprise system, which leads to the high cost of risk control on the capital side. The information between the various participants in the supply chain cannot be shared, which leads to difficulties in trust transmission, complicated procedures and high cost of increasing credit, and the digital assets at all levels on the chain cannot be split, transmitted and circulate. Blockchain technology can realize the credit penetration of the supply chain financial system and solve the problems of difficult and expensive financing for secondary suppliers and distributors. The blockchain can be used to confirm the rights of the core enterprise, including the verification and confirmation of the authenticity and validity of the entire bill, prove the authenticity and validity of the circulation of the creditor's rights certificate, ensure that the creditor's rights certificate itself cannot be faked, achieve credit opening, and solve the credit financing dilemma of the second-tier suppliers. In this trust ecosystem, the credit of core enterprises (bills, credit lines or accounts payable confirmation) can be converted into digital warrants, and smart contracts can be used to prevent performance risks, so that credit can be effectively transmitted along the supply chain, reduce cooperation costs and improve compliance efficiency. More importantly, after the digital warrant is anchored on the chain, the smart contract can also separate the funds of upstream and downstream enterprises and make them circulate, greatly improving the speed of funds, and solving the problems of difficult and expensive financing for small and medium-sized enterprises.

China's banking industry still relies on international organizations such as swift and EDI, but since 2017, some domestic banks have started to think about the establishment of inter-bank business message sending and receiving alliance and started to build their own trade finance platform based on blockchain. Through blockchain letters of credit, letters of guarantee, forfaiting, factoring and bills

under trade finance, an inter-bank message interaction network is established in the form of alliance chain. Once the ecology is completed, with the participation of banks, enterprises and official institutions, it can also help banks and regulatory institutions to identify the authenticity of trade background, track credit risk, establish business standards, message standards and technical standards based on Chinese banking, so that Chinese banking can truly play a leading role in the international financial field.

The traditional letter of credit is delivered in paper form. The establishment of an alliance between multiple buyer and seller's banks based on blockchain can realize the real-time writing and reading on the L/C chain to verify the pledge in real time, thereby reducing the transit time of bills and letters of credit and speeding up the capital turnover. This way the L/C information can be transmitted safely, quickly and traceably on the chain, and can support Chinese messages. It can replace swift in domestic L/C settlement, thus realizing an independent, safe and controllable domestic L/C exchange system.

Most of the processes of traditional letter of guarantee business need manual participation, the security of the letter of guarantee is not high, and there is information asymmetry. Blockchain, however, can improve the work efficiency of the parties of a letter of guarantee, and effectively reduce costs by realizing information sharing and reducing the risk of information asymmetry.

Tracking forfaiting transactions on the blockchain can solve the problems of information transmission security, high costs of inquiry, low efficiency, and legitimacy certification of the creditor's rights.

The factoring business platform based on blockchain technology can enable exporters or export factoring agents to send seller information or credit limit application information.

The unchangeability of blockchain records prevents the problems related to the bill market, such as multiple sales of one bill in paper form and asynchronous payment and endorsement in electronic tickets. Moreover, the value of the digital bill based on blockchain can be transmitted in a decentralized manner. Finally, with the programmability and data transparency of the blockchain, the balance between the asset side and the liability side of the participants can be effectively controlled to form a more real market price index, so as to better control the market risk.

In credit reporting, blockchain technology can connect the blacklist business systems of various alliance institutions to establish a blacklist certificate deposit platform for alliance institutions, integrate the blacklist data scattered among various credit reporting agencies to achieve data sharing, and achieve system autonomy. The advantages of this solution are low costs, small transformation of the existing system, data traceability, sharing, real-time synchronization, timely update and high availability, and system versatility. The system also provides general API services and can interface with the application systems of various banks and credit agencies.

Based on the blockchain technology, quasi real-time transactions (i.e. clearing functions) can be realized and the clearing/settlement efficiency of the existing financial system can be improved. Through the blockchain system, the trading parties or multiple parties can share a set of reliable and mutually recognized ledgers. All transaction clearing and settlement records can be checked on the chain, which is safe, transparent, tamper free and traceable, greatly improving the accuracy and efficiency of reconciliation. By carrying smart contracts, transaction clearing and settlement are automatic, reducing costs and error rate of reconciliation personnel, and greatly improve the efficiency of clearing.

The point system consists in providing members of banks and enterprises with point system services, cards and marketing solutions. Based on the blockchain technology, a tamper-proof trustworthy registration mechanism can be established among various enterprises, which makes it possible for different points to be exchanged, so as to activate the points, promote the upgrading of various consumer service means, and jointly create a collaborative business circle with mutual trust and win-win results.

In insurance operations, credit is fundamental, while the traditional "social trust" model has been difficult to meet the needs of social and economic development. Under the background of blockchain application, its distributed and cryptographic features, combined with relevant identification technologies, can provide a solution framework and implementation path for solving the dilemma of identity uniqueness, ensure the authenticity, reliability and effective traceability of data and information, and provide a strong technical guarantee for preventing insurance fraud. The time stamp and distributed characteristics of the blockchain, combined with the Internet of things technology, it can provide new solutions for insurance uniqueness in time and space.

The blockchain technology has also created an opportunity for the development and maturity of China's securities industry. Securities issuance, distribution and transaction can be more efficient, the cost of trust is reduced, and illegal behaviors of curve enrichment can be exposed on the blockchain. Regulatory authorities and social intermediaries can easily query, compare and verify the data, and further improve the transparency of the company's IPO. Securities clearing and settlement can be simplified. Asset-backed securities based on blockchain are characterized by an improved cash flow management, thanks to automatic accounting book synchronization and audit, automatic fund transfer, asset circulation purchase and income distribution, reduced error rate and labor cost, and increased penetration of underlying assets.

Chapter 4 analyzes blockchain application exploration and trials in the real economy.

At present, blockchain technology has begun to be applied in many fields of the real economy, such as product traceability, copyright, electronic evidence storage, financial management and digital identity.

At present, China's traceability industry is still at an early stage of development, mainly driven by national policies supporting mostly the food and pharmaceutical industries. Blockchain provides solutions for the lack of trust in the traceability sector, and provides a transparent mechanism for the information, goods and capital flows. In recent years, many enterprises at home and abroad have actively explored the application of blockchain in traceability and anti-counterfeiting, logistics, supply chain management and other scenarios. Blockchain technology is gradually infiltrating into traditional supply chain business.

Blockchain and digital copyright protection can be perfectly combined to solve the problem of piracy. The blockchain's distributed ledger and timestamp technology make it possible for the whole network to quickly reach a consensus on the ownership of intellectual property rights. Asymmetric encryption technology ensures the uniqueness of copyright, time stamp technology ensures the copyright owner, and the copyright owner can easily and quickly complete the process of rights confirmation, which solves the problem of low efficiency of traditional rights confirmation mechanism. In addition, the copyright trading link faces the problems of difficult matching of demands and high intermediate costs. In Internet digital media, content platforms are a new form of middleman. Blockchain provides a public platform to store the transaction records, encrypt the copyright content and execute the copyright transaction process through a smart contract without the intervention of a middleman. It can help the creator obtain the maximum income and makes the copyright transaction transparent.

In electronic evidence storage blockchain technology can secure storage of evidence and improve the efficiency of evidence collection. When the electronic evidence is generated, it is given a time stamp. When the electronic evidence is stored and fixed, the data integrity is verified by comparing the hash value. In the transmission process, the asymmetric encryption technology is used to encrypt the electronic evidence to ensure the transmission security, which fully guarantees the authenticity and security of the evidence. In the aspect of forensics, since the blockchain storage mode is distributed storage, it allows multiple nodes such as judicial institutions, arbitration institutions and audit institutions to share electronic evidence on the alliance chain. In theory, it can achieve second level data transmission, reduce the time cost of forensics, optimize the arbitration process, and improve the efficiency of multi-party cooperation.

In financial management, blockchain can be applied to account management and audit. In account management, blockchain and distributed ledger technology have become the connectors between organizations. Due to the characteristics of real-time confirmation, data tamperability and high consistency, they have greatly improved the operation efficiency of the middle and back offices, improved the degree of process automation, and reduced the operating costs. The distributed storage and consensus mechanism of blockchain technology enable it to optimize the traditional audit

industry by improving the supervision level of enterprise financial information, improving audit efficiency, and reducing the risk of audit data being attacked.

Blockchain can make ad clicks data more transparent and no longer rely on third-party monitoring. Blockchain allows advertisers to clearly track clicks, views and conversion rate of advertisements, and accurately judge whether the users reached by advertisements are target groups. This solves the trust problem of the data marketing industry, makes the cost of each advertising budget open and transparent, greatly saves the marketing cost of the enterprise, and solves the problem of false traffic in the advertising industry. Another pain point in the traditional advertising industry is the problem of user data collection. By building a blockchain data trading platform, advertisers can directly collect information that users are willing to share. The data dimension is richer, the information source is authentic and reliable, and the user portrait is more three-dimensional, helping advertisers improve the conversion rate of advertising. For users, sharing data can be rewarded, and their privacy can be protected. In addition, in the long run, the blockchain may completely change the profit distribution mode of the digital marketing industry. In the traditional digital marketing industry, the centralized advertising platform can obtain huge advertising revenue through user traffic and data.

Blockchain can be used to isolate and verify the legally marketable data, it can not only protect the legitimate use of the data demander, but also protect the privacy of users to the maximum extent. Using the blockchain to trace the data can confirm the data ownership and circulation channels, provide evidence materials for the infringement investment stage, and provide a more reliable big data trading environment.

The application of industrial blockchain technology can promote the transformation and upgrading of the manufacturing industry in many aspects such as multi-party collaborative production, industrial Internet data security, and industrial asset digitization. The organic integration of industrial blockchain and industrial cloud will greatly improve the operation efficiency of the real economy and promote the transformation and upgrading of the manufacturing industry.

Blockchain is expected to become an important means of realizing energy Internet infrastructure. Blockchain technology can be widely used in combination with energy industry distributed trading system and clean energy. Aiming at the energy production link, improve the energy production efficiency, reduce the management cost and increase the monitoring accuracy; For the energy trading market, provide safe trading guarantee and reduce communication costs for the wholesale energy trading market, provide a real-time payment and settlement system for the retail energy trading market, and promote the popularization of clean energy; Increase investment and financing channels and reduce investment and financing risks for the investment and financing links of the energy industry;

Improve participation and provide liquidity for energy conservation and emission reduction in the energy industry to stabilize climate change.

As a distributed accounting technology with multi-party maintenance, full back-up and information security, blockchain will bring a good breakthrough to the innovative ideas for medical data sharing. The blockchain has no central server, so that the system will not have a single point of failure, and the system stability is well maintained. The application scenarios of blockchain in the medical field include privacy protection and access control.

In the aspect of digital identity verification, blockchain technology can greatly improve the credibility of digital identity. Personal digital identity information is distributed and stored on different nodes, and data source records cannot be tampered with. Unless the blockchain network reaches an agreement on the change, the current status of the entities on the blockchain cannot be changed, which ensures that the existing information status is an effective representative of the entity identity. In addition, the entity corresponding to the digital identity holds the private key, and the authenticity of the digital identity can be determined by verifying the key during the authorization process. Blockchain can also solve the problem of data sovereignty and privacy in digital identity. In the verification link, asymmetric encryption technology is used to verify the identity of the requester without original data, and only by comparing the hash value of the digital identity, eliminating the risk of personal privacy disclosure. In addition, the blockchain can eliminate the possibility of one party using false information, such as address information, telephone number, etc. This helps prevent identity theft and eliminates the risk of inconsistent information when personal digital identity is used in different scenarios.

Blockchain can solve the scale problem of the Internet of things and enable billions of devices to share the same network at a low cost. The IOT system using blockchain technology is verified by multiple nodes, recording the transactions reached in the whole network in the distributed ledger, replacing the role of the central server. The consensus mechanism of the whole network node verification of the blockchain, asymmetric encryption technology and distributed data storage will greatly reduce the risk of hacker attacks.

Blockchain technology can solve the problems of lack of trust and opaque information in the charity industry. By using the blockchain to track the flow of funds, donors can clearly understand the whereabouts of charity funds, how the money is used, and whether it really helps people in need. In addition, the tamper proof nature of the blockchain makes it possible for donors, recipients, and charities to register relevant information on the blockchain to improve the transparency of the public welfare industry and the reliability of the three parties.

The blockchain allows the government departments to independently authorize the visitors and access data, record the data calling behavior, and accurately track the responsibility in case of data leakage, which greatly reduces the security risk of e-government data sharing and improves the efficiency of law enforcement.

The development trends of blockchain industry are discussed in Chapter 5 and include: blockchain as the forefront of global technology development; blockchain as a new hotspot for innovation and entrepreneurship; blockchain implementation in the real economy and support for the construction of a digital China; new platform and sharing economy creation; blockchain as the driver of credible digitization and financial industry shift from virtual to real; improvement of blockchain supervision and standard system.

As an important infrastructure of the "value Internet", blockchain will lead global technology development and will open up a new track for international competition, striving for the first mover advantage.

The technological innovation of China's blockchain industry is undergoing an obviously accelerated process, and it is in a leading position in some related technologies. China will continue to promote the construction of public chains and other value Internet infrastructure, and actively build a blockchain industry ecology with Chinese characteristics, which is very important in the fields of people's livelihood and public security.

Blockchain technology will drive a new wave of entrepreneurship and innovation with the increasing involvement of unicorn companies, and the integration of blockchain and other new technologies will expand the space of application. As a matter of fact, blockchain guarantees the security and authenticity of big data, which are necessary for AI development. The consensus mechanism and distributed computing of the blockchain can solve security and computing power issues of IoT.

Blockchain will be widely implemented in the real economy in the next three years and become an important support for the construction of the digital China. In the future, the blockchain technology will continue to accelerate its wide application in the industrial scene, deeply integrate with the real economy industry, and form a number of "industrial blockchain" projects also with traditional industries. The wide application of blockchain technology in the real economy provides an opportunity for the real industry to "overtake" and directly realize "trustworthy digitization".

Blockchain will create a new platform economy and open a new era of sharing economy. The application of blockchain technology is expected to transform "sharing economy" into an economy where things are enjoyed together, thanks to the token system.

Blockchain will accelerate the "trustworthy digitization" and drive the financial industry to "move from virtual to real" and serve the real economy, by ensuring the accurate transmission of real industry

operation information to financial institutions and integrating the physical world with the digital and financial worlds.

Finally, blockchain supervision and standard system will be further improved to create a good development environment and provide a strong guarantee for the in-depth service of the industrial blockchain projects to the real economy, and the foundation for industrial development will continue to be consolidated.

The Guiding Opinions on Developing the Digital Economy to Stabilize and Increase Employment issued by the National Development and Reform Commission in collaboration with the MIIT, the MOE and other bodies in 2018 do not explicitly mention blockchain technology. However, they are relevant in any case for two reasons: they deal with other digital technologies connected to blockchain and digital technologies in general, and they also deal with digital talent training, which has already been mentioned in the 2016 White Paper on Blockchain Technology and Application Development and the 2018 Blockchain Industry White Paper. As a matter of fact, the rapid development of digital technologies has caused a shortage of digital talents. Therefore, the employment management system needs to be adapted to the booming digital economy, based on the guiding ideology of simultaneously promoting industry digitization and workers' skills. The guiding opinions set 2025 as the milestone for the achievement of the main objectives, i.e. the improvement of the digital economy, digital literacy, legal and institutional framework, services, and employment environment. On one hand, in order to accelerate the cultivation of new employment opportunities in the digital economy, China will promote the development and growth of the digital industry and expand employment opportunities; promote the digital transformation of traditional industries, drive more workers to change jobs and improve their quality of employment; stimulate the vitality of innovation and entrepreneurship in the digital economy and create a fertile ground for employment growth. One the other hand, the continuous improvement of workers' digital skills requires China to strengthen the education of digital talents; strengthen digital skills training; build a digital platform system for lifelong learning; innovate the training methods of personnel training; attract social forces to participate in the training of digital talents.

The objective of vigorously promoting the digital transformation of employment and entrepreneurship services will be achieved by accelerating the digital transformation of public employment and entrepreneurship services; encouraging the development of digital human resources market service institutions; making the digital economy innovation and entrepreneurship service Incubation Platform bigger and stronger. To constantly improve the policy and legal system, China will continue to improve new forms of employment, the social insurance participation, payment policies and management, service mechanisms that adapt to the new employment pattern, and the incentive mechanism.

The efforts to improve safeguard measures include strengthening demonstration and guidance; focusing on market advancement; optimizing the development environment; strengthening risk response.
The Provisions on the Administration of Blockchain Information Services are written in accordance with the Cybersecurity Law and their purpose is to standardize the activities of blockchain information services. The body responsible for the supervision, administration, and law enforcement of blockchain information services on the national level is the CAC. Blockchain industry organizations are encouraged to strengthen the industry's self-discipline through industry standards and industry trustworthiness evaluation system and promote the healthy and orderly development of the industry. Blockchain information service providers (BISPs) are required to implement management systems related to security and user registration; provide the technical prerequisites suitable for their services and comply with laws, administrative regulations, and national standards and specifications; formulate and publish management rules and platform covenants and sign and abide by clear service agreements with blockchain information service users (BISUs); verify real identification information of BISUs; report new products, applications, or functions to the national and regional offices of the CAC for security assessment; avoid activities prohibited by laws and administrative regulations; rectify information services in case of information security dangers; carry out corrective measures if BISUs violate laws; record information produced by BISUs and back it up; cooperate with supervisions and inspections of the CAC and accept society's supervision. The filing procedures shall be fulfilled within ten working days after beginning to provide services, and the CAC shall complete filing procedures within twenty working days. The filing number must visibly appear on the website or application of BISPs. Change procedures shall be conducted within five working days and cancellation procedures within thirty working days before termination. The CAC shall regularly inspect the filing information. Articles 19-22 regulate the violation of specific provisions. Pre-existing blockchain information services shall adjust to this Regulation within twenty days from the enforcement date, i.e. February 15, 2019.
Blockchain technology, thanks to its features of being tamper-proof and undeniable and involving multilateral participation, naturally meets the needs of electronic data storage and offers solutions to its problems. It can reduce storage costs, facilitate the identification of electronic data evidence, and improve the litigation efficiency in the field of judicial storage. The White Paper on Blockchain Technology Application in Judicial Evidence Storage briefly and deeply introduces the characteristics and system design principles of blockchain electronic data storage. Starting from the development status of electronic data storage, this paper explains the relationship between blockchain electronic data storage and the identification of the three characteristics of evidence, points out the combination and significance of blockchain and electronic data storage, and describes and summarizes the overall

design and key technologies of blockchain storage system. Finally, the white paper also shares several blockchain judicial deposit business fields and practical cases, providing a multi perspective thinking for the development and innovation of blockchain applications.

The use of blockchain and its extension technology can provide security protection, tamper prevention and audit trail of data operation for electronic data in the whole life cycle of generation, collection, transmission and storage of electronic data, thus providing effective means for relevant institutions to review.

The special storage mode of the blockchain is used to store electronic data. The technology is used as third party identity (the technology and algorithm are used as the virtual third party). The electronic data that needs to be stored is recorded in the form of transactions, stamped with time stamps, and recorded in the block, thus completing the process of card storage. In the data storage process, data consistency is maintained among multiple participants, which greatly reduces the possibility of data loss or tampering.

The ability of the blockchain to apply to electronic data storage is derived from the key technologies of the blockchain system. The key technologies include two aspects: core technologies and related technologies. The core technologies of the blockchain include: consensus mechanism, signature verification, storage structure, and P2P communication mode, which are used to ensure multilateral participation, unchangeability and inability to lose data. The reated technologies include: trusted storage, electronic identity, trusted time, data encryption, data storage, and smart contracts, which provide support for a variety of application scenarios of the blockchain system.

Blockchain technology can be easily applied to judicial evidence storage because the time stamp of blockchain indicates the occurrence time of electronic data, the signature of the user's private key to the data is the expression of the user's real intention, the unchangeability and traceability facilitate the extraction and identification of electronic data, the process of evidence storage, collection, presentation and cross examination in judicial practice corresponds to the action flow of electronic data storage, extraction, presentation and inquiry.

Blockchain evidence storage improves the efficiency of electronic evidence identification, which regards three aspects: authenticity, relevance, and legitimacy of electronic data. The authenticity element regards three levels: electronic evidence carrier, electronic data itself, and electronic evidence content. Blockchain technology itself does not enhance the relevance of electronic evidence but may make the correlation of evidence clearer and facilitate the identification of correlation. The legitimacy of electronic evidence is closely related to the legal provisions.

The technical requirements of the blockchain certificate storage system include legal compliance, strong data consistency, convenience, and safety.

The reference architecture of blockchain-based electronic data storage system is composed of three layers: the participants management layer, the blockchain layer and the application layer. The blockchain layer is also composed of two sub layers: key technology and application service.

In courts, the application of blockchain technology in litigation services will, first of all, provide solid evidence for electronic materials, business data, user behavior and other information in the process of litigation services; secondly, it will ensure that the whole process of production, storage, dissemination and use of litigation service data is safe and reliable; in addition, it will improve the authority, professionalism and judicial credibility of electronic litigation services.

Blockchain will also assist the judge in checking the chain of the evidence submitted by the parties when handling the case, checking and tracing the certificate of deposit, time source, etc. It will also contribute to the identification of the evidence, and improve the efficiency of handling the case. Blockchain will save time for judges in confirming the publicity and serving notice.

Blockchain technology is applied to record the whole process of property inquiry, control, disposal and other information involved in the process of handling the execution case, so as to realize the full traceability of the property disposal process, and ensure that the inquiry, control and disposal process of the executed person's property in the execution case is standardized and reliable.

In judicial cooperation, a cross departmental case handling coordination platform for public security, procuratorates, courts, and judicial bureaus can be built based on blockchain.

In social deposit certificate, blockchain can be used for electronic contracts, to collect evidence for copyright infringement and to certify copyrights.

Blockchain finds application scenarios also in the probation of will.

The application of blockchain-managed judicial deposit has bright prospects, but there are also some challenges stemming from the nature of the judicial field and the lag between law and social phenomena. Blockchain technology and legal affairs are poorly connected and a blockchain-based judicial deposit requires more compound talents who are familiar with both the judicial business and the blockchain technology. In addition, blockchain technology is still in a very early and rapid development stage, therefore it needs to develop and refine itself to better adapt to the business scenario of judicial deposit. Moreover, the norms of judicial identification of electronic evidence need to be clarified and the perspective must shift from traditional evidence to electronic evidence.

Finally, the public’s understanding and acceptance of electronic evidence needs to be improved.

In conclusion, the development of electronic data brings challenges related to security and costs; although blockchain features can solve the problem of electronic evidence preservation or authenticity identification, they are still not widely used in the judiciary. Blockchain improves the efficiency of electronic data identification, it provides a structured collection process for electronic data storage,

makes the identification of electronic data very simple, solves the pain point of losing and identifying the electronic evidence, and speeds up the identification of electronic evidence. Through multilateral interoperability and cooperation of the public security, procuratorial and legal departments and technology suppliers the promotion and application of standards can be improved.

The Blockchain-based Service Network (BSN) is a global infrastructure network used to deploy and operate all types of blockchain applications that aims to reduce the costs of developing and deploying blockchain applications. The Blockchain-based Service Network (BSN) Introductory White Paper categorizes blockchain into permissionless (public) and permissioned blockchains.

The first type of blockchain is transparent, private and completely decentralized. It is very difficult to legally operate permissionless blockchains in China due to their lack of administration and liberal nature. They are mainly used for cryptocurrencies. On the other hand, a permissioned blockchain's business attributes are formulated by the application owner, and users are required to seek approval from the application owner before they are able to use the application. If the application owner is an alliance of organizations, the blockchain is defined as a consortium blockchain. If there is only one organization, the blockchain is private. BSN supports both consortium blockchains and public blockchains. Just as with the internet, the BSN is also a cross-cloud, cross-portal, cross-framework global infrastructure network. The participants of the BSN are cloud service providers, blockchain framework providers, and portal operators. Direct users of the BSN are developers and technology companies. The BSN is an information infrastructure that allows blockchain application publishers and participants to use uniform public services and lease shared resources as needed. The BSN can be viewed as the internet of blockchains. The architecture of the BSN comprises the following key parts: public city nodes, which are the basic operational element of the BSN and provide system resources; the blockchain framework, which is the operating system of blockchain applications (in China there are multiple mainstream frameworks with their own consensus algorithm, transmission mechanism, development tools, etc.); BSN portals, within which developers can purchase BSN resources, deploy applications, manage applications, etc.; deploying or operating public blockchain nodes on BSN portals and public city nodes is not permitted within China; BSN Network Operations Platform, which includes functions such as public city node management, application management, maintenance management, billing and settlement management, CA management and supervision management.

The BSN entails some advantages such as: cost savings in blockchain application development, deployment and operations; lower barrier to entry for blockchain application development; easier access to blockchain applications; flexible access modes; rapid expansion mechanism. The BSN is developed, operated and maintained by the BSN Development Association, which was established by the State Information Center of China, China Mobile Communications Corporation Design Institute Co.,

Ltd. and China Mobile Communications Corporation Government and Enterprise Service Company, China UnionPay Corporation and China Mobile Financial Technology Co., Ltd., and Beijing Red Date Technology Co., Ltd. The BSN development plan consists in the global deployment of the BSN. In 2020, almost one hundred public city nodes had been created in China. As the BSN takes hold in countries around the world, it will become the only global infrastructure network autonomously innovated by Chinese entities. The BSN will also be made adaptable toward data transmission for all types of pioneering technologies such as 5G, the Internet of Things and AI, adapt more blockchain frameworks and establish more portals. Furthermore, the BSN Development Association will open source public city node systems and portal empowering systems. Finally, the BSN, in a low-cost manner, will facilitate the mutual trust of data between multiple business organizations anywhere in the world.

1.1.3. Blockchain as a key emerging industry in the 14th five-year period (2021-2025)

In the five-year period from 2021 to 2025 the blockchain industry is considered crucial for the implementation of the national development strategy and is considered as a key emerging industry that will contribute to the construction of the "Digital China". The Government expands the boundaries of its long-term plan and establishes 2025 as the approximate milestone to develop the world's most advanced blockchain and 2030 to implement further reinforcement, expansion of application scenarios and integration with other new IT. Although China has become the world's first source of blockchain patent applications, the industry still needs further improvements. This chapter focuses on the 14th Five-Year Plan for Economic and Social Development (2021-2025) and Long-Term Objectives Through the Year 2035, the Guiding Opinions of the MIIT on Accelerating and Promoting Blockchain Technology Applications and Industrial Development, and the 14th Five-Year Plan for National Informatization.

Blockchain technology is widely mentioned in Part Five of the 14th National Plan, which is about accelerating digitalization-based development and constructing a digital China. The digitalization process involves different areas such as economy, society, and government and is aimed at changing production methods, lifestyles, and governance in the three respective fields. In order to build a digital economy, the Chinese government is willing to leverage the potential of big data and expand the application range of key digital technologies, integrate digital technology and the real economy, upgrade traditional industries, generate new ones, and reinforce the engines of economic development. Blockchain technology is mentioned as a key emerging industry of the digital economy that the government intends to expand. Article 15 makes clear reference to protocols, algorithms, and systems based on blockchain technology such as smart contracts, consensus algorithms, encryption algorithms,

and distributed systems, the innovation of which will be promoted. The main fields of application of BCT will be fintech, supply chain management, and government services. China will also focus on improving supervision mechanisms. As for the areas of digital society and digital government, there is no explicit reference to blockchain technology, but only to digital technology in general. To accelerate the construction of a digital society, digital technology will be integrated into social communication and daily life so as to allow everyone to enjoy them. Public services, urban and rural development, as well as communities will undergo the digitalization process. Digital technology will also be used in government management. Public data will be organized in an improved and secured national public data resource system, shared in a more efficient and open way. The informatization process of government affairs will be further implemented. Government operation methods, business processes, and service models will be more digitalized and undergo further intelligentization. The last chapter of this part focuses on the regulation of data protection, the digital economy, and cybersecurity and the promotion of cooperation in cyberspace. The application fields of digital technologies include transportation, energy, manufacturing, agriculture and water conservancy, education, healthcare, culture and tourism, communities, home, and government.

Blockchain is expected to solve the problems of trust and security in cyberspace and transform the Internet from an information transmission network to a value transmission network. The Guiding Opinions on Accelerating and Promoting Blockchain Technology Applications and Industrial Development specify the general requirements, key tasks, and implementation measures to accelerate and promote blockchain applications and industrial development. These guiding opinions revolve around the ideology of strengthening technological research, consolidating, expanding, upgrading and modernizing the blockchain industry, and integrating blockchain and other new technologies. The basic principles include: application promotion, innovation improvement, industry ecology cultivation, and safe and orderly development. The development objectives set 2025 as the milestone for blockchain industry to reach the world's most advanced level with a wide range of application scenarios, a few internationally competitive backbone enterprises and industrial development clusters, an established standard system, blockchain professionals, and industry ecology. Blockchain will also support other national strategies, such as manufacturing superpower, cyberpower, and digital China. 2030 is in turn the milestone for further improving the strength of blockchain industry, expanding the industrial scale, integrating blockchain and other new technologies, etc. The guiding opinions also set five main tasks. First, it is necessary to empower the real economy by penetrating the application into various fields, such as supply chain management, product traceability, and data sharing. Second, public services (namely government services, evidence collection, and smart cities) shall be improved with the application of blockchain technology. Third, the industrial base is going to be consolidated through

adherence to standards, underlying platform construction, quality brands cultivation, network security reinforcement, and IP rights protection. Moreover, a modern industry value chain with blockchain "famous products", "famous enterprises", and "famous park" needs to be created by establishing an open source ecology and improving the industry value chain overall. Finally, it is necessary to promote the integrated development of blockchain and the industrial Internet, big data, cloud computing, and AI. To implement these tasks, six measures must be followed: actively promote the application of pilot projects; increase policy support; guide local governments to speed up exploration; build a public service system; strengthen the training of industrial personnel; deepen international exchanges and cooperation focusing on the strategic deployment of the "Belt and Road Initiative".

It is useful to consider also the 14th Five-Year Plan for National Informatization which mentions blockchain more extensively than the previous Plans. With regards to the current development status of the country, the Plan states in chapter one that the main objectives of the previous Plan have been reached successfully, and the construction of a digital China has achieved significant results. As for blockchain in particular, China is the world's first patent application source. In general, China's IT industry has become bigger and stronger and the ecosystem of strategic technology industries has been continuously optimized.

Furthermore, according to Chapter 3, China's primary directions of advancement include preventing and neutralizing risks and ensuring increasingly secure development, therefore governance principles and standards for blockchain and other new technologies should be established, and the development of the latter should always be oriented to social benefit.

Chapter 4 deals with the major tasks and focus projects of this Plan and blockchain is part of several points.

Point 1: building a digital infrastructure system that is ubiquitous, intelligent, and connected, for the sake of people's well-being. Building computing power and algorithm centers oriented to blockchain can contribute to that. It is also necessary to build blockchain infrastructure based on distributed identification and enhance blockchain inter-system linkage and interconnection capabilities. One of the focus projects is building a nationwide integrated big data center system, which provides for the innovative application of blockchain in the circulation of public data among regional facilities and platforms.

Point 3 is about building innovative development systems to liberate digital productive forces, which includes building open and flexible structures, systems and innovation environments. In order to do this, it is necessary to perfect the legislative framework on the security of critical information infrastructure, cybersecurity, and data security, as well as expand legislative research for blockchain and other new technologies. This point contains the projects of information technology intellectual

property rights and standardized innovation. They require the reinforcement of IT patent innovation, which can be implemented by strengthening the advancement of high-value patent focusing on blockchain besides other technologies, and the construction of informatization standards innovation systems, giving priority to such areas as blockchain and other technologies.

Point 4 focuses on cultivating advanced and secure data industry systems. Digital industry capabilities must increase following, for example, the advancement and expansion of the blockchain industry.

Building digital transformation and development systems for industry is at the center of Point 5, which includes projects for digitizing the manufacturing sector. Such digitization transformation projects require the in-depth advancement of informatized and industrialized converged development and smart manufacturing development. It is necessary to research and formulate guidelines for the converged application of blockchain and other technologies in the manufacturing sector. In addition, it is necessary to conduct research on and development of applied technologies based on blockchain for industry application.

According to Point 9, one of the tasks of this Plan is to expand mutually beneficial and win-win international cooperation systems in the digital area, for instance, by creating high-quality investment cooperation platforms and global-level innovation centers for blockchain.

The last Point provides for the establishment and completion of standardized and orderly digitization development governance systems, for which technology norms and governance systems are required. In particular, it is necessary to clarify legal responsibilities in key technologies such as blockchain.

Chapter 5 expounds the priority actions of the Plan, including actions for breakthroughs in cutting-edge technologies and actions for universal digital financial services.

The first set of actions pursue the accomplishment of significant advances in blockchain R&D and the implementation of integrated application demonstrations in some sectors by 2023; by 2025, cutting-edge digital technology innovation ecosystems are expected to be increasingly complete, sector-level integrated application demonstrations and benchmarks should continue to emerge, and the industry scale should increase rapidly. To achieve such goals, it is necessary to foster the healthy and orderly development of blockchain technology applications and industrial ecologies, by focusing on research, security, standardization, and applications. Therefore, efforts will be made to promote research on core technologies such as encryption studies, consensus mechanisms, smart contracts, etc.; support the construction of a secure, controllable and sustainable underlying technology platform and open source blockchain community; build a blockchain standard and norm system, reinforce the testing and evaluation of blockchain technology, and formulate application standards and norms for the blockchain sector in key basic areas; carry out pilot projects for innovative applications of blockchain, focusing on application demonstrations in areas such as fintech, supply chain services, government

services, and business technology; establish a security guarantee and supplementary support system that adapts to the blockchain technology mechanism.

The second set of actions strive for producing a clear transformation following financial industry digitization, in terms of further improving the model of financial services and increasing the product supply and scope of business contact by 2023; by 2025, starting to form an advanced, reliable, and flexible infrastructure service system, implementing preliminary digitization and intelligentization of the financial industry, strengthening financial inclusiveness and the capability to serve the real economy, forming a supervisory system for financial technology, providing comprehensive support for the new development pattern. It is therefore necessary to improve the level of financial services for people's livelihoods, by comprehensively use blockchain, 5G, and other technologies to build a multi-level, extensive new financial services model, promoting the continuous maturing and improvement of digital financing and digital correspondence, and increasing the reach and capability of financial services.

1.2. Microeconomic perspective: blockchain regulations in the accounting sector

When the regulations focused on the accounting sector are considered, i.e. the ones on highlighted background in Table 1, the Informatization Strategy of the CICPA first includes blockchain only in the Development Plan for Informatization of Accounting Sector in China (2021-2025), as it has already been utilized by some large accounting firms. The Plan establishes that blockchain should be used to upgrade the audit system at big firms and further applied in the accounting sector. Before that, informatization in general has been a crucial driver of the development of the accounting sector and the accountancy profession in China, as can be seen from the Ministry of Finance's Opinions on Accelerating Development of Chinese Accountancy Profession (2009), the Overall Plan for the Informatization of the Chinese Accountancy Profession (2012), the Incentive Measures for Informatization of Accounting Firms (2014), the Development Plan of the Accounting Sector in China (2016-2020), Development Plan for the Informatization of the Accounting Sector in China (2016-2020), and the Development Plan of the Accounting Sector in China (2021-2025). Therefore, this paragraph is divided in two parts, the first one concerning the opinions, plans, and measures about the informatization of the accounting sector, and the second one regarding the Plan that specifically deals with the role of blockchain in the accounting sector.

1.2.1. Informatization of accounting in China

The attention of the CICPA for the use of blockchain technology in accounting originates from the need to measure up to international counterparts in terms of development of the accountancy profession, which must first and foremost undergo a process of informatization. In order to spur big

accounting firms to build world-IT infrastructures by 2015, they are given a monetary reward for outstanding efforts in informatization. In addition, modern IT should be fully used to improve professional accounting services and by 2020 the accounting sector will be highly equipped with IT. In 2021, China starts focusing on quality improvement of the accounting sector through further digitalization. This subparagraph expounds the Ministry of Finance's Opinions on Accelerating Development of Chinese Accountancy Profession (2009), the Overall Plan for the Informatization of the Chinese Accountancy Profession (2012), the Incentive Measures for the Informatization of Accounting Firms (2014), the Development Plan of the Accounting Sector in China (2016-2020), Development Plan for the Informatization of the Accounting Sector in China (2016-2020), and the Development Plan of the Accounting Sector in China (2021-2025).

As of 2009, Chinese accountants lagged behind their international counterparts. In order to accelerate the development of the Chinese accountancy profession, the Ministry of Finance prepared the Opinions on Accelerating the Development of the Chinese Accountancy Profession, which makes reference to information technology. As a matter of fact, one of the key development objectives includes the improvement of the level of information technology (IT) in accounting firm's internal management. Large and medium size accounting firms shall universally use IT in financial reporting audit, internal control audit and other services. The long-term and sustainable development of accounting firms requires the full use of modern IT and the establishment of specific departments for information technology.

The Overall Plan for the Informatization of the Chinese Accountancy Profession issued in 2012 focuses on the transformation of the accountancy profession in China using information technologies. Even though the Plan is not specifically about blockchain technology, its relevance for this work lies in the attention attached by the CICPA to the informatization process, which will pave the way to the application of blockchain technology in the accounting sector in the following years. The reason why IT is important for the Chinese accountancy profession is that it would increase competitiveness, boost practice development, foster the building of a professional integrity monitoring system, and drive globalization of the profession. The purpose of putting IT at the forefront of the development of Chinese accountancy profession is to improve Chinese accounting firms' performance and allow them to measure up to the international level. At the time the Plan was issued, the accountancy profession in China generally lacked IT awareness and knowledge, it did not sufficiently appreciate the importance and urgency of digitization, it made relatively little use of IT applications, had relatively poor IT R&D capabilities as compared with international counterparts, it was under-invested and frequently upgraded and revised, which resulted in slow progress in IT application, low level of data integration and exchanges. Consequently, a significant amount of redundant data and information

was produced, and there was shortage of IT personnel, which resulted in the poor establishment and maintenance of IT operations. Therefore, the Plan aims at exploiting and maximizing the use of IT in the accountancy profession by establishing and operating solid IT infrastructures, extensively deploying IT applications, as well as by means of a high-level connectivity between IT systems and sharing of open data and information. According to the milestone set by the Plan, by 2015, world-class IT infrastructures and online platforms providing an all-around range of web-based supervisory and service facilities to the profession and general public should be established; big accounting firms should have IT systems that measure up to those of international accounting firms, and small- and medium-sized practices (SMPs) should set up their websites and deliver their audit assignments by using audit software.

The Incentive Measures for the Informatization of Accounting Firms were introduced in 2014 in accordance with the Overall Plan for the Informatization of the Chinese Accountancy Profession and establish a yearly reward (from 2014 to 2016) of 500,000 CNY for the top fifteen accounting firms that make outstanding efforts in informatization.

As of 2016, the informatization of the accounting sector has gradually improved and should continue to be promoted in depth. The significant improvement of informatization is indeed a major development objective of the Development Plan of the Accounting Sector in China (2016-2020) and requires the full use of modern IT in the accounting sector and to upgrade the profession management information system. In addition, an IT system that is connected to the Internet, mobile, and intelligent is needed to modernize professional services.

The Development Plan for the Informatization of the Accounting Sector in China (2016-2020) was issued in order to innovate and integrate the application of information technologies and provide the IT platform to rapidly develop the accounting sector. During the previous period (2011-2015), IT applications have improved the profession management and service and their adoption in accounting firms has increased. However, the informatization level of Chinese accounting firms still need to improve, in order to match the elevation of IT development to the level of a national strategy. By the end of this period, the accounting sector will be highly equipped with IT. The specific objectives include enhancing the informatization framework and form a standardized system; modernize the Profession Management Information System and establish an OA system and an information sharing database; new generation IT will be used by firms to deliver audit services and manage internal affairs. In order to implement the tasks necessary to achieve these objectives, the organizational leadership will be strengthened; the funding commitment will increase, especially towards firms and underdeveloped areas such as Central and Western China; talent training will be accelerated; a performance evaluation system will be established.

The Development Plan of the Accounting Sector in China (2021-2025) focuses on the quality improvement of the accounting sector in China. Although during the previous five years significant progress in informatization had been achieved, it still needs to keep up with the national strategy of building a digital China. The main development objectives of this period require the accounting sector to shift the focus of informatization onto digitalization and SMPs to universalize informatization products in audit practice and internal management. According to the Plan, the accounting sector should deepen the informatization of CPAs institutes at all levels. In order to implement the high-quality development, the "3456" informatization project will be promoted. It consists in three tasks for fundamental informatization, four tasks for data application, five tasks for informatization of profession management and service and the collaborative OA system, as well as six tasks for informatization of firms. To accelerate basic research on informatization and construction thereof, the basic systems for informatization will be improved to enhance standardization. Such systems include information systems and a scientific and applicable system of data standards. The security of application systems and data assets will be ensured according to the Cybersecurity Law. Informatization rules need to be improved to promote the interconnection and data sharing among information systems and develop an Internet-based ecology among the information systems in the accounting sector. As for accounting firms, SMPs will be encouraged to popularize informatization products in the audit practice and internal management fields and big firms will be upgraded intelligently, i.e. they will be encouraged to build intelligent audit practice platforms covering the whole audit processes and develop supporting tools in order to enhance informatized governance. Efforts will also be made to explore the integration and application of modern information technologies to foster new technologies, new products, new business forms and new service models. The path to informatization will be diversified and a technology platform for data sharing should be constructed.

1.2.2. Blockchain technology in the Informatization Strategy of the CICPA

The Development Plan for the Informatization of the Accounting Sector in China (2021-2025) was formulated by the CICPA to guide the accounting sector to promote the high-quality development of informatization. It is the first time that blockchain is mentioned in the Informatization Strategy of the accounting sector. Although some big accounting firms already use blockchain, overall it should be used more to upgrade the audit system and further applied in the accounting sector.

During the previous period, informatization has made new progress, its infrastructure and the informatization of profession management and service have been further enhanced, and the informatization of firms has gradually improved, with some large firms having already used blockchain technology and other new information technologies to dive into the application of robot process

automation and the observation of physical inventory counting with drones. Nevertheless, the accounting sector still needs to keep pace with the surging IT-driven digitalization and be compatible with the national strategy of making China a cyber superpower. There is still a progress gap between big firms and SMPs, insufficient awareness of informatization and innovation drivers (e.g. investments, training, applications, etc.), and a certain difficulty for some firms in meeting their clients' needs of audit practice.

The Plan sets 2035 as the milestone for building the strengths of CPAs institutes at all levels in cyberspace, and 2025 as the milestone for advancing the above-mentioned "3456" informatization project. The major development objectives include: reaching a new level of informatization infrastructure; further enhancement of data analysis and application capability; achieve new progress in informatization of profession management and service and OA system at CPAs institutes; making new breakthroughs in informatization of firms. The informatization infrastructure and standardization need more research and construction of a technical framework, data standards and cyber-security. The accounting sector should improve supporting and service capabilities of data all-around by constructing a knowledge library and a data center, deepening the application of big data analysis and promoting data governance. The informatization of profession management and service as well as the collaborative OA system at institutes of CPAs at all levels requires the optimization of the Profession Management Information System, the improvement of the integrity information monitoring system, the reinforcement of the collaborative OA system, the promotion of interconnectivity among information systems, and the improvement of informatization-related rules. The informatization of accounting firms shall be strengthened in terms of upgrading the audit system at big firms with blockchain and other frontier IT, building an integrated and comprehensive management system between headquarters and branches of firms, popularizing informatization products at SMPs, realizing digitalization of external information procedure, exploring and researching the integration and application of blockchain and other modern IT in the accounting sector, and diversifying their paths to informatization.

Chapter 2. Literature review

Blockchain technology development and application is still at an early stage in China. However, as a result of its vigorous promotion by the Government, the blockchain industry is growing. Most authors agree that blockchain technology is transforming the traditional industrial system in the direction of collaboration, sharing, and transparency. Its application started with cryptocurrency and soon expanded to a vast array of scenarios, including accounting. In this field blockchain technology provides many advantages in terms of quality and efficiency, but also undermines the traditional functions of accountancy and audit. On one hand it produces significant improvements in these activities, on the other hand it presents some issues that need to be tackled in order to allow blockchain technology to thrive in the accounting sector as well as other social and economic areas.

This chapter, therefore, presents the relevant literature on this matter, highlighting differences and similarities of different authors' perspectives, and reports their suggestions for the improvement of the blockchain industry in China and China's accounting sector.

2.1. Blockchain in China

In order to better understand the current situation and development of blockchain technology in China, this paragraph examines and summarizes a number of publications dealing with blockchain in China. In particular, the topics touched by the studies include the blockchain industry ecosystem, the government's support of blockchain technology and its domestic and international strategies, blockchain applications and projects, blockchain research, talent training, and challenges to blockchain development and corresponding countermeasures. The studies are organized in order to describe the ecosystem of the blockchain industry in China, including industry size and scope, patent applications, investments, applications and projects, research, and talent training, and explain how the development of the ecosystem is the result of the Government's policy support. Eventually, the challenges to blockchain development and corresponding countermeasures signaled and suggested by the authors are presented.

2.1.1. Blockchain industry ecosystem in China

According to Zhang H. et al. (2021), blockchain's philosophy of synergy, transparency, sharing, and border crossing contributes to the creation of a new model of industrial ecology, the formation and development of industrial clusters, and the transformation and upgrading of traditional industries. This new model of industrial ecology can be defined in terms of value co-creation, which means that different value units create value together in a synergistic way and by integrating resources.

China's blockchain industry ecosystem is organized in three value subsystems: the first one has the function of value pivot and comprises blockchain enterprises, platforms, and user organizations that realize the division of labor, cooperate, and integrate blockchain technology with different fields in the system; the second one serves as value support and includes government and regulatory agencies, financial institutions, universities and research institutions, intermediary service institutions, etc. that provide policy guidance, financial support, theoretical methods, talent support and so on; the third subsystem serves as value integrator and is composed of financial services, property rights protection, Internet of Things, healthcare, and supply chain management. The research suggests that the development of the Chinese blockchain industry ecosystem during the 2015-2020 period has continuously improved. In the first two years the industry increased at a slow pace, reaching a turning point in 2017 thanks to central policies. The central government's measures to strengthen the regulation of the blockchain industry introduced in 2018 led to a fall of the value-support units, but in 2020 the pandemic caused crises and opportunities that further highlighted the important role of blockchain and other frontier information technologies. The research also prospects a promising overall development in the post-pandemic era. As a matter of fact, national policy guidance, breakthrough in basic technologies, and growing demand for application fields have caused the number of registered blockchain enterprises in China to surge from 1,670 in 2016 to 24,687 in 2020, the number of patent applications to account for 63.52% of the global amount, and the integration of blockchain technology with the real economy to continuously improve. Nevertheless, the level of blockchain industry ecosystem development is still low and mainly driven by central and local policies. As a result, in the development and operation process, the majority of blockchain enterprises need assistance from solid upstream and downstream businesses, supporting organizations, and other connected units. The entrance of blockchain in the industrial ecosystem affected the original structure and development operation mode of the region and transformed the industrial policy system and environment and the market structure. These problems must be addressed to maintain the stability of the ecosystem's value transfer and ensure the efficiency of the blockchain industry value creation.

As for investment in the blockchain industry, initially there have been massive injections in research and development, which caused application landing to peak in 2017. Nevertheless, such application development has not produced a return on investment yet, causing the blockchain business of each enterprise not to be self-sufficient and needing additional businesses to cover costs, which leads to the expansion of application fields.

In addition, when promoting the development of the blockchain industry, macro units such as the Government, the market, etc. have excessively focused on the application landing and industrial integration of blockchain technology, overlooking the coordination of the relationship with blockchain

companies. As a result, the three value subsystems have not achieved synergy yet but are still in a state of reconciliation and the synergistic evolution of China's blockchain industry ecosystem must be further promoted.

This description of the blockchain industry ecosystem is supported by other studies that provide additional data and information about blockchain enterprises, patents, investments, strategies, applications, research, talents, and so on.

As stated above, national policy guidance has caused the number of registered blockchain enterprises to surge from 1670 in 2016 to 24,687 in 2020. Wang Q. et al. (2020) also emphasize the connection between the proactive promotion of blockchain development by the Government through policies and guidelines and the increment in the number of blockchain enterprises introducing blockchain projects. Besides this, Li R. et al. (2021) add that in 2019 there were already 510 listed companies using blockchain, as a result of the vigorous promotion of blockchain development policies by the Government. Out of all industries, the one that has the biggest ratio of blockchain companies to all companies is the IT industry, followed by finance, leasing, and business services, while the most blockchain companies are in the manufacturing industry, despite the low percentage. Also Wan Y. et al. (2022) focus on Chinese listed companies and state that an increasing number of them are involved in the R&D of blockchain technology in order to keep up with technological development, enhance their efficiency, and reach sustainable growth.

In 2020 the number of blockchain patent applications accounted for 63.52% of the global amount. Aysan A.F. et al. (2020) add that China has over 10,000 blockchain-based patent applications in the China Intellectual Property Administration as of 2020, with Alibaba being the first and China Unicom the second sources of patent applications. This indicates the high level of creativity and innovation of Chinese companies in blockchain projects, despite the strict economic regulations for investors and the ban of cryptocurrencies in 2017. Furthermore, Jiang et al. (2022) use patent data from 2009 to 2018 to measure the level of technological collaboration on blockchain. Similarly to Zhang H. et al. (2021), they consider the rapid increase in blockchain patent applications in China the effect of consistent national strategies. The number of patent applications in China exceeding that of the US in 2017 provides evidence for the sustained and significant interest of the Government for blockchain technology and for its vigorous promotion and reinforcement of blockchain research and development, application, investment and innovation. The study also focuses on patentees and geographical distribution of patents. In 2018, the top twenty patentees in China hold a total of 1,748 patents, Alibaba ranking first with 253 patents, followed by Tencent, State Grid of China, Ping An Insurance and Hangzhou Fuzamei. The top twenty patentees include enterprises, universities and scientific institutions. Start-ups such as Hangzhou Fuzamei (headquartered in Zhejiang), Launch Tech

(headquartered in Guangdong) and Hyperchain (headquartered in Beijing) occupy a large proportion of enterprises that were granted patents, while, among universities and scientific institutions, the Chinese Academy of Science ranks 13th, the University of Electronic Science and Technology in China 18th and Beihang University 19th. In terms of geographical distribution, 73.96% of patents are granted in Beijing, Guangdong, Zhejiang, Shanghai, Jiangsu, Sichuan, Fujian and Shandong. Among these top eight provinces, patents are mostly applied for in Beijing (20.87%) and the least in Shandong (2.81%). Nearly 50% of the whole country's share is held by Beijing, Guangdong and Zhejiang. This indicates that the development of blockchain in China is not well distributed and concentrates in three regions: Beijing, South China and Yangtze River Delta, which have a relatively developed economy and are active market players in China. The agglomeration of innovators in these regions results from spatial knowledge spill-over, government policies such as direct subsidies, cultural attraction and institutional construction, the agglomeration of population, and the presence of several high-tech talents and a high-quality university incubation system. In China's blockchain patent cooperation network, the group with State Grid as the core is the one with the most collaborators, including universities, scientific research institutions and companies.

Governmental support for blockchain technology development and application is not a Chinese prerogative but more an Asian phenomenon, according to *Li Z. et al.* (2021). Despite innovation currently occurs in Europe and the US, the application of blockchain technology is rapidly being popularized over the Asia-Pacific region under the support of Asian governments. As a result, investments in blockchain-based companies in the Asia-Pacific region have increased significantly. However, Daluwathumullagamage et al. (2020) indicate China as a crucial driver of blockchain investments in Asia. As mentioned before, the initial massive investments in blockchain research and development have cause a peak in application landing but it will take long to see a return on such investments. In addition, according to Li R. et al. (2021), blockchain companies establish blockchain businesses too early, under the influence of the government's vigorous promotion. As a matter of fact, blockchain technology development in China is still at an early stage and not all companies are appropriate to carry out blockchain activities and their performance does not improve. Such enterprises usually have decentralized ownership and poor earnings, they are private or in regions with weak marketization and law environment. Therefore, the fact that blockchain is one of the most promising technologies in China on one hand can cause investors to act blindly under the influence of the blockchain hype, and on the other allows companies that disclose blockchain technology to attract more investors and obtain a positive market response.

The stock market response to blockchain announcements by Chinese firms has been the object of different studies. Klökner et al. (2022) focuses on 27 emerging markets including China, since its

firms actively engage in the advancement of blockchain by adopting it or providing technology. According to this study, the market reaction is positive and delayed of one day compared to developed markets. In contrast with these findings, Liu et al. (2022) state that on the release day of blockchain announcements by Chinese companies the stock market's reaction towards the announcing company is significantly positive, especially for announcements pertaining blockchain technical innovation and strategies. Their study uses a sample of 143 "non-Bitcoin" blockchain announcements by 102 Chinese A-share listed companies between 2016 and 2021, which is more representative of the Chinese market than considering emerging markets in general without distinctions. The paper specifies that the factors influencing a positive market reaction are technological innovation and strategic planning, while blockchain partnerships and enterprise characteristics, such as firm size and enterprise innovation ability, do not affect stock market reactions to blockchain announcements. This is probably because technological innovation improves competitive advantages and organizational performance, and strategic planning means that the enterprise will likely continue to follow development of blockchain over the long run, giving investors a positive signal. On the contrary, blockchain partnerships are compatible and complementary to independent R&D, therefore this factor is not relevant for the stock market. Firm size is also not important, because small firms experience the same market reaction as large firms. Similarly, enterprises with strong innovation abilities do not show more positive market reactions than other enterprises, according to the findings. Chen et al. (2022) also recognize the positive effect of blockchain announcements on the value of listed companies in China. Their study used a sample of 302 blockchain announcements of Chinese A-share listed companies in Shanghai and Shenzhen over the period of 2016-2020 and they discover that investors' reaction to blockchain announcements released by high-tech firms is stronger, because they reckon that the announcements of such firms are more credible. The factors that positively affect the signaling credibility of blockchain announcements are technological properties, voluntariness, being a SOE, while the factors influencing investors' perception of signaling credibility are positive textual sentiment, attention and mania to bitcoin, and national government's support.

Because of the vigorous political promotion of blockchain technology by the Chinese government, the scope of blockchain application landing in China has expanded.

> "With the continuous development of China's blockchain technology and industrial chain, governments and enterprises in various regions are actively exploring the development path of the blockchain industry, and the application scenarios of the blockchain are becoming increasingly rich. In recent years, the application of blockchain in financial services, e-government, fair certification, food and drug traceability, etc. has achieved remarkable results. In addition, the application fields of the blockchain are expanding, […]

which is conducive to the further promotion of blockchain technology." (Wang Q. et al., 2020)

According to Li Z. et al. (2021), the number of blockchain-related industrial application enterprises was the largest at the end of the first quarter of 2018. 86 of those enterprises work in finance and 109 in the real economy. In addition, the number of blockchain-related projects from the National Natural Science Foundation of China[9] has risen from 2 in 2016 to 25 in 2019 and the corresponding funds have also steeply increased. Li R. et al. (2021) presents several examples of blockchain applications and projects carried out by different entities, such as financial institutions, governments, and enterprises. Among the financial institutions that started blockchain businesses, the China Merchants Bank uses blockchain to execute direct settlement business across borders, the Postal Savings Bank of China operates letters of credit and asset custody services based on blockchain, the Bank of China in collaboration with Tencent Financial Technology Group has applied blockchain to digital wallets, trade finance, house leasing, public welfare, cross-border payments, digital bills, etc., the China Zeshang Bank has developed an accounts receivable platform based on blockchain, the Shenzhen Stock Exchange shares information between intermediaries in the stock market of the region using blockchain, and the People's Bank of China has developed digital currency. As for governments, the city of Foshan in Guangdong has implemented blockchain-based services to accelerate government affairs, Beijing has developed electronic invoices, admission tickets, and parking tickets based on blockchain, and Xiong'an has established a government construction funds platform using blockchain. The blockchain application scenarios for enterprises range from tax management to supply chain finance, the Internet of Things, etc. Alibaba uses blockchain to realize cross-link data connection, distributed identity, application platform, trusted computing, etc., it provides other companies with comprehensive solutions in finance, industry, and government, and it applies blockchain to improve product traceability, financial leasing, marketing, risk management, health care, trusted data service platform, bills circulation, intellectual property protection, economic sharing, authentication, etc.; Huawei provides blockchain support services (e.g. supply chain finance and traceability, digital assets, crowdfunding, notarization) using a blockchain cloud platform. Other companies that are engaging in the development of blockchain applications include but are not limited to Baidu, Tencent, and JD.com. Wang Q. et al. (2020) recognize that blockchain applications are not limited to government and

[9] The National Natural Science Foundation of China is an institution founded in 1986. It was initially subjected to the authority of the State Council until 2018, when it became subordinate to the Ministry of Science and Technology. Its mission consists in promoting basic research, cultivating talented researchers, encouraging international cooperation and stimulating socioeconomic development. (*NSFC at a Glance*, 2017)

enterprise services but the technology is also penetrating further in fields relevant to people's daily lives, including public welfare, charity, healthcare, transportation, etc. Aysan A.F. et al. (2020) comment the coexistence of both public and private blockchain projects and state that it gives endurance and power to Chinese institutions in the development of blockchain technology, as those projects are supported by scientific evidence.

Besides these application landing cases and projects, according to Aysan A.F. et al. (2020) and Jiang N. et al. (2022), there are two major initiatives of the Chinese government that exemplify its efforts to promote blockchain technology: the Blockchain-based Service Network (BSN) and the digital yuan. The BSN consists of a global infrastructure network that allows enterprises to develop new blockchain applications more conveniently, by lowering the cost barrier of the technology. This global project is initiated by the State Information Center in collaboration with China Mobile, China Union Pay, and Huobi China as a way of increasing world technology giants' investments in China, since it is expected to lower the cost of carrying out blockchain business in China by 80%, according to Daluwathumullagamage D.J. et al. (2020). The BSN also supports the global adoption and distribution of the digital yuan. The development of the Chinese national digital currency is carried out by the People's Bank of China and is aimed at strengthening the Chinese yuan against the US dollar in the international financial system. The new currency is already being tested with a pilot project involving major cities such as Shenzhen, Suzhou, Chengdu and Xiong'an. Despite the prohibition of ICOs, which are based on cryptocurrency, the Central Bank has implemented the e-CNY initiative in ten Chinese regions and presented it at the 2022 Olympic Games in Beijing and Zhangjiakou, as explained by Nelaturu K. et al. (2022), because cryptocurrency is merely one form of digital currency and is different from the digital yuan, i.e. a central bank digital currency (CBDC). As a matter of fact, digital currencies are a use case of blockchain-related advancements and include cryptocurrencies, stablecoins, platform-based digital currencies, and CBDC. The latter is a digital version of a national currency issued by the monetary authority of a state. Therefore, the digitalization of the yuan is not related to the adoption of cryptocurrencies. Daluwathumullagamage D.J. et al. (2020) add that there will most likely be a significant further increase of interest in blockchain in the post-pandemic era due to three factors: the digital transformation of enterprises brought about by Covid-19 lockdowns, China's massive investments in BSN, and the development of the digital yuan.

In order to reach global leadership in the blockchain industry, China has vigorously promoted and invested in blockchain research. According to Wang Q. et al. (2020), China is the world's first source of blockchain papers, leading the blockchain research. China's blockchain research is growing rapidly, its scope is constantly expanding, and its focus is gradually shifting towards applied research. The study presents some data: out of a sample of 4463 research papers about blockchain from the

Web of Science Core Collection database, China counts 826 articles; 23% of blockchain papers in the world published between 2013 and 2019 belong to Chinese scholars; more than half of the world's top twenty research institutions studying blockchain are Chinese, among which, the Beijing University of Posts and Telecommunications in China ranks first with a total of 73 published papers about blockchain, and the Chinese Academy of Sciences ranks second with a total of 60. Among the top ten scholars engaged in blockchain research, six come from China, which means that Chinese scholars are essential for global blockchain research. Aysan A.F. et al. (2020) report that to concurrently share their knowledge and experiences and raise themselves to international standards, scientists, entrepreneurs and state officials established platforms of diverse networks in universities, research institutions, and worldwide blockchain summits in China. At present, 86% of people employed in Chinese institutions are deemed suitable for future jobs.[10] In order to reduce this talent gap, besides building a diversified network in universities and incubators all around the country, additionally, China is building blockchain research facilities and hackathons that will house more vibrant, creative, and exploratory communities.[11] Therefore, in the next ten years China will most likely lead the development of global blockchain and dominate the global blockchain research.

As already stated above, the Chinese government is vigorously supporting blockchain technology development and application, which is an overall Asian phenomenon where China plays a crucial role. This commitment to promote blockchain technology has led to the expansion of the blockchain industry ecosystem in terms of number of enterprises, patent applications, investments, application scenarios and projects, research, and blockchain talent training. The Government has focused its strategy not only on domestic affairs, but also on international objectives. Li R. et al. (2021) define the role played by blockchain in the domestic strategy. Blockchain is a representative of the new generation information technologies, it is significant for national development and independent innovation of core technologies and accelerates technological and industrial innovation. The support of infrastructures such as 5G, cloud platforms, etc., enable China to use blockchain on a large scale. The political support of blockchain has spurred the expansion of the Chinese blockchain industry in terms of scale, patent applications, investments, research etc. However, the attention attached by the Government to blockchain technology has changed over the years. According to Wang Q. et al. (2020), in the initial phase (2013-2016) few policies were issued and mainly focused on cryptocurrencies. Since 2016, as discussed in the first chapter, when the State Council mentioned blockchain in the 13th Five-Year Plan for National Informatization as a cutting-edge technology, blockchain received

[10] Xu Jie 许洁, 2020, as cited in Tran, S. 2020, as cited in Aysan, A.F. et al., 2020.

[11] Manganiello, F., 2019, as cited in Aysan A.F. et al., 2020.

attention from all sectors of society. Subsequently, in 2017-2018 the national and local policy output increased rapidly, and even more in 2019. From a functional perspective, the current policies mainly focus on application and industrial integration. While "non-Bitcoin" blockchain development advances fast in China (Liu et al. 2022), the Government has always been wary of cryptocurrencies, to the point of prohibiting initial coin offerings (ICOs). According to Li Z. et al. (2021), the prohibition of ICOs in China makes it harder to avoid financial risks and discourages financial innovation. Therefore, on the long-run, China should regulate and supervise ICOs for the long-term development of the blockchain industry. Aysan A.F. et al. (2020) also reckon that the Communist Party is most concerned about China's inability to manage cryptocurrencies without destroying the entire Internet. When we broaden the focus and consider China's strategy in the global arena, it is evident that not only China desires to become a global leader in blockchain technology, but its blockchain strategy is also part of a broader objective, that is enhancing its status as a great power and reach global authority. Blockchain offers an opportunity to get around the restriction of the current financial system dominated by the dollar and gain relative advantage. That is why China has been promoting blockchain companies and projects' empowerment and investing in blockchain research.

2.1.2. Challenges and countermeasures

Despite the government support towards blockchain development, the technology in China is still at the primary and exploratory stage, as affirmed by Li R. et al. (2021). The majority of the companies have established the consortium type of blockchain and there is an unbalance in the strengths of supply chain companies. Chinese firms are unlikely to completely abandon the traditional transaction mode, but this one will probably coexist with the blockchain transaction mode. In addition, there is a shortage of skilled operators in this field. Therefore, blockchain might not be employed to its full potential, causing a decreased level of efficiency and lower firm performance. Even when blockchain can slightly improve efficiency, not all companies want to share activities. This is because Chinese blockchain is usually established by strong firms, which try to attract other firms to participate in it and gradually create monopolies and hierarchies. Consequently, in order to avoid the risk of data leakage, some enterprises do not want to share data, which results in the isolation of supply chain data. Besides these issues, Wang Q. et al. (2020) consider also other challenges faced by the blockchain industry, such as paucity of special policies and safeguard measures, hidden security risks due to insufficient strict technical standards, poor innovation of blockchain companies and homogeneous service types, and absence of third-party assessment system. Countermeasures include targeting support actions to each province or region, establishing standardized security level evaluation standards

and accelerating the improvement of the regulatory system, and encouraging blockchain technology innovation and accelerating deep integration with the real economy.

2.2. Blockchain in the Chinese accounting sector

The application of blockchain technology started with cryptocurrencies and then its range of scenarios has expanded as a result of the prohibition of ICOs and the vigorous promotion of blockchain development and application by the Chinese government. In accounting, blockchain has a promising future and this paragraph discusses its current status in the Chinese context with a focus on the way it transforms the traditional accounting process, the accountancy profession and auditing activities, the challenges it faces and countermeasures suggested by the literature on this matter.

2.2.1 Blockchain technology's potential for transforming China's accounting sector

Many studies suggest solutions to the current problems affecting the Chinese accounting sector that are provided by blockchain technology and the ways it can improve the quality and efficiency of accounting and transform audit.

Blockchain solutions in the accounting field originate from the necessity to tackle certain issues pertaining accounting activities. Yang X. et al. (2020) affirm that blockchain can solve the problems of accounting fraud, distortion of accounting information, and reliability guarantee of accounting information. They explain that in China accounting fraud takes the forms of listing, avoiding special treatment and delisting, allotted shares, additional issuance, manipulating stock prices, and so on. Moreover, inconsistent interests and information asymmetry are the main reasons for accounting information distortion in China, and blockchain technology solidifies the transaction information twice, first at the source and then in the accounting process, ensuring the reliability and authenticity of transaction information. Another problem highlighted by Chen Y. et al. (2021) is the information asymmetry stemming from the centralized equity structure of Chinese A-share listed companies. As a result, financial reports largely reflect the will of major shareholders, mining the reliability of accounting information. In addition, as explained by Shao H. et al. (2021), the Chinese accounting information security system (i.e. servers, storage devices, network devices, and users) is flawed, Chinese accountants are not consistently cautious in handling accounting information and unintentionally disclose accounting information, and managers tend to buy more advanced equipment rather than focusing on accounting personnel, which may cause the business to close or even the company to collapse.

These problems can be solved with the application of blockchain to different areas of accounting activities such as financial accounting and management accounting. According to Liu S. et al. (2019), blockchain can be used to establish a new financial accounting system as it ensures a high degree of

security of accounting and the inalterability and traceability of data and in the future blockchain technology will most probably be applied in financial accounting in the form of a blockchain storage technology based on big data, Internet of Things, and a distributed financial accounting system. As for management accounting, Han J. et al. (2021) design a management accounting information system model that combines blockchain and intelligent data management and performance. Their study shows that besides achieving data security, data sharing, innovative services, and resource saving, the combination of blockchain and management accounting can solve the existing problems related to the latter, namely lagging platform information, personnel redundancy, alterability of system data, system design unicity, and high information acquisition costs. The use of blockchain in management accounting can also promote the informatization of management accounting and enhance the value creation of management accounting within a company. In another study, Zhao Y. et al. (2022) focus on the mechanism of blockchain technology that influences management accounting and attribute to blockchain technology the ability to ensure the authenticity and security of management accounting data, support their sharing, improve management accounting efficiency, and reduce the cost of trust among stakeholders. Blockchain technology affects management accounting innovation in that it shifts the responsibility of management accounting from the supply of financial information to strategic planning and value management. It also changes the creation of value, which is promoted as a mainstream management accounting goal. It is based on consensus, and the construction of multilateral participation platforms, algorithms and models creates value. Blockchain also enhances the quality of management accounting information, reduces information asymmetry, increases the cost of data modification by managers. Furthermore, blockchain technology reduces enterprise costs by improving the efficiency of information transfer. It is used as the basis of a cost control system composed of a profit center, cost center and investment center. Finally, blockchain technology improves the efficiency of management accounting in terms of data collection and data transmission. The innovation of blockchain-based management accounting includes collection, classification, storage, processing, transformation and application. Raw data collection is the basis for traceability, validation, and processing of data. Data definition consists in converting the collected information into a recognizable language for the blockchain. Subsequently, both internal and external information is verified, timestamped and stored. Data is then analyzed and classified. Data connection indicates the establishment of smart contracts and the application of data consists in the preparation of accounting reports. Blockchain influences the enterprise's strategic management accounting by establishing an alliance chain with consumers, suppliers, and other participants in the system to share information and achieve win-win, as well as a private chain to record and transmit information within the enterprise. Zhong M. et al. (2021) see in the integration of financial accounting and management accounting

with the help of blockchain technology the means to improve the accuracy of accounting information and its commercial value and optimize the accounting system, which leads to enhanced market competitiveness of enterprises and further development of Chinese enterprises. Nevertheless, at present most Chinese companies still direct their attention more towards management accounting than financial accounting.

Many papers discuss the improvements brought about by the application of blockchain technology to the accounting sector. Generally speaking, blockchain enhances the quality of accounting information and the efficiency of the accounting system.

In particular, as discussed by Wu J. et al. (2019), blockchain technology improves the quality of accounting information in terms of relevance, faithful representation, timeliness, comparability, etc. Blockchain technology provides transparent, credible, and real-time accounting information and improves financial reporting.

Wang Z. et al. (2021) also indicate different benefits brought by blockchain to accounting activities. In accounting information recording and disclosure, while reducing human intervention and achieving self-management, blockchain can optimize the bookkeeping model, by using a distributed bookkeeping model that allows data to be recorded automatically by each node at the same time the event occurs; improve the system's security, as the irreversible timestamp makes the transaction data tamper-proof and the encryption process protects the parties' privacy; customize financial reporting with an on-demand reporting process, making disclosure interactive and real-time. In management and operation, blockchain can lower trust cost, because transaction data are open, transparent, true and reliable; labor costs, by automating manual tasks and saving auditing costs; time cost, by automating accounting information recognition, measurement, recording and reporting, improving audit efficiency and reducing operational risks; and maintenance costs, because each node is independent and even if one node is down all the others can still operate. Another paper by Mai X. et al. (2021) explains how a supply chain system based on blockchain can reduce the cost of holding. By using a distributed accounting technology, the flow of information within the company and between the company and external parties can be accelerated, which makes the inventory purchase quantity better match the production schedule and reduces the delivery delay time. As a result, the transportation cost, out-of-stock cost, opportunity cost, operating cost and risk cost are all reduced, which in turn reduce the total inventory costs, and the use of inventory by the company is more efficient. Through efficient communication, enabled by blockchain technology, a better Enterprise Resource Planning (ERP) system can be developed to optimize inventory and resource allocation, which enables the implementation of a timely production system. Therefore, the application of blockchain technology

in the accounting industry ultimately promotes the healthy development of listed companies in China. In the simulation, holding costs decrease from 200,000 CNY to 80,000 CNY.

Blockchain technology also improves financial reports. Zheng R. et al. (2021) locate the problems of traditional financial reports in the absence of objectivity, truth, and timely issuance. In contrast, blockchain allows to conduct financial analysis in advance or during the process, it enables on-demand and timely financial reports, it provides a true representation of the financial status, it guarantees the authenticity of financial information and the quality of audit. The paper suggests studying the accounting information processing model to build an accounting supervision system based on blockchain technology. Enterprises can divide their departments into blocks and establish a distributed ledger where data are shared to serve production and operation activities. This reduces, once again, fraud risk and enhances the reliability of financial information. Chen Y. et al. (2021) add that the information asymmetry present in traditional financial reporting can be solved by blockchain technology, which allows transaction data to be recorded in real time on the distributed ledger and unable to be tampered with.

The study of Zhang Y. et al. (2020) focuses on the impact of blockchain on the accountancy profession and the transformation of accounting education in China provoked by the advent of blockchain technology. As of 2017, accounting education in China is divided into liberal education and professional training. Blockchain and other new technologies have reduced the workload of financial accountants by automating repetitive tasks. Accountants are now required to engage in more value-added tasks, understand corporate operations and contribute to corporate governance. Therefore, liberal education will be more important than professional training in accounting. This is affirmed by Zhong M. et al. (2021) as well, who attribute the cause of the gradual shift of focus of the work of accountants to forecasting future development trends to the reduction of the workload of repetitive tasks that results from the application of blockchain technology.

The study also touches other points about blockchain in accounting. It specifies that the efficiency and accuracy of accounting can be improved with the use of distributed bookkeeping instead of double-entry bookkeeping. In addition, blockchain can maximize the relevance of accounting information for the users. Through cryptography it can also increase accounting information security and through signatures it can improve transparency. Since the process of data recording is automatic, blockchain also improves the timeliness of accounting information. Mutual supervision by participants ensures neutrality. Distributed bookkeeping is a solution to the problem of trust, improves audit efficiency and reduces financial management costs. A more credible information disclosure leads to better corporate financial decisions. Similarly, Zhu Y. et al. (2019) analyze the application of blockchain in accounting in a comprehensive way and explain that an accounting system based on

blockchain uses a distributed ledger that is accessible by multiple nodes through encrypted keys. Each node can record business transactions on the account book without the possibility to modify the information unless at least 51% of the nodes agree to. The ledger is updated in real time. This distributed ledger is less time-consuming and more convenient compared to traditional centralized account books. In a blockchain-based accounting system, balance is achieved by checking and confirming each node, accounting measurement is open and transparent, transaction information is recorded in real time and automatically verified, accounting data are objective and accurate, which reduces the risk of fraud, information asymmetry and data leakage is prevented by on-demand reporting, cross-border payment is simpler, faster and thus cheaper, because intermediaries are not involved. Blockchain can reduce the links in traditional accounting processing, time and financial risk. The advantages of blockchain are high efficiency and low cost, because it simplifies the tasks of accounting activities and it reduces time and intermediation costs. Besides, it facilitates auditing and improves its efficiency. As for the accounting process, blockchain automates the whole process from acquisition of accounting data to reporting. Moreover, blockchain can promote the standardization of accounting and the comparability and fairness of accounting information, which prevents information asymmetry. Another comprehensive study is that of Zhang L. et al. (2021), which reveals that blockchain technology has a positive impact on the accounting industry, in that it eliminates the need for a third-party audit and solves the problems of tax evasion, corruption and bribery, thus contributing to the strengthening of China's accounting industry and its integration with international accounting. Blockchain technology has a positive impact on the quality of accounting information in terms of reliability, timeliness, security and accuracy, thus improving the efficiency of financial personnel in bookkeeping. The study also provides additional explanations to the reduction of costs enabled by blockchain. It is specified that there is no need to print out invoices, because they are directly transmitted to the terminal and enter the tax bureau system, labor costs are also reduced due to a lower workload of the tax bureau, trust costs are reduced as an effect of lower trust risk, since data information on the blockchain is transparent. Furthermore, blockchain avoids data loss because data information is backed up in each node. Smart contracts enable fast trading and reduce administrative costs; the distributed ledger ensures data reliability and transparency; non-tamperability ensures data integrity; real-time data validation enables timely reporting and reduces audit work; automatic processing reduces the workload of traditional accounting repetitive tasks. Zhao Y. et al. (2022) also study the impact of blockchain in accounting and specify that blockchain influences the overall budgeting through distributed accounting, distributed storage and smart contracts. This way employees can understand the strategy of the enterprise and participate in budget preparation. It also influences cost management in that it reduces financial costs, it provides a better platform for cost management, forms a new cost control

management, and provides data support for motivation, activity, and performance analysis when applied to activity-based costing. Blockchain thus affects performance evaluation by changing the evaluation criteria for the internal performance of the enterprise.

In the matter of auditing, blockchain technology brings changes and improvements. It has already been stated above that blockchain facilitates auditing, guarantees the quality of audit, eliminates the need for third-party audit, distributed bookkeeping improves audit efficiency, non-tamperability reduces audit work, and automation reduces audit costs.

Diving more deeply in the matter, Zhou F. et al. (2021) affirm that the application of blockchain in the accounting sector can lead to a reform of auditing, in that the latter originates from the lack of trust while the former increases the trust between two parties. This reform occurs in two ways. First, blockchain can substitute auditing. It can ensure the authenticity of financial information, which in turn improves audit efficiency. With the use of blockchain, the risk of material misstatement of financial statements and the workload of auditors are greatly reduced. Therefore, blockchain can reduce the cost of market supervision. Second, blockchain can increase the independence of auditing. It can change the test of internal control, because it is necessary to conduct an effectiveness test of blockchain operations. It can also change the evidence collection for audits, by lowering the sufficiency requirement of substantial audit evidence collection. Due to the introduction of blockchain, the volume of audit business will decrease, allowing only large audit firms to survive, and the quality and efficiency of audit will improve. Audit will be carried out on the entire private chain guaranteeing the authenticity of massive financial information. Audit will be intelligent, continuous and in-process.

In addition, Chen Y. et al. (2021) find in the automatic verification of data through blockchain the driver of auditing automation and popularization, while Cao S. et al. (2017), citing Li Yishuo[12] (2016), indicate that blockchain technology can enhance audit efficiency and lower audit costs. They also cite the example of some companies that have developed self-auditing applications, liberating the manual audit and changing accounting firms' business model.

Chen W. et al. (2021) list as improvements brought by blockchain to auditing the automatic auditing role played by blockchain and the achievement of a full range of data auditing by auditors. As a matter of fact, blockchain can identify and reject false financial information on any node, which increases the credit value of financial information without auditing, leading to a decrease in legal risk, corporate credit risk, and overall risk of the company. Zhang L. et al. (2021) further explain how blockchain improves the efficiency of audit. The timestamp function makes data records tamper-proof. As a result, auditors are assured to be checking authentic data. The automatic execution of smart contracts

[12] Li Y., 2016.

reduces the cost of corporate audit because the credibility of accounting information is stronger. Therefore, auditors and managers can engage more in decision-making activities. Blockchain-based audit is more comprehensive, prevents favoritism and fraud, thus reducing the audit risks. It also saves costs and time, is more integral and promotes auditors' skills improvement.

2.2.2. Current status, challenges and solutions of blockchain application in China's accounting sector

The application of blockchain technology in accounting presents some challenges, as some studies have suggested.

Wang Z. et al. (2021), for instance, point out three main problems. The first one is the presence of technical security risks, in that the damage caused by the slightest vulnerability of the chain could be immense, the limited as much as big storage volume cannot guarantee the stable operation of the blockchain, and criminal acts are not clearly regulated yet. The second is the shortage of professional digital talents with knowledge in both accounting and IT. As a matter of fact, in 2019 in China the supply of blockchain talents does not meet the growing demand. The third one is the diversity in accounting standards, which may lead to insufficient data comparability. The authors suggest countermeasures such as strengthening the security of blockchain technology by developing ever complex verification mechanisms, conducting security tests and improving the legal system of blockchain; strengthening the technical training of accountants and updating and increasing blockchain courses at universities; promoting the convergence of accounting standards.

Wu J. et al. (2019) also address the matter and specify that blockchain is not applicable to the service industry yet, its application is limited to accounting information verification, and the safety of sensitive accounting information is not guaranteed.

The problem of digital talents shortage is addressed also by Zhang Y. et al. (2020), who add that in China the demand for IT professionals with accounting experience is higher than the demand for accounting major graduates, and Zhong M. et al. (2021), who expound that accounting professionals not only need to have advanced financial management theoretical knowledge but also strong computer skills in order to proficiently operate the computer software.

Additional solutions to these obstacles are suggested by Zhang L. et al. (2021), according to whom, further research and application trials are needed to ensure that there is no delay in information transmission affecting the enterprise's year-end report. Therefore, it is necessary to cultivate compound talents, promote research, and integrate blockchain and auditing. More regulatory policies of the government are also needed to prevent harmful usage of the blockchain technology.

Yang X. et al. (2020) also put forward their suggestions: on the macroeconomic level, china should actively participate in international frontier innovation of blockchain; while on the microeconomic level, compound talents with comprehensive knowledge of accounting, finance, computer and law are needed to transform the accounting industry. They also add that to apply blockchain technology to the accounting field, it is necessary to ensure the legality of its application by updating the rules and regulations of blockchain technology application in accounting law, audit law, etc.

With a game-study approach, Kong Y. et al. (2020) find problems and countermeasures as well. One problem is the indulgence in speculations among corporate accounting bodies due to blockchain technology features such as transparency and openness. Such speculations can occur within the same supply chain or within the same industry. In the first case, the publication of private information such as corporate customers, suppliers, and prices generates speculation and even collaborative cheating. In the second case, self-interested speculations are made by different companies by using information found on the blockchain. As a matter of fact, each node on the blockchain can query another node's information and user information in real-time. All these problems appear because companies are driven by the desire of maximizing profits. The countermeasures suggested by the authors include issuing legal documents to compel the enterprise to make every participant in the system a node user on the blockchain and promptly record every transaction information to avoid tax evasion through private offline transaction. Another measure is increasing penalties to avoid collaborative cheating among node users and intensifying auditing of downstream enterprises. Furthermore, tax data should not be shared between enterprises but only with the tax department, which should be able to collect the transaction information of each enterprise through a private encrypted key. Finally, policy support and rewards for model enterprises should be established.

Some papers also present blockchain-based system for accounting information handling. For instance, Yang X. et al. (2020) mention the case of the company Youyou, which is developing an accounting information service platform based on blockchain in China. In general, practical research on blockchain applications is in the stage of exploration and trials, and according to the authors a blockchain-based system that ensures the credibility of accounting information is necessary because, in case transaction information is tampered with, the tampering of information leaves no traces and the result of the accounting process is unreliable. In contrast, a blockchain-based system meets the demand of the enterprise for reliable data as well as the requirements of audit institutions and regulatory departments. As a matter of fact, there are two operation modes of accounting information system. One is the artificial intelligence mode, in which accounting information is automatically processed and traced by a computer, and the other is the human-machine collaborative mode, which involves accounting personnel to process transaction information. Currently, the human-machine collaboration

mode is the prevalent accounting information system used in China. Examples include UFIDA U8 and Kingdee K3. This mode needs a double layer blockchain. The first layer records and solidifies the original transaction information and the second layer solidifies the accounting process in terms of confirmation and measurement. Another system is proposed by Shao H. et al. (2021). It manages and improves accounting information security. Experimental results show that this system has a high degree of information fusion, scheduling ability, convergence, feature recognition and management accuracy, and high overall effectiveness. Other systems require the integration of blockchain with other new technologies such as Internet of Things, as in the transaction model proposed by Wu J. et al. (2019). The combination of blockchain with artificial intelligence can also solve the problem of poor financial information security. Liu S. et al. (2019), point out that financial data can indeed still be tampered with when a single node grasps more than 51% of the computing power of the whole network.

Despite all the solutions and improvements that the blockchain technology can provide for the accounting sector, as of the beginning of 2018, the application of blockchain technology in the accounting field is still restricted, blockchain intellectual property rights have not yet been safeguarded, and blockchain patents have not been filed yet, due to the insufficient security of financial information, according to Liu S. et al. (2019). This is confirmed by Wang Z. et al. (2021), who ascribe the lagging popularity of blockchain application in China's accounting field to the newness of the technology. Even in research, this area has been narrowly explored, as shown in the study of Cao S. et al. (2017): out of a sample of 188 Chinese research papers, 1.60% are about the accounting profession and adopt a qualitative research method. Therefore, there is insufficient quantitative analysis, which is more convincing, and the essence behind the phenomenon has not been dug yet. In order to promote the application of blockchain technology in the accounting system, Zheng R. et al. (2021) suggest strengthening policy guidance, in terms of incentive measures and technical guarantee, as well as using market mechanisms; improving legislative guarantee, in terms of preventing loopholes; cultivating compound talents, i.e. talents with both algorithm knowledge and accounting theory literacy, through the cooperation of the government, enterprises and universities. Zhang L. et al. (2021) remark the importance of establishing industry standards to allow blockchain to thrive in the accounting industry. While Kong Y. et al. (2020) bestow the cause of the restricted application of blockchain to its feature of information transparency, which is an advantage on one hand, but a stumbling block on the other, because, as reported above, it can lead to speculation and collaborative cheating. To conclude,

> "At present, the blockchain technology cannot be well 'landed' in the accounting field. […] 'blockchain plus accounting' is still in its initial formation stage, the security cannot be well guaranteed. As a necessary tool for the growth of enterprise value, the application

of blockchain in the reconstruction of management accounting should be based on China's national conditions, not only to adapt to the development of the times but also to solve the practical problems of enterprises." (Zhao Y. et al., 2022)

Table 2: Summary of the publications

	Author, year	Research question(s)	Results
2.1.	*Aysan A.F. et al., 2020*	How are Venezuela and China experiencing blockchain technology development as states with different competitive market capacity and scope of power in international finance?	Venezuela is investing in blockchain technology to create an alternative financial system to survive in the current one dominated by Western actors, by utilizing a national cryptocurrency; whereas the Chinese government is largely investing in public and private blockchain projects to become a global leader in global blockchain technology.
	Daluwathumullagamage D.J. et al., 2020	1. What are the current and future use cases of blockchain applications in corporate governance? 2. What are the trends, gaps and similarities between prior industry and academic literature? 3. What are the implications of adopting blockchain in corporate governance and links to theories in prior literature? 4. What are the advantages, challenges, misconceptions and limitations for blockchain adoption in corporate governance during COVID-19 and post COVID-19? 5. What are the links between investments in blockchain internationally and future forecasts?	1. Present use cases of blockchain applications in corporate governance include private bond and stock trade, natural gas exchange, clearing and settlement, securities trade, KYC data protocol, security system, post-trade, etc. 2. The common themes in industry and academic literature are Bitcoin, markets, technology and fintech related to blockchain. However, industry focuses more on privacy, business and global, while the academia concentrates on governance, networks and ledger. 3. higher cost and speed of voting, lower interference by managers, more incentives and profits opportunities for managers (agency costs theory) and for institutional investors, insiders and traders, and more shareholder and stakeholder participation (stewardship theory); improved liquidity, higher frequency, higher demand for stock investments, more efficient markets (transaction cost theory); unwarranted shareholder panic due to absolute transparency, unless permissioned blockchain are used (resource dependency theory); empty voting more difficult (political theory). 4. During COVID-19 most firms underwent digital transformation including China's massive investments in BSN and the digital yuan, while in the post-pandemic era interest in blockchains is most likely to largely increase. 5. Investments and deal counts in blockchain reach up to 6.173 and 6.051 billion US dollars in 2020 and 822 and 937 billion US dollars in 2021.
	Wang Q. et al., 2020	1. What is the global status of China's blockchain research and how has it developed? 2. What are the subject areas, high-yielding institutions and authors of China's blockchain research? 3. What are the challenges faced by China's blockchain research and corresponding measures?	1. China is the world's first source of blockchain papers, and its institutions and authors dominate global blockchain research. China's blockchain research is growing rapidly, the research scope is constantly expanding, and the focus is gradually shifting to applied research. 2. Top subject areas are computer science, engineering, telecommunications, business and economics; high-yielding institutions are the Beijing university of Posts and Telecommunications and the Chinese Academy of Sciences; high-yielding authors are Du Xiaojiang, Xu Xiwei, Wang Feiyue, Yu F Richard, Yuan Yong, Zhang Yan. 3. Challenges include lack of special policies and safeguards measures, hidden security risks due to lack of strict technical standards, insufficient innovation of blockchain companies and homogeneous service types, and lack of third-party assessment system. Countermeasures include targeting support measures to each province or region, establishing standardized security level evaluation standards and accelerating the improvement of the regulatory system, and encouraging blockchain technology innovation and accelerating deep integration with the real economy.
	Li R. et al., 2021	Can the use of blockchain improve enterprise performance or	There is a negative correlation between the application of blockchain and enterprise performance in Chinese listed companies, because of

	does it reduce enterprise performance?	adverse selection behaviors by enterprises that are not currently suitable to use blockchain to attract investors.
Li Z. et al., 2021	1. What are recent blockchain applications in industrial fields such as finance, supply chain, manufacturing, healthcare, energy, and smart city? 2. What is the current status of blockchain technology in the world?	1. Supply chain: advanced tracking and tracing, improved product safety and security, improved quality management, reduced counterfeiting and product ownership management, improved sustainability, improved inventory management and replenishment, reduced need for intermediaries, new product design, reduced transaction costs, agriculture and drugs, double-spending prevention, credit evaluation, information sharing, IKEA, TradeLens, Food Trust, Provenance, Co-op, Chronicled, MediLedger. Manufacturing: knowledge and services sharing, cloud manufacturing, reduced emissions, communication security, hierarchical framework, access control, anti-counterfeiting, traceability, custom manufacturing, BSM framework, integration with IoT, Trusted IoT Alliance, BaaS, MOBI. Supply chain financing: blockchain-driven supply chain finance, blockchain-enabled logistics finance execution platform, Trusple, WeChain, JD Logistics. 2. North America: the NSF of the US supported projects from 2015 to 2020 mainly in computer and information science and engineering and mostly in 2019; Canada is leading the world in blockchain. Europe: Spain and Italy support the most projects. Asia Pacific: significant growth in the blockchain market due to investments; the innovation of blockchain currently happens in the USA and Europe, but the its application is quickly spreading over the Asia-Pacific region, due to the support from Asian governments. Singapore is leading blockchain research; China's government considers blockchain as a pillar technology to help its economic development strategy; Japan has initiated several programs to explore blockchain technology; Australia is focusing on standardization and regulation; New Zealand is planning to apply blockchain to several fields.
Zhang H. et al., 2021	What are the value relationships among industrial units and the trend of synergistic evolution of China's blockchain industrial ecosystem from 2015 to 2020?	Despite ongoing improvements, the blockchain industrial ecosystem in China is still in its early stages of development and the impact of regulation is clear. Overall, the ecosystem of the blockchain industry in China is in a stage of reconciliation and has not yet produced a synergistic result.
Chen K. et al., 2022	How do market reactions change when firms' blockchain announcements suggest credibility?	When compared to non-high-tech organizations, high-tech firms may be perceived as more credible and result in larger stock returns since they have more technological assets and reserves. State-owned high-tech companies with sound financial conditions and voluntary disclosure would also increase the credibility of such signaling. The findings generally confirm that the signaling credibility of business announcements is crucial for market response.
Jiang N. et al., 2022	Based on patent data, what are the differences and similarities between Chinese and US blockchain technology development and technological collaboration?	Due to China's government creating unified national strategies for blockchain technology, the number of blockchain patent applications in China is rising quickly. Overall, there are several prominent agglomerations in both countries. In contrast to the Chinese university or enterprise block, which is more likely to cooperate inside blocks and has more isolated blocks, the American university or enterprise block has broader and deeper cooperation. Finally, there are numerous patent features that affect why node collaboration is so crucial. The findings demonstrate that in China's network of collaboration, cooperative inventors or significant patents are more prevalent, but in the United States, enterprises rather than universities or people have a higher influence.

	Klöckner M. et al., 2022	What effect do blockchain projects have on the company's market value?	There are signs that blockchain announcements will have beneficial long-term effects on shareholder value and that they relate to a significant average anomalous return of 0.30% on the announcement day. When blockchain is used in product tracing or sensitive data sharing, the stock market's response is less favorable. The positive stock market response is tempered when an outside IT service provider is involved in a blockchain initiative. Blockchain announcements by more innovative firms are not met with a larger stock market response. The level of data restrictions imposed by the nation and the sector both have a significant impact on the value placed on blockchain activities.
	Liu W. et al., 2022	How do blockchain announcements affect the stock market value of enterprises?	On the announcement day, the market reacts well to blockchain disclosure. Blockchain technological innovation announcements show a more favorable market response than those which are not related to technical innovation do. Compared to operational-level releases, strategic-level announcements show a more favorable market response. Enterprise scale and innovation capacity have no impact on how the stock market responds to blockchain news.
	Nelaturu K. et al., 2022	What technological gaps exist between blockchain and fintech applications, and how can they be closed?	A system that is more effective than the current one in terms of performance should be developed. That is a considerable advancement over blockchain technology as it stands today. The main goal of financial regulators has been to regulate criminal activities and hacking. It will be interesting to watch if the advent of blockchain results in a stronger regulatory framework or opens new opportunities for unscrupulous actors. Finally, client confidence in blockchain technology must be fostered, which is a challenging undertaking given the pervasiveness of security and privacy concerns across important blockchain platforms.
	Wan Y. et al., 2022	What effects can social trust and blockchain applications have on the cooperative innovation of businesses?	Trust in strangers fosters collaborative innovation in businesses more than trust in acquaintances. Applications of blockchain improve cooperative innovation and promote the beneficial effects of social trust on cooperative innovation. Blockchain technology use enhances business collaborative innovation performance.
2.2.	*Cao S. et al., 2017*	What are the blockchain technology's development patterns, research limitations, and current state in China?	Domestic blockchain research is less organized, less systematic, and has not yet reached a particular level of depth. Additionally, there is not enough quantitative analysis. Future research will concentrate on blockchain technology risk, Internet finance, and digital money.
	Liu S. et al., 2019	What is the current state of blockchain technology's application in China's accounting sector?	The use of blockchain technology has grown, and so has the amount of study. Blockchain technology can be used to achieve value creation and transmission. Blockchain storage technology is the predictable trend of blockchain technology entering the sector of financial accounting in the future. It is based on 'big data + IoT + distributed financial accounting system'. The security of financial data is not entirely solved by the blockchain, though. The actual advantages of the blockchain sector could be impacted if the security issue cannot be resolved. The only way to ensure that blockchain technology develops healthily in the accounting sector is to improve its underlying technology, implement pertinent laws and regulations, and integrate it with other emerging IT and legal frameworks.
	Wu J. et al., 2019	How can IoT and blockchain technology be combined to improve accounting information quality?	If specific conditions are met, the BC-IoT transaction model is capable of automatically gathering, uploading, and recording all pertinent data in the enterprise transaction process. No manual involvement is necessary in this approach at any stage of the procedure, and the distributed ledgers can never be used to alter or cancel any data that has been recorded there. The information gathered using this model can be utilized to provide data on events, supporting the events approach to fundamental accounting theory. This practice is in response to Sorter's crucial

		insight, which suggests that the availability of accounting information in real time and on demand will greatly increase the information's utility. The relevance, faithful representation, timeliness, and comparability of accounting information quality can all be considerably enhanced by blockchain technology.
Zhu Y. et al., 2019	What are the applications of blockchain in accounting and finance and how can they improve?	First, blockchain streamlines laborious accounting processing methods, enhances corporate operations, lessens accounting workload at the source, and ensures complete automation of accounting data from accounting acquisition to balance-sheet report. Second, it increases the accuracy of accounting data by going beyond the bounds of the cost-benefit concept. The complex settlement, multiparty communication, and traditional accounting account registration processes are significantly reduced when blockchain technology is linked with the accounting and financial system. Blockchain technology makes it possible to automate the entire accounting data collection, recording, analysis, and reporting process, drastically reducing the need for manual labor and judgment calls while also enabling users to access more accurate and timely information services. Thirdly, it can encourage uniformity of accounting as well as the fairness and comparability of accounting data. The accounting processing processes used by blockchain technology can result in standardized accounting processing outcomes. It may effectively suppress the phenomenon of information asymmetry and improve communication with businesses that are similar to its own through its information sharing function. The acquisition of accounting data has also improved in terms of simplicity, effectiveness, timeliness, and speed, and the features of accounting measurement have improved in terms of reasonableness. Fourthly, block chain technology can maintain all accounting report operation traces as well as complete process records. Its immutability and timestamp function make supervision, self-audit, and real-time audit simple, enhance the business's external supervision environment, and boost enterprise supervision effectiveness.
Kong Y. et al., 2020	How can speculative behavior among accounting organizations based on blockchain technology be prevented?	To ensure a seamless integration of blockchain technology into the accounting information system, measures such as legal restrictions, institutional penalties, privacy protection, policy support, etc. should be employed.
Yang X. et al., 2020	How can the credibility of the accounting information system be guaranteed?	The credibility guarantee mechanism for the accounting information system is built using blockchain technology's technical properties, including transparency, autonomy, non-tamperability, and inability to falsify information. It can effectively stifle accounting fraud, totally ensure the reliability and authenticity of accounting data, and advance the growth of the accounting sector. It also has a significant impact on government oversight, which will encourage accounting information technology and allow the entire accounting sector to move toward a sound development path.
Zhang Y. et al., 2020	What is the impact of AI and blockchain on the accounting profession?	The accounting industry has undergone significant change as a result of the deep integration of emerging technologies, including reengineering accounting procedures, lowering accounting information errors and distortions, increasing accounting efficiency, and encouraging the transformation of accounting career structures. Large-scale and instantaneous automated audits can be produced with the use of blockchain audit application platforms. At the same time, how to secure data privacy becomes a crucial concern given the growing adoption of technologies in accounting. Corporations can improve their data security protocols, but authorities must also tighten up on related crime laws and put them into practice.

		Accounting professionals are expected to increase their technology skills in order to develop more effective accounting processes, even though the top accounting firms are embracing these new technologies and difficulties.
Chen W. et al., 2021	What connection exists between macroeconomic uncertainty and blockchain technology? What feature of blockchain technology reduces risk?	Blockchain technology has the potential to allow businesses to lower systemic risks and improve investment efficiency as macroeconomic uncertainty rises.
Chen Y. et al., 2021	What is the impact of blockchain technology on accounting information disclosure?	The equity structure of China's A-share listed businesses is centralized and consists of "one big share alone." The collusion between powerful shareholders and management has its origins in the governance framework and is particularly pronounced in private listed businesses. This will inevitably result in financial reports that mostly reflect the preferences of key shareholders, which is not ideal for developing strong bonds of trust. More gravely, there is a crisis of confidence that affects the timeliness, relevance, and effectiveness of financial information. The emergence of the digital economy, coupled with the development and testing of financial sharing centers for group companies, will significantly aid in the innovation and auditing of financial reports as well as the restoration of the trust relationship surrounding financial reports. Examples of these technologies include mobile Internet and blockchain. However, there is still more work to be done in terms of automating financial auditing and making it more widely accepted throughout the economy by utilizing digital technology to reinvent financial reporting paradigms.
Han J. et al., 2021	How can blockchain be combined with a management accounting information system?	This article employs software engineering as its main theme and focuses on the blockchain-based commercial bank management accounting system that combines performance and intelligent data management. The purpose of this article is to provide a brief overview of the function, history, and characteristics of the commercial bank management accounting system before delving deeply into its functional needs. The performance combined blockchain model and intelligent data management system are examined. Finally, a blockchain-based intelligent commercial bank management accounting system is built. A management accounting information system built on blockchain is created by the author and is divided into six layers: the data physical layer, the data definition layer, the data storage layer, the data processing layer, the data link layer, and the data application layer.
Mai X. et al., 2021	What are the uses of blockchain technology and distributed bookkeeping in financial accounting?	All business nodes must periodically upload inventory data to the distributed system for it to function. Only once the majority of the system's nodes affirm that the data are accurate can it be submitted. To make sure that the data is truthful, accurate, and reliable, invalid information is filtered out. The integration and reconstruction capabilities of the supply chain can be enhanced by building a blockchain-based supply chain system. The supply chain's capacity for learning can be enhanced by the information recording of internal data and external related multi-source data in the block. The cost of holding significantly fell over time, going from 200,000 CNY before the experiment to 80,000 CNY after the simulation.
Shao H. et al., 2021	How can the shortcomings of low feature identification and poor adaptability in the current accounting information management be fixed?	In order to increase the effectiveness of accounting information security management, this article suggests a methodology for blockchain-based accounting information security management.

Wang Z. et al., 2021	What are the benefits and drawbacks of using blockchain in accounting?	Blockchain technology can address issues including unclear accounting roles, redundant supervision, poor audit quality, and lack of certainty in the accuracy of accounting data. Blockchain is still a young technology, and China's accounting industry has not yet used it widely. Technical security risks provide difficulties in the adoption of blockchain in accounting. Lack of technical expertise and a wide range of accounting standards make it difficult to compare data. Countermeasures include fostering "blockchain + accounting" skills, consistently enhancing the security of blockchain technology, and promoting the convergence of accounting standards.
Zhang L. et al., 2021	What is the impact of blockchain technology on the Chinese accounting industry?	Blockchain technology is crucial to the reform of the accounting sector. The quality of the original accounting information has significantly improved, and the quantity of data-enabled accounting information has increased thanks to blockchain technology. The traditional accounting profession has considerably reduced all types of misconduct. It goes without saying that blockchain technology is still in its infancy and that there are still a lot of unanswered questions. However, the accounting industry will undoubtedly undergo significant change as technology advances.
Zheng R. et al., 2021	Is the application of blockchain technology in the accounting industry necessary and feasible?	Financial report post-analysis is transformed into pre- and post-process dynamic analysis thanks to blockchain technology. Each block creates a full data chain, creating a shared database. Each record is linked from start to finish during the recording of financial data, creating a chain that is made up of numerous companies. Financial information is not tampered with by people or affected by subjective variables. Personnel will be audited on numerous blocks after the data is successfully entered in one block. Many departments are involved in data modifications. One could argue that it can effectively guide the entire body in ensuring the veracity of financial data and the caliber of financial supervision. Blockchain technology ensures the validity and dependability of accounting data thanks to its robust shared database and cutting-edge encryption mechanism. By examining the accounting information processing model, it is entirely possible to create a reliable blockchain-based accounting information system.
Zhong M. et al., 2021	What is the effect of integrating corporate financial accounting and management accounting under big data and blockchain?	These two technologies have the potential to significantly advance the accounting sector's growth. The use of big data technology will accelerate the digitization of accounting data. It may encourage the original financial and non-financial information's digitization, broadening the reach of financial staff management. The effectiveness of accounting data analysis can be increased by the effective deployment of block chain technology. Therefore, businesses need to research the specific applications of big data and blockchain technology in the current development of the accounting industry. In order to integrate financial accounting and management accounting against a backdrop of big data and blockchain technology, businesses must also assess specific strategies.
Zhou F. et al., 2021	What effect will blockchain technology have on future audit reform?	First, the role that blockchain technology plays as a substitute for audit directly contributes to a major decline in audit and industry business. In the future, most audit businesses will be enormous corporations, and audit quality and efficiency will both significantly improve. Second, the private chain will serve as the foundation for audit corporate operations. The audit will include more than one company. The implementation of blockchain technology will allow for the auditing of all the businesses along the private chain. Data from many sources can be combined and examined with ease. A cross-checking relationship will be established between all business activities throughout the audit

		of the complete private chain by using blockchain to audit the entire private chain. In the future, many audit procedures might not be required. Thirdly, for data transfer, intelligent audit, continuous audit, and in-process audit, we can create interface contacts with clients. We can get through analysis individual, regional, and industrial risk and present audit risk alerts online by gathering and categorizing data from the intricate business network made up of all parties connected to the examined firm. Fourth, the independence in the underlying framework protocol may be resolved by the independent audit made possible by blockchain. When the audit service given satisfies the contract's conditions, payment for the audit service can be made directly through the blockchain system, preventing the influence of the payment issue on audit independence.
Zhao Y. et al., 2022	How does blockchain technology influence management accounting?	Management accounting and blockchain technology both benefit from each other. Management accounting innovation is given fresh technological support by blockchain technology, and blockchain technology can be applied in the right situations thanks to management accounting. "Value generation" may be encouraged as a common management accounting objective via distributed bookkeeping technology. In systems, information asymmetry will be reduced by blockchain technology, which will also facilitate thorough budgeting based on strategy. The development of budgets will be done more quickly and effectively thanks to decentralization, which will also reduce the time it takes for superiors and subordinates to communicate. Improved budgeting techniques will be built on current and upcoming data. Independent transactions are supported by blockchain technology, which also reduces the cost of financial operations, timely monitors the setting of the entire product manufacturing process, modifies cost accounting procedures, and shifts the role of cost control from cost control to value management.

Chapter 3. Research method and data analysis

The current status and the evolution of the blockchain industry in China and in the Chinese accounting sector are the result of the Government's increasing support to blockchain technology development and application in recent years. Several authors as well as regulators have concluded that despite the vigorous promotion of the Government and the benefits provided by blockchain technology to the accounting sector, the accountancy profession and the audit activities, the blockchain industry is still in its initial development stage and its application in accounting is still restricted.

The aim of this chapter is, therefore, to verify with empirical data that there is a connection between the evolution in the regulatory framework and that of blockchain industry development in China and in China's accounting sector and whether the results of the following analysis are representative of the policy-driven approach adopted by the Government. In other words, this work is aimed at understanding whether the regulation of the blockchain industry has contributed to its current status and how. In addition, the second purpose of this chapter is to compare the existing literature reviewed in the second chapter and the empirical data collected for this research. Organizing the results in a dual perspective, i.e. macro- and microeconomic, will facilitate the comparison with the regulatory framework and the literature review.

3.1. Data collection and research method

This paragraph expounds the research method adopted to conduct the following analysis by clarifying the type of data collected, the selection criteria, and the sources.

The empirical data needed for the following analysis regard the blockchain industry ecosystem in China with a focus on industry size, scope and distribution, patent applications and registrations, investments amount, application scenarios and projects, research amount and scope, and regulations amount and scope. In addition, data about the application of blockchain technology in the Chinese accounting field (e.g. rank of blockchain in comparison with other technologies for accounting, share of blockchain-related research in accounting, etc.). Given the scope of the sample needed, relevant information is collected through secondary data collection.

The criteria for selecting relevant data are their nature, the date of publication and the reliability of the source. Collected data must be quantitative and possibly illustrated through graphs. They must be published after the invention of blockchain, which occurred in 2008. However, data published after 2016 have greater relevance as the Government has openly supported the technology only in the 13th five-year period and the effect of this attitude can only be observed in the following years. In addition, given the restricted application of blockchain in the accounting field, related data are expected to be

limited, as opposed to the expected abundance of general statistics due to the allegedly rapid development of blockchain in China. The reliability of the sources is assessed in terms of objectivity and reproducibility of the research, depth of analysis, and affinity of data with other sources'.

The sources considered for the collection of relevant secondary data are both Chinese and foreign sources so as to balance potential biases and avail of different degrees of depth and accuracy. Information sources include reports, statistics, insights, etc. elaborated by research institutes of government departments and universities, state associations, market insights and consulting providers, and knowledge exchange and business cooperation platforms. The data collected derive from two research organizations under the Chinese Ministry of Industry and Information Technology: the China Academy of Information and Communications Technology (CAICT) and the China Center for Information Industry Development (CCID); the Institute of Internet Industry, Tsinghua University; the largest European research institute focusing on China (https://www.merics.org/en/about): the Mercator Institute for China Studies (MERICS); a State association founded by the People's Bank of China: several market insights and consulting companies such as Statista, CB Insights, and Forkast.News; a knowledge exchange and business collaboration platform founded by the Danish Industry Foundation: the Blockchain Business Bridge; the Shanghai National Accounting Institute under the Chinese Ministry of Finance.

The reports, statistics, insights, etc. include four blockchain white papers published from 2018 to 2021 by the CAICT; the 2021 "China's Blockchain Industry Development White Paper" and the "2020-2021 China's Blockchain Enterprises Development White Paper" by the CCID; three "China's Blockchain Industry Ecological Map Reports" published by the Institute of Internet Industry at Tsinghua University between 2020 and 2021; MERICS' researches and database of 130 national blockchain-related policies, government announcements and key speeches on the subject by President Xi Jinping; statistics by Statista; a 2019-2020 report on blockchain in China by Forkast.News and two 2020 reports by CB Insights and Blockchain Business Bridge; a 2020 survey by the SNAI on the top ten information technologies influencing Chinese accountants.

3.2. Results and interpretation

From the review of the existing literature on blockchain technology in China, it can be concluded that several authors see the Government's dedication to advancing blockchain technology as a driver of the increase in the ecosystem of the blockchain sector in terms of businesses, patent applications, investments, projects and application scenarios, research, and blockchain talent training. However, blockchain technology cannot currently be successfully 'landed' in the accounting industry and requires further research, regulation and technological advancement to reach its full potential.

In order to investigate the effect of blockchain policies and regulations on the development of the blockchain industry and the application of blockchain technology, particularly to the accounting sector, and compare the literature with empirical data, this paragraph analyzes and interprets the secondary data pertinent to the blockchain industry in China and in the Chinese accounting sector.

3.2.1. China's blockchain industry growth and current challenges

The following aspects of China's blockchain industry are considered: enterprises growth and distribution, investment trends, applications and projects, innovation output, and current challenges.

As for enterprises, in comparison with other countries, the total number of Chinese enterprises has accounted for around one fourth of the global share since 2018, according to the CAICT, ranking second in the world after the US. This shows a stable trend in the number of blockchain enterprises until November 2020. In addition, among the world's most powerful blockchain industry alliances, six are Chinese: Trusted Blockchain Initiatives, Beijing FinTech Industry Alliance, BCEAC, FISCO (Shenzhen), Zhongguancun Blockchain Alliance, and CBCA.

Table 3: Share of Chinese blockchain enterprises in the world[13]

Date	Share
2018.06	24%
2019.09	25%
2020.11	24%

Table 4: Blockchain industry alliances per number of members[14]

2019		2020	
R3 Corda	385	Interbank Information Network	415
Blockchain in Transport Alliance	380	R3 Corda	410
TBI	350	TBI	405
Hyperledger	275	Blockchain in Transport Alliance	365
Enterprise Ethereum Alliance	210	Hyperledger	205
INATBA	151	Chamber of Digital Commerce	180
Chamber of Digital Commerce	149	Enterprise Ethereum Alliance	160
Beijing FinTech Industry Alliance	148	INATBA	155
BCEAC	125	BCEAC	130
Japan Blockchain Association	120	Japan Blockchain Association	115
FISCO (Shenzhen)	117	FISCO (Shenzhen)	110

[13] China Academy of Information and Communications Technology, 2018, 2019, 2020.

[14] China Academy of Information and Communications Technology, 2020; Von Carnap, K., 2021.

Zhongguancun Blockchain Alliance	80		
TradeLens	60		
Shanghai Enterprise Alliance	55		
Blockchain Alliance	45		
CBCA	10		

In absolute terms, at the end of September 2021 there are over 91,000 blockchain-related enterprises in China.[15] The Institute of Internet Industry and the CCID's reports related to 2020-2021 show different numbers of enterprises with blockchain as their main business, but the growth trend is similar. They increase rapidly from 2014 to 2018, with an increment in 2017 of around three times that of 2016 and the same in 2018 compared to 2017. Such enormous increment happens in parallel with the issuance of the White Paper on Blockchain Technology and Application Development and the 13th Five-Year Plan for National Informatization in 2016, with which the Chinese government begins to recognize the core values of blockchain technology and support its development and applications. In 2017, while strengthening the regulation of cryptocurrencies and digital tokens on one hand, China is still vigorously encouraging the use of blockchain technology and its innovation on the other. In 2019 there was a slowdown, with a decrement of the number of enterprises affected by factors such as the burst of the virtual currency market bubble,[16] the weakening of venture capital enthusiasm and the natural fall in investment.[17] In 2020 the situation improves with a positive growth in the number of total enterprises, but it slows down again in 2021 with a little increment.

Table 5: Number of Chinese blockchain enterprises (main business), 2014-2021[18]

Year	Institute of Internet Industry, Tsinghua University	CCID
2014	787	-
2015	1,115	649
2016	1,670	1,152
2017	4,869	4,259
2018	16,218	15,714
2019	11,823	11,460
2020	24,687	25,169
2021	24,876	-

[15] Institute of Internet Industry, Tsinghua University, 2020.

[16] Institute of Internet Industry, Tsinghua University, 2020.

[17] China Academy of Information and Communications Technology, 2020.

[18] Institute of Internet Industry, Tsinghua University, 2021; China Center for Information Industry Development, 2021.

About blockchain-related enterprises, if we consider the distribution of enterprises per cluster it can be observed that most blockchain activity is registered in four regional hubs. New blockchain companies established between 2019 and the first half of 2020 are concentrated in four main agglomeration areas: first, the Bohai Economic Rim (comprising Beijing and Shandong); second, the Pearl River Delta (Guangdong); third, the Yangtze River Delta (represented by Shanghai, Zhejiang and Jiangsu); fourth, the central area comprising Sichuan, Hunan, Guizhou and Chongqing.[19] Considering the total number of businesses as of 2021, the Bohai Economic Rim is still in the lead, while the Yangtze River Delta cluster is second, and the Pearl River Delta cluster becomes third.[20] These data are in line with the literature analyzed in the second chapter, according to which, the Yangtze River Delta, South China, and Beijing, which have highly established economies and are active market actors, are where the majority of the blockchain development is occurring in China.

Table 6: Cluster distribution of blockchain enterprises[21]

New (2019-2020)		Total (2020-2021)	
Bohai Economic Rim	33%	Bohai Economic Rim	36%
Pearl River Delta	29%	Yangtze River Delta	26%
Yangtze River Delta	24%	Pearl River Delta	24%
Sichuan-Hunan-Guizhou-Chongqing	11%	Sichuan-Hunan-Guizhou-Chongqing	6%
Other	3%	Other	8%

If we consider only registered enterprises, throughout 2020-2021 Guangdong remains first, increasing its enterprises of almost ten thousand units; Zhejiang, Jiangsu and Shandong remain in the top four in March 2021 but in eight months Shandong and Hainan almost double their numbers, while Zhejiang and Chongqing show a slower increase. Fujian enters the top ten in March 2021 and in less than a year more than doubles the number of its enterprises. Beijing, Hunan and Anhui increase at a slower pace and exit the top ten surpassed by Sichuan and Liaoning at the end of 2021.

[19] Von Carnap, K., 2021.

[20] China Center for Information Industry Development, 2021.

[21] Von Carnap, K., 2021; China Center for Information Industry Development, 2021.

Table 7: Number of registered enterprises per province in 2020-2021[22]

October 2020		March 2021		November 2021	
1. Guangdong	24,772	1. Guangdong	28,923	1. Guangdong	34,343
2. Zhejiang	3,064	2. Zhejiang	4,480	2. Shandong	7,478
3. Jiangsu	2,070	3. Jiangsu	4,053	3. Jiangsu	6,801
4. Shandong	1,906	4. Shandong	3,841	4. Hainan	6,797
5. Chongqing	1,569	5. Hainan	3,818	5. Zhejiang	5,982
6. Hainan	1,546	6. Chongqing	2,549	6. Chongqing	3,783
7. Shaanxi	1,282	7. Shaanxi	1,972	7. Fujian	3,446
8. Beijing	1,213	8. Fujian	1,555	8. Shaanxi	3,350
9. Hunan	1,121	9. Beijing	1,444	9. Sichuan	2,733
10. Anhui	1,077	10. Hunan	1,186	10. Liaoning	1,739

According to the reports of Tsinghua University, among the over 64,000 registered enterprises, only more than 2,000 have actually carried out blockchain business. Guangdong is still in the first position as the province with the most enterprises already conducting blockchain business, while all the other provinces rank differently. Zhejiang and Jiangsu rank high as places of registration, while they fall more to the middle for operating blockchain enterprises. In turn, many enterprises in Beijing and Shanghai have already launched their businesses but a relatively small number of enterprises is registered in the capital and Shanghai is not even in the top ten.

Table 8: Distribution of enterprises that have officially launched their blockchain business

Province	Oct 2020	Mar 2021	Nov 2021
1. Guangdong	477	489	527
2. Beijing	411	461	471
3. Shanghai	209	223	236
4. Zhejiang	167	187	202
5. Jiangsu	95	103	108
6. Sichuan	74	81	78
7. Fujian	69	65	69
8. Shandong	50	61	66
9. Hunan	37	36	43
10. Hubei	35	33	40

[22] Institute of Internet Industry, Tsinghua University.

Similar statistics were released by the CCID in the "2020-2021 Chinese Blockchain Enterprises Development White Paper" considering a sample of 1,384 enterprises with established blockchain businesses. The results show that Beijing and Guangdong have the most enterprises, comprehensively half of the total. Jiangsu and Shanghai also have relatively significant shares with around one tenth each. Zhejiang and Shandong have a lower share but still rather big, around one out of twenty each, while the remaining provinces are below 5%.

Table 9: Distribution of enterprises with established blockchain businesses[23]

Beijing	348	25.14%
Guangdong	341	24.64%
Jiangsu	164	11.85%
Shanghai	127	9.18%
Zhejiang	81	5.85%
Shandong	66	4.77%
Chongqing	46	3.32%
Sichuan	43	3.11%
Hunan	23	1.66%
Hubei	23	1.66%

There are also some data regarding the distribution of enterprises across cities published by the CAICT in 2018. Out of a sample of 298 enterprises, more than half are in Beijing and a big share are in Shanghai, Shenzhen, and Hangzhou. Guangzhou and Chengdu have a relatively small but still significant share.

Table 10: Distribution of enterprises per city[24]

Beijing	58.7%
Shanghai	31.9%
Shenzhen	18.8%
Hangzhou	10.7%
Guangzhou	5.1%
Chengdu	4.4%
Nanjing	2.7%
Xiamen	1.3%
Chongqing	1.3%
Guiyang	1.0%

[23] China Center for Information Industry Development, 2021.

[24] China Academy of Information and Communications Technology, 2018.

In 2019, the CAC established that all Chinese enterprises providing blockchain services file for registration with its offices. The reports published by the MERICS and the Institute of Internet Industry show the share of blockchain companies that have completed the filing process as of February 2020, October 2020, March 2021 and November 2021.

Table 11: Share of enterprises registered with the CAC[25]

February 2020	1%
October 2020	69%
March 2021	80%
November 2021	76%

According to the reports, enterprises' awareness of compliance has increased. According to the CAICT, considering the 801 blockchain information services on the list published by the CAC, filing enterprises are mostly in Beijing, Guangdong, Shanghai, Zhejiang, Jiangsu, and Shandong provinces.[26] The MERICS also reports the number of blockchain enterprises registered with the CAC as of February 2021, using a sample of 1,015 blockchain service providers and it can be seen that only in Beijing and Shanghai the industry's regulation has advanced. The share of enterprises that have not yet completed the process is due to the fact that the launch of the blockchain project requires less time than the record with the CAC.

Table 12: Province distribution of filing enterprises[27]

CAICT						MERICS			
2020		Share	2021 (top ten)		Growth rate	2021.02	Registered	Listed	Ratio
Beijing	250	31%	Beijing	286	14%	Beijing	309	1,554	20%
Guangdong	179	22%	Guangdong	226	26%	Guangdong	220	30,585	1%
Shanghai	95	12%	Shanghai	116	22%	Shanghai	120	743	16%
Zhejiang	86	11%	Zhejiang	98	14%	Zhejiang	117	5,517	2%
Jiangsu	43	5%	Jiangsu	72	67%	Jiangsu	55	5,921	1%
Shandong	27	3%	Shandong	35	30%	Shandong	33	6,671	0%
Fujian	22	3%	Fujian	33	50%	Hunan	23	3,753	1%
Hunan	16	2%	Yunnan	29	-				

[25] Von Carnap, K., 2021; Institute of Internet Industry, Tsinghua University, 2020, 2021, 2021bis.

[26] China Academy of Information and Communications Technology, 2020.

[27] China Academy of Information and Communications Technology, 2021; Von Carnap, K., 2021.

Chongqing	14	2%	Sichuan	23	130%				
Hubei	11	1%	Hunan	22	38%				
Sichuan	10	1%	Anhui	-	-				
Tianjin	8	1%	Chongqing	-	-				
Shaanxi	8	1%	Hubei	-	-				
Hebei	6	1%	Tianjin	-	-				
Anhui	5	1%	Shaanxi	-	-				
Guizhou	4	1%							
Hainan	4	1%							
Jiangxi	3	0%							
Liaoning	2	0%							
Ningxia	2	0%							
Heilongjiang	2	0%							
Henan	2	0%							
Guangxi	1	0%							
Inner Mongolia	1	0%							
Total	801	100%							

In terms of distribution per industry, most blockchain enterprises operate in the software and IT service industry and in research and trial development, while the rest is distributed between technology promotion and application service industry, wholesale industry and others.

Table 13: Distribution of enterprises per industry[28]

Industry	2020.10	2021.03	2021.11
Software and IT service industry	40%	35%	39%
Research and trial development	29%	18%	27%
Business service industry	15%	17%	15%
Technology promotion and application service industry	8%	15%	8%
Wholesale industry	4%	7%	4%
Other	4%	8%	7%

From a structural perspective, blockchain enterprises can be divided on the basis of the operation processes, i.e. upstream (platform and infrastructure layers), midstream (external interactions,

[28] Institute of Internet Industry, Tsinghua University, 2020, 2021, 2021bis.

presentation, interface layers) and downstream (user layer). Most enterprises conduct downstream operation processes; a relatively big share have midstream processes and both upstream and midstream processes; fewer enterprises perform downstream and midstream processes together as well as all three levels of processes, while only a small number carry out only upstream and both upstream and downstream processes.

Table 14: Distribution of enterprises per operation processes[29]

	Upstream	Midstream	Downstream
43%			x
14%		x	
14%	x	x	
10%		x	x
10%	x	x	x
6%	x		
3%	x		x

In terms of enterprise size, most blockchain business is carried out by small enterprises, while in terms of registered capital most enterprises have between one and ten million yuan. Obviously, the figures can vary according to the sample considered. For example, the CCID uses a sample of just over 1,300 enterprises, while the Tsinghua University considers a much larger sample of over 46,000 in the first edition of the report, over 62,000 in the second edition, and around 82,000 in the third one; hence the difference in statistics. It is worth noting that even if the share of enterprises with a registered capital larger than 100 million yuan is small, the absolute number is increasing and rather significant.

Table 15: Enterprises per size[30]

Size	2019	2020
Small	88%	87%
Medium	7%	7%
Large	4%	3%
Micro	1%	2%

[29] China Center for Information Industry Development, 2021bis.

[30] China Center for Information Industry Development, 2021.

Table 16: Enterprises per registered capital[31]

	CCID		Institute of Internet Industry		
Registered capital (million yuan)	2019	2020	2020.10	2021.03	2021.11
<0.1	6%	6%	6%	5%	6%
0.1-1			27%	30%	14%
1-10	45%	46%	49%	48%	47%
10-100	42%	43%	16%	15%	31%
>100	9%	6%	2% (994)	2% (1,289)	2% (1,640)
Total	>1,300		46,449	62,270	~82,000

Another variable to analyze blockchain enterprises distribution is the enterprise type. According to the CCID, most blockchain enterprises are start-ups and a big share are Internet companies. Traditional listed companies and financial institutions have also started to enter the blockchain industry. This layout reflects the vigorous promotion of the blockchain industry by the Government in recent years. As a matter of fact, until 2018, China's blockchain startup financing totaled 602 million US dollars, ranking second in the world after the US. In addition, there are low costs and a low investment threshold to start a business.[32] These three factors have led to the entrance of many new blockchain enterprises in the industry. The presence of many Internet companies is also connected to the overall informatization process that has been encouraged since the 11th Five-Year Plan.

Table 17: Enterprises per type[33]

Start-ups	65%
Internet companies	25%
Traditional listed companies	6%
Financial institutions	4%

Table 18: Top three countries per blockchain startup financing in million USD[34]

USA	2,542
China	602
Canada	247

[31] China Center for Information Industry Development, 2021; Institute of Internet Industry, 2020, 2021, 2021bis.

[32] China Academy of Information and Communications Technology, 2018.

[33] China Center for Information Industry Development, 2021.

[34] China Academy of Information and Communications Technology, 2018.

As for investment trends, equity deals are heading eastward. According to CB Insights, Only 2% of deals in 2015 went to Chinese enterprises while 51% were for US-based businesses. In four years, China's share of deals increased to 22% while the US' share decreased to 31%. On the domestic level, data from different sources are not perfectly corresponding to each other. However, some trends can be observed. 2018 saw a huge increase in Chinese investments in the blockchain sector. The increased supervision of the blockchain market in 2019 and the overall relatively large economic pressure brought by the pandemic in 2020 led to insufficient financing of blockchain enterprises and rational investments.[35] For this reason, in 2019 China ranks third in terms of blockchain investment amounts.[36] Thanks to various state, ministries, commissions, and local governments' special policies in 2020 and 2021, investments started to increase again.[37] This trend is in line with the study of Li R. et al. (2021), who expounds how businesses that disclose blockchain technology attract more investors and get a favorable response from the market, mainly influenced by the blockchain hype. About the sector distribution of investments, as seen in the second chapter, R&D was initially the sector receiving the most investments, which allegedly caused a surge in application landing. Based on statistics from 2018, investments in blockchain industrial applications account for half of all industry investments. Additionally, 21% and 15% of all investments are made respectively in cryptocurrency projects and in blockchain media and community. In 2019, blockchain enterprises in the financial sector benefit the most from investments and financing. The enterprise services sector also has a large proportion and other relevant fields are healthcare, community management, videogames, and software, while the ones where blockchain enterprises are just starting to develop are life services, Internet of Things, education, and entertainment media. In 2020-2021 the situation is quite different: blockchain technology research and development surges and together with digital assets is the most popular investment scenario in the blockchain field. Other industries such as culture and copyright services, public resources transactions, energy, infrastructure, and videogames have a relatively balanced proportion. Throughout 2021, blockchain enterprises have increased their outbound investments. At the beginning of the year around one third of enterprises was investing abroad, while at the end of the year the proportion increased to more than two thirds. Alongside with the increase in

[35] China Center for Information Industry Development, 2021.

[36] China Academy of Information and Communications Technology, 2019.

[37] China Center for Information Industry Development, 2021.

corporate customers, the improvement in financing, and growth of target markets, this reflects the growth of blockchain enterprises.[38]

Exhibit 1: Share of equity deal activity, 2015-2019[39]

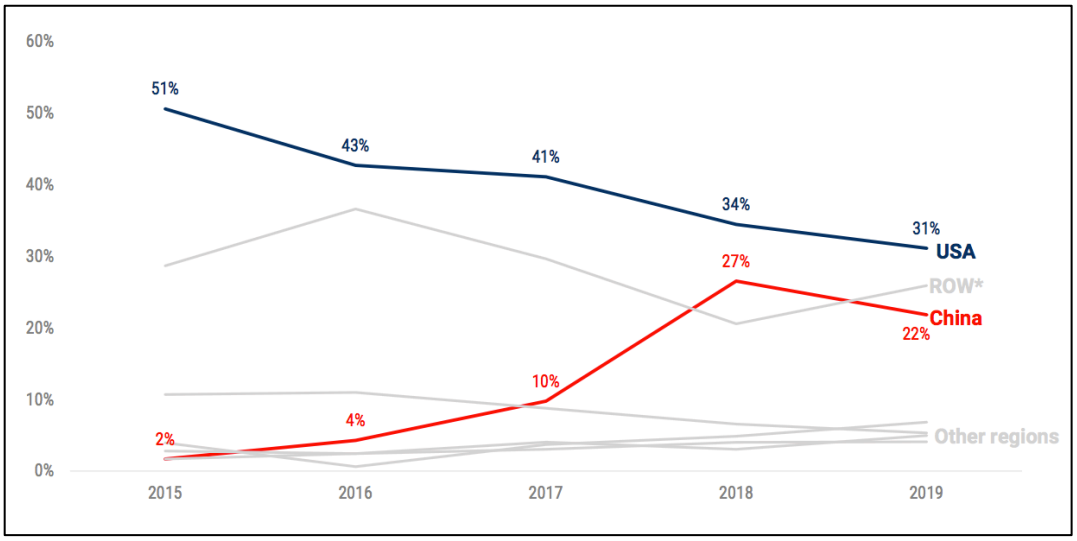


Table 19: China's investment events in the blockchain industry[40]

	CCID		Blockchain Business Bridge
Year	Events	Growth rate	Events
2015	28	-	-
2016	58	107%	61
2017	113	95%	116
2018	404	258%	363
2019	148	-63%	245
2020	114	-23%	-

[38] Institute of Internet Industry, Tsinghua University, 2021.

[39] CB Insights, 2020.

[40] China Center for Information Industry Development, 2021; Blockchain Business Bridge, 2020.

Table 20: China's investment amounts in billion CNY[41]

	CCID, CAICT		Blockchain Business Bridge
Year	Amount	Growth rate	Amount
2014	-	-	7.5
2015	-	-	4.3
2016	32	0%	12.7
2017	3.5	-89%	36.7
2018	115.6	3,186%	174
2019	17	-85%	24.4
2020	6.5	-62%	-

Table 20: Sector distribution of blockchain investments[42]

2018		2019		2020-2021	
Industry	50%	Finance	42%	Technology R&D	52%
Cryptocurrency	21%	Enterprise services	27%	Digital asset services	14%
Media & community	15%	Healthcare	11%	Consulting services	9%
Applied technology	10%	Community management	4%	Energy	5%
Infrastructure	4%	Videogames	3%	Infrastructure	5%
		Software	2%	Public resources transactions	5%
		Other	10%	Culture and copyright services	5%
				Videogames	5%

Table 21: Blockchain enterprises investing abroad[43]

Mar 2021	32%
Nov 2021	68%

The blockchain industrial scale shows a steady growth, as reported by the CCID. In 2018 and 2019 a large amount of capital was invested in the industry. In 2020, as a result of various provincial governments support policies in response to the pandemic, the scale of the industry reached almost five billion yuan and was expected to continue to rise in 2021.

[41] Blockchain Business Bridge, 2020; China Academy of Information and Communications Technology, 2019; China Center for Information Industry Development, 2021.

[42] Blockchain Business Bridge, 2020; CCID, 2021.

[43] Institute of Internet Industry, Tsinghua University, 2021.

Table 22: Industrial scale in billion CNY[44]

Year	Amount	Growth rate
2017	0.24	-
2018	1.00	317%
2019	1.20	20%
2020	4.82	301%

From the perspective of the blockchain industrial ecosystem, five elements can be considered: applications, industry services, underlying platforms, infrastructure, and solutions. In 2020 and 2021, the Chinese blockchain industry is mainly focused on blockchain applications and solutions, while industry services, underlying platforms and infrastructure are relatively underdeveloped.[45]

In regard to blockchain applications, the number of cases has increased significantly in six years, reaching 1,154 in 2021. From the perspective of fields of application, as highlighted in the second chapter, their range is expanding and becoming increasingly rich. Different surveys conducted by the CCID, the CAICT, and Tsinghua University report different proportions in various fields. However, all reports agree on one point: the largest proportion of applications is in the field of finance. Tracing also tends to be one of the major application scenarios. Using data from CCID Consulting and Ping An Securities, the Blockchain Business Bridge 2020 research states that blockchain applications in China are mostly targeted at financial services and business services. Bills, insurance claims, stocks trading, and cross-border payments are the four main blockchain applications in financial services. The development of the underlying blockchain infrastructure, the delivery of blockchain solutions to Internet businesses and traditional corporations, supply chain applications, data services, the BaaS (Blockchain as a Service) platform, and depository services are the main blockchain applications in enterprise services. In the first half of 2020, as reported by the MERICS using data collected by the CCID, the main application categories are supply chain and finance, and government services. In the first one, financing in credit is the primary application field, while administrative approval is leading among government services. According to the CCID 2020-2021 report, other important fields besides finance are e-government and judicial evidence storage. Credit reporting and industry also have relatively significant shares. The CAICT considers application cases of blockchain enterprises that have filed with the CAC and reports that there are specific projects in the sub-fields of finance such as supply chain finance, trade finance, payment and settlement, and fund management. Tsinghua University reports from the first survey based on a sample of 113 projects carried out by fifty companies

[44] China Center for Information Industry Development, 2021.

[45] Institute of Internet Industry, Tsinghua University, 2021.

that the other important categories are award points and e-commerce, judicial evidence storage, etc. while the proportion of other categories is relatively large, indicating that blockchain has deepened and broadened its industrial integration in supply chain management, security, copyright, intelligent shipping, industrial Internet and other fields. In the second survey, one hundred cases are considered and grouped in typical categories. After finance, trusted certificates are the most practical direction for blockchain applications, followed by government affairs (besides tracing). It is worth noting that the scope of application scenarios of blockchain continues to expand. In addition to healthcare, public welfare and charity, people's livelihood and e-commerce, exploration and attempts have been made in a wider range.

In terms of vertical application solutions, blockchain is again mainly applied in trade finance. Large proportions are also almost equally distributed among electronic licenses, product traceability, data services and administrative approval.[46]

Table 23: Blockchain application cases per year[47]

Year	Number	Growth rate
2015	8	-
2016	14	75%
2017	101	621.43%
2018	214	111.88%
2019	346	61.68%
2020	444	28.32%
2021	1,154	159.91%

[46] China Center for Information Industry Development, 2021.

[47] China Center for Information Industry Development, 2021; Institute of Internet Industry, Tsinghua University, 2020, 2021, 2021bis.

Table 24: Distribution of blockchain applications across industries according to different sources[48]

Blockchain Business Bridge		MERICS		CCID		CAICT		Institute of Internet Industry, 2020		Institute of Internet Industry, 2021	
Financial services	18%	Supply chain & finance	31%	Finance	30%	Finance	25%	Financial services	14%	Finance	20%
Business solution	10%	Government services	29%	E-government	29%	Supply chain finance	11%	Reward points, e-commerce	12%	Trusted certificates	18%
BaaS platform	9%	Healthcare	13%	Judicial evidence storage	10%	Tracing	10%	Tracing	9%	Tracing	13%
Supply chain	8%	Legal deposit registration	12%	Logistics tracing	8%	Internet	9%	Judicial evidence storage	8%	Government affairs	7%
Data services	6%	Product tracing	11%	Credit reporting	6%	Supply chain, logistics	6%	Data services	6%	E-commerce	5%
Media & community	5%	Smart city	5%	Industry	6%	Government affairs, public services	6%	Government affairs	5%	Charity	5%
Underlying protocol	4%	Social devices	4%	Healthcare	5%	Intellectual property	6%	Electronic certificates and invoices	4%	Education	5%
Others	40%	Charity	2%	Service governance	5%	Digital assets	5%	Storage software and hardware	3%	Healthcare	5%
		Other	9%	Community management	3%	Law	4%	Encryption hardware	3%	Electrical power	3%
				Charity	2%	Industry informatization	4%	Other	37%	Storage software and hardware	3%
				Transport	2%	Healthcare	3%			People's livelihood	2%
						Internet of Things	2%			Other	14%

[48] Blockchain Business Bridge, 2020; Von Carnap, K., 2021; China Center for Information Industry Development, 2021; China Academy of Information and Communications Technology, 2020; Institute of Internet Industry, 2020, 2021, 2021bis.

Table 25: Subcategory distribution of blockchain applications in supply chain & finance and government services[49]

Supply chain & finance		Government services	
Financing in credit	44%	Administrative approval	24%
E-signature	26%	E-licenses	19%
Supply chain finance	20%	Data sharing	17%
Cross-border payment	4%	Precision poverty alleviation	10%
Asset securitization	2%	Customs trade	7%
Other	4%	Urban governance	7%
		E-bills	14%
		Other	2%

From the perspective of blockchain projects promoted by central governments, China has a relatively small number as of 2019, counting just six projects and ranking sixth in the world, while the Netherlands, South Korea, the US, the UK, and Australia are the top five.[50] Since 2020, provincial government departments in China have launched more than ninety blockchain projects mainly in the fields of government services, justice, traceability and trade finance, and the scale of application continues to expand.

Table 26: Sector distribution of blockchain projects promoted by provincial governments[51]

Government services	42
Judiciary	12
Traceability	8
Trade finance	7
Healthcare	5
City management	4
Finance	4
Public welfare	2
Customs	1
Infrastructures	1
Supply chain finance	1
Agriculture	1
Cross-border e-commerce	1
Public security	1

[49] Von Carnap, K., 2021.

[50] China Academy of Information and Communications Technology, 2019.

[51] China Academy of Information and Communications Technology, 2021.

In order to understand the position of Chinese blockchain technology in the global blockchain industry, it is useful to consider the level of blockchain innovation output, which can be measured by patents, research papers, R&D investments, and industrial parks.

The literature analyzed in chapter two agrees that the rapid increase in blockchain patent applications in China is the effect of consistent national strategies. Various surveys report that the global blockchain patent application volume is growing rapidly, indeed. From 2013 to September 2020, the number of global blockchain invention patent applications reached 35,000.[52] As of July 2018, China ranks first in terms of patent applications, accounting for 58% of global patent applications (considering only the top 8 countries), and the main field of patent applications is smart contracts.[53] In September 2020, China is still leading with the number of applications reaching 21,000, accounting for 60% of the global share.[54] This record is recognized by the Government in the 14th Five-Year Plan for National Informatization, which states that China has become the world's first blockchain patent application source. As for the number of patent authorizations, until July 2018 China obtained only 53 authorization, accounting for 7% of the global share, while in September 2020 it could count almost one thousand authorizations, i.e. 46% of the global share, dominating the chart. However, if the ratio of applications to authorizations is considered, it is not unreasonable to suspect a lack of quality in the numerous blockchain patent filings in China. Furthermore, according to Forkast.News, compared to the approved 68% of patents filed by non-residents, only 26% of applications submitted by residents were accepted, which could mean that resident-led patents are less innovative, less competitive, and lower quality compared to those of non-residents.

Different figures are reported by the CCID, which counted the amount of blockchain patent applications in China from 2016 to 2020. However, the trend is similar and shows a rapid increase in the application of patents. Considering the global blockchain patent applicants, in 2019 Alibaba and China Unicom ranked first and fifth in the world respectively,[55] while in 2020 Alibaba, Tencent, and WeBank (微众银行), rank high.[56] In general IT companies are the main force in the output of blockchain patents. Over 10,000 blockchain-related patents have been filed with the China National Intellectual Property Administration (CNIPA), according to online patent search engine Innojoy, as

[52] China Academy of Information and Communications Technology, 2020.

[53] China Academy of Information and Communications Technology, 2018.

[54] China Academy of Information and Communications Technology, 2020.

[55] China Academy of Information and Communications Technology, 2019.

[56] China Academy of Information and Communications Technology, 2020.

reported by Forkast.News. Alibaba Group is in the lead, followed by China Unicom, a government-owned telecom corporation; whereas, according to CCID, Tencent, Alibaba, and Ping An Group are in the lead. Tsinghua University data show that in October 2020 among more than 40,000 blockchain companies, more than 900 companies have blockchain-related patents (in various phases of the application process, i.e. acceptance, disclosure, and authorization) in China, while at the beginning of 2021 the ratio is 1,100/60,000 and in September 2021 1,500/90,000 companies. Through a hot-word analysis of the patents' abstracts, the Institute of Internet Industry reports that the patents focus most on security, followed by smart contracts, consensus mechanism, encryption algorithm, cross-chain, and storage.

On one hand, this shows that China's blockchain industry has formed a certain theoretical innovation and technological accumulation; on the other hand, the need for further investment in basic theory and technological innovation is evident.

Exhibit 2: Country distribution of patent applications per country, 2018[57]

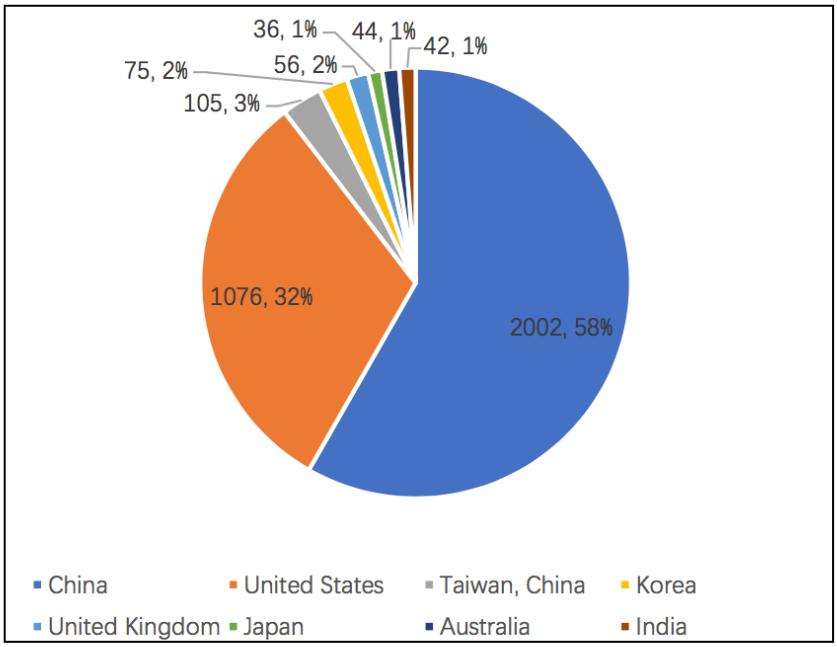


Table 27: Blockchain patent applications and authorizations[58]

	Applications			Authorizations			Authorizations/ applications
Date	World	China	China/world	World	China	China/world	
2018.07	3,731	2,002	54%	771	53	7%	3%
2020.09	35,000	21,000	60%	2,165	998	46%	5%

[57] China Academy of Information and Communications Technology, 2018.

[58] China Academy of Information and Communications Technology, 2018, 2020.

Table 28: China's blockchain patent applications, 2016-2020[59]

Year	Amount	Increase rate
2016	108	-
2017	846	683.33%
2018	3,451	307.92%
2019	8,582	148.68%
2020	13,808	60.89%

Table 29: Top ten blockchain patent applicants[60]

CCID			Innojoy	
Enterprise	Patents	Share	Enterprise	Patents
Tencent Technology (Shenzhen)	803	22%	Alibaba Group (Hangzhou)	543
Alipay (Hangzhou) IT	641	17%	China Unicom	214
Ping An Technology (Shenzhen)	421	12%	Hangzhou FUZAMEI Technology	199
Alibaba Group (Hangzhou)	343	9%	Ping An Technology (Shenzhen)	186
Ping An International Smart City Technology	320	9%	LAUNCH (Shenzhen)	166
Shandong Aicheng Network IT	294	8%	Baidu (Beijing)	148
Shenzhen OneConnectSmart Technology	277	8%	Shenzhen OneConnectSmart Technology	140
Ping An Insurance	226	6%	Zhong An Information Technology Service	136
China Unicom	180	5%	Tencent Technology (Shenzhen)	127
Rongzer Technology	163	4%	Shenzhen One Thing Tech	119

Table 30: Distribution of enterprises per number of patents[61]

Number of patents	2020.10	2021.03	2021.09
1	299	330	389
2-9	463	544	808
10-50	137	195	267
50-100	19	26	27
>100	18	33	35

Another proxy of the blockchain innovation output is the number of papers published. According to the literature, China has actively supported and invested in blockchain research, which, as a result, is growing rapidly, its scope is constantly expanding, and its attention is gradually shifting towards applied research. The CAICT reports the number of blockchain research papers collected on the

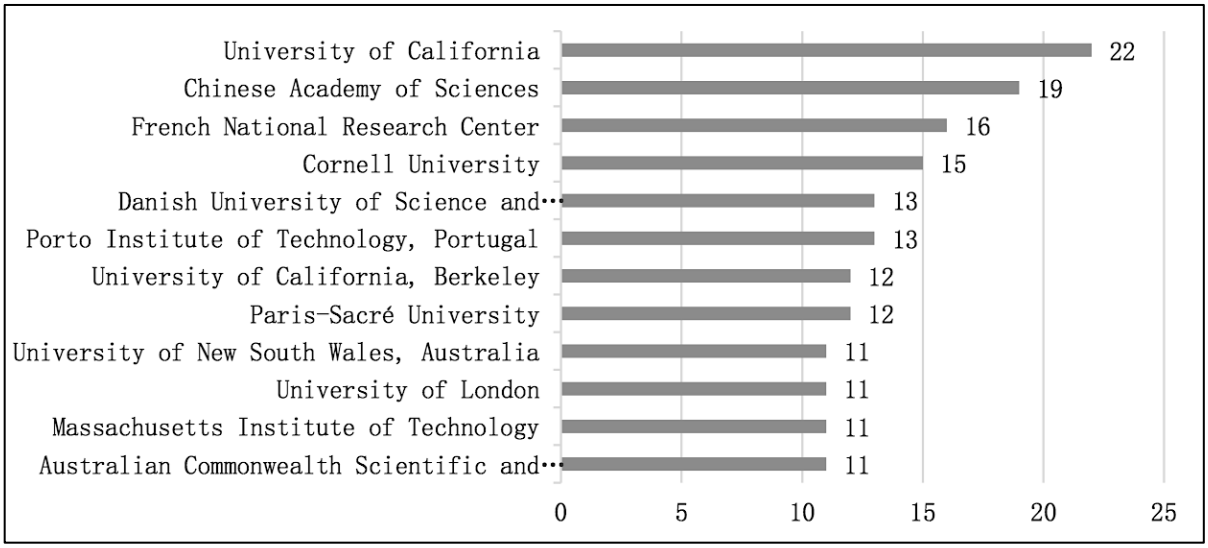
[59] China Center for Information Industry Development, 2021.

[60] China Center for Information Industry Development, 2021; Forkast.News, 2020.

[61] Institute of Internet Industry, Tsinghua University, 2020, 2021, 2021bis.

platform CORE per publishing agency as of July 2018 and the Chinese Academy of Sciences ranks second with 19 papers. As of 2019, China ranks first in terms of global blockchain-related research output, counting 1,189 publications, 42 high-level papers, and 437 international collaborative papers.

Exhibit 3: Publishers of blockchain-related CORE papers[62]



From the perspective of enterprises' investments in research and development, an increasing trend in terms of share of R&D personnel can be observed. In 2020, more than half of blockchain enterprises has over 50% of personnel employed in R&D, and in the first quarter of 2021 the share of enterprises rises to 96%. The size and amount of investments in non-human R&D are also increasing. The share of enterprises investing over ten million yuan in non-human R&D have increased from half in 2020 to almost 70% in 2021, and some enterprises are even starting to invest more than 100 million yuan. As for the number of investments, in 2020 the majority of enterprises were making up to five investments, while in 2021 most enterprises are making more than twenty investments.

Table 31: Distribution of enterprises per share of R&D personnel, investment size, and investment events[63]

	2020.10	2021.03	2021.11
Share of R&D personnel			
<20%	10%	0%	-
20-30%	10%	0%	-
30-40%	4%	4%	-
40-50%	13%	0%	-
>50%	63%	96%	-

[62] China Academy of Information and Communications Technology, 2018.

[63] Institute of Internet Industry, Tsinghua University, 2020, 2021, 2021bis.

Investment size (millions)			
0.1	9%	8%	0%
1	41%	36%	28%
10	50%	56%	68%
100	0%	0%	4%
Investment events			
<5	34%	24%	-
5-10	14%	12%	-
10-20	20%	8%	-
>20	32%	56%	-

The development of industrial parks creates a blockchain innovation platform. There are discrepancies between different sources, but it can be observed that the majority of blockchain industrial parks was established in 2017-2018, and there are even some pioneering projects as early as 2015.[64] By the beginning of 2020, more than thirty blockchain industrial parks had been established, and the number has increased to more than fifty in 2021. There are a large number of blockchain industrial parks in Zhejiang, Guangdong, Shandong, and Shanghai, forming an aggregation effect that follows the cluster distribution of enterprises described above. It is worth noting that some industrial parks have been established in many central and western provinces, which indicates that the central Government's commitment through supporting policies and regulations is reflected in the development pattern of the blockchain industry.

Table 32: Total blockchain industrial parks, 2015-2021[65]

Year	CAICT	CCID
2015	-	2%
2016	6%	6%
2017	44%	29%
2018	39%	35%
2019	8%	10%
2020	3%	14%
2021	-	4%

[64] China Center for Information Industry Development, 2021.

[65] China Academy of Information and Communications Technology, 2020; China Center for Information Industry Development, 2021.

Table 33: Province distribution of industrial parks[66]

2020			2021	
Zhejiang	7	19%	Zhejiang	19%
Guangdong	5	14%	Guangdong	13%
Shanghai	4	11%	Shandong	8%
Hunan	3	8%	Shanghai	8%
Jiangxi	2	6%	Hunan	8%
Shandong	2	6%	Jiangxi	4%
Chongqing	2	6%	Chongqing	4%
Jiangsu	2	6%	Jiangsu	4%
Hainan	2	6%	Beijing	4%
Beijing	2	6%	Hebei	4%
Hubei	1	3%	Sichuan	4%
Hebei	1	3%	Hainan	2%
Guangxi	1	3%	Hubei	2%
Guizhou	1	3%	Guangxi	2%
Liaoning	1	3%	Guizhou	2%
			Liaoning	2%
			Xinjiang	2%
			Yunnan	2%
			Shaanxi	2%
			Henan	2%
			Gansu	2%

As highlighted by the policies and studies analyzed in the previous chapters, China's blockchain industry has been facing some challenges such as talent gap, immaturity of the technology, application implementation, and insufficient regulation.

From the perspective of the blockchain talent market, according to Tsinghua University, as many as 96% of enterprises are facing a shortage of talents, which continues to expand compared with 94% in the previous round. The Tsinghua University's survey found that enterprises have the greatest demand for bottom-level R&D talents, accounting for 88%. In addition to the bottom-level R&D personnel, there is also a high demand for product talents, sales talents and market talents. In addition, 96% of enterprises expressed their willingness to supplement talents through targeted training in colleges and universities. According to the Blockchain Business Bridge report based on 2019 data from the BOSS Zhipin Research Institute and zhaopin.com's "2019 Blockchain Talent Supply, Demand

[66] *ibid*.

and Development Report", more than half of all companies seeking blockchain expertise are in the financial, software, and corporate services sectors. Other sectors acquiring blockchain talent include gaming, smart devices, and online education. Enterprises that have blockchain technology of products as their core business mainly look for technical talents and sales talents. Technical talents include software engineers, senior software engineers, Java development engineers, and software development engineers, while sales talents include sales representatives, sales managers, telesales, and online sales.

In terms of talent supply, China's share in 2018 accounts for only 4% of global talent supply and professionals in this field mainly come from Beijing, Shanghai, Shenzhen and Hangzhou.[67] The majority of job applicants for blockchain-related professions are engaged in the sectors of Internet/e-commerce, computer software, and IT services.[68] At present, the supply of blockchain talents cannot meet the demand because blockchain technology requires multidisciplinary and cross-disciplinary knowledge and skills and Chinese universities have only just started to provide interdisciplinary education and blockchain-related courses, as indicated in the 2018 "Blockchain Industry Whitepaper" by the MIIT and remarked by Aysan et al. (2020) in their study. As explained in the first chapter, this situation had already been addressed by the MIIT in 2016. In its whitepaper it encouraged and supported key universities to set up blockchain professional courses and promotes the cooperation between key enterprises and universities to build a training base for blockchain talents and accelerate their cultivation. In 2018, the NDRC also promoted digital talent education and training in the Guiding Opinions on Developing the Digital Economy to Stabilize and Increase Employment. Some results can already be observed. Compared to other nations, China still has a small number of blockchain developers, which indicates that the Chinese software development sector is relatively immature, but that number is rising. In China, there were 5,290 blockchain developers in 2019, up from 3,780 in 2018, according to a Forkast.News analysis of LinkedIn profiles. However, they are mainly employed by internet giants and other large enterprises, and other fields such as artificial intelligence, media and sharing economy are more popular.

[67] China Academy of Information and Communications Technology, 2018.

[68] Blockchain Business Bridge, 2020.

Exhibit 4: Distribution of enterprises recruiting blockchain talents per industry[69]

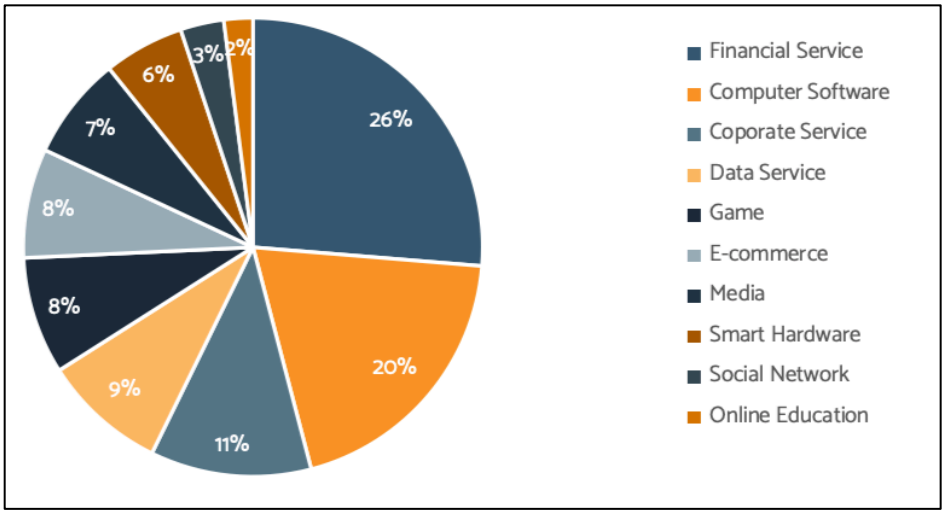


Exhibit 5: Most demanded blockchain-related positions[70]

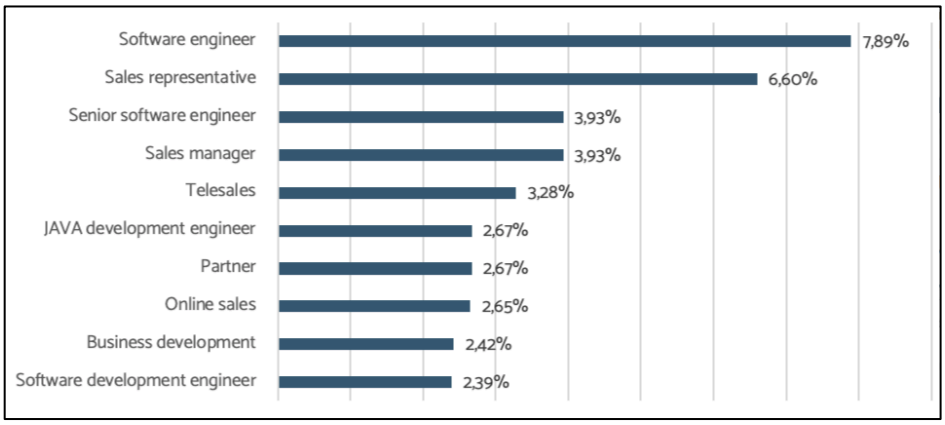
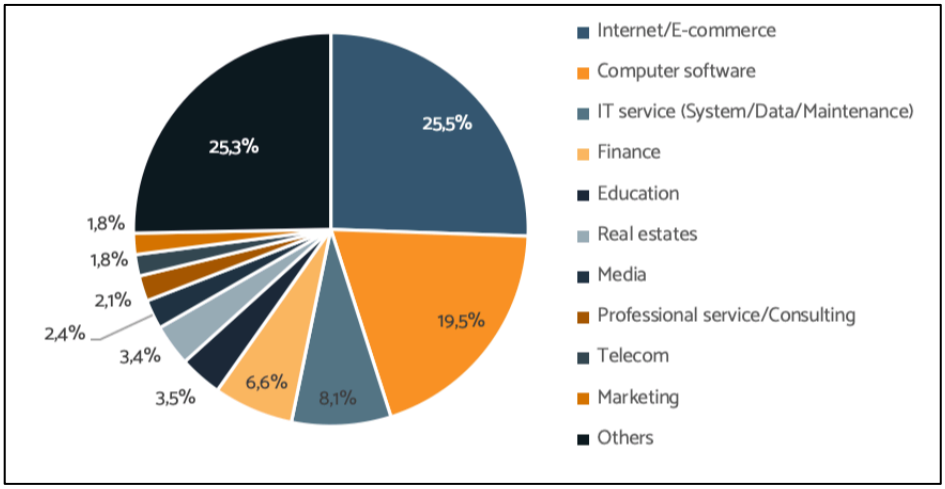


Exhibit 6: Industry distribution of blockchain job applicants' background[71]



[69] Blockchain Business Bridge, 2020.

[70] *ibid*.

[71] *ibid*.

On the technological level, despite the increasing trends in entrepreneurial activity, innovation output and application exploration, China's blockchain technology is not sufficiently mature and cannot cope with the blockchain system's rapidly increasing business volume, encountering performance issues such as system delays in transactions and low throughput. This technological immaturity can be observed considering China's influence on blockchain open source platforms, encryption algorithms, and security.

According to the CAICT, China doesn't have sufficient influence on blockchain open source platform. As a matter of fact, China has few independent technology platforms, and more than 90% rely on products or fork versions created by open source software developed overseas, such as Hyperledger or Ethereum. China's contribution to open source drastically decreased in 2017 compared to 2016 as it is focusing more on the application level of blockchain development.

As for encryption algorithms, Chinese blockchain enterprises widely rely on internationally accepted encryption algorithms. China has been making many efforts in supporting the development of its encryption industry to create competitive domestic firms and cutting-edge encryption technologies necessary for emerging information technologies such as blockchain, but after years of protectionist measures it still lacks a top-tier encryption industry. Openness to foreign collaboration and competition is necessary for further growth in these cutting-edge applications. Therefore, with the 2020 Cryptography Law, China has encouraged foreign participation and competition in the encryption industry, which has led to the wide use of commercial encryption algorithms in combination with State secret algorithms by blockchain enterprises.[72] On the other hand, this means that additional supervision is required

Regarding platform and application security, China is also facing some challenges. Incomplete data from the National Blockchain Vulnerability Database indicates that in 2020 there were more than five hundred security incidents in the blockchain industry in 2020, an increase of about 240% from 2019 and the resulting economic loss was 17.9 billion US dollars, up 130% from 2019. Fraud/phishing, ransomware, DeFi security incidents, digital wallet security incidents, trading platform security incidents, and public chain security incidents are the most common types of security incidents related to blockchain platforms and applications. This makes blockchain technology subject to risks, restricting its commercial application.

[72] Laskai, L., 2021.

Table 34: Open source projects per year[73]

	2014	2015	2016	2017
China	263	274	834	527
Beijing	67	76	225	137
Shanghai	62	35	134	119

Table 35: Distribution of encryption algorithms employed by blockchain enterprises[74]

Combination of State secret and international encryption algorithm	60%
State secret algorithm	15%
International encryption algorithm	10%
Self-developed encryption algorithm	9%
Other	6%

Table 36: Blockchain security incidents in 2020[75]

Security incidents	Number	Share
Fraud/phishing	204	37%
Ransomware	143	26%
DeFi	103	19%
Digital wallet	41	7%
Trading platform	31	6%
Public chain	17	3%
Other	16	3%
Total	555	100%

Although there has been some advancement in the use of blockchain technology across numerous industries, in addition to technological immaturity, there are still many other obstacles that prevent applications from being developed in-depth. For instance, applications for blockchain are primarily used in multiparty alliance businesses, which have certain requirements for the selection of the appropriate blockchain application scenarios for their development. There is also a lack of top-level planning of the blockchain's decentralized construction, leading to repeated platform construction, excessive investment, and business fragmentation. In addition, leading enterprises have not yet entered the stage of large-scale promotion, without which SMEs cannot achieve scalability due to their insufficient application power. Moreover, cross-chain communication is still difficult because

[73] China Academy of Information and Communications Technology, 2018.

[74] China Center for Information Industry Development, 2021.

[75] Institute of Internet Industry, Tsinghua University, 2021.

different blockchain systems employ different data structures, encryption methods, consensus procedures, and other technologies.

According to the CAICT, in 2020, China's national ministries, provincial administrations, and province capitals collectively published 217 documents such as policies, regulations, and programs relating to blockchain technology. While the CCID in 2020-2021 counts 64 blockchain-related policies published by national and provincial governments, 38 of which are special blockchain policies. On the national level, the top emitting government agencies until 2017 are the Ministry of Information Technology, the State Council, the People's Bank of China and the Cyberspace Administration of China,[76] while as of 2020 besides the MIIT, top emitting bodies include the Ministry of Transport, the Ministry of Agriculture, and the National Development and Reform Commission. According to the provincial distribution, the government of Beijing issued the most policies until 2020, but in 2021 the government of Guangdong increased its policy output and surpassed the Capital. Despite the large regulatory framework, however, blockchain technology's governance, supervision, and standards still need to be improved.

Table 37: Blockchain-related policies, 2015-2021[77]

2015	1
2016	3
2017	12
2018	13
2019	25
2020-2021	64

Table 38: Distribution of blockchain policies per emitting body (national level)[78]

2017		2020	
MIIT	21%	MIIT	17%
State Council	16%	MOT	12%
PBOC	11%	MOA	11%
CAC	7%	NDRC	9%
		PBOC	6%
		China Post	6%
		CBIRC	6%
		Supreme People's Court	6%

[76] Von Carnap. K., 2021.

[77] China Center for Information Industry Development, 2021.

[78] Von Carnap, K., 2021; China Center for Information Industry Development, 2021.

Table 39: Province distribution of blockchain policies[79]

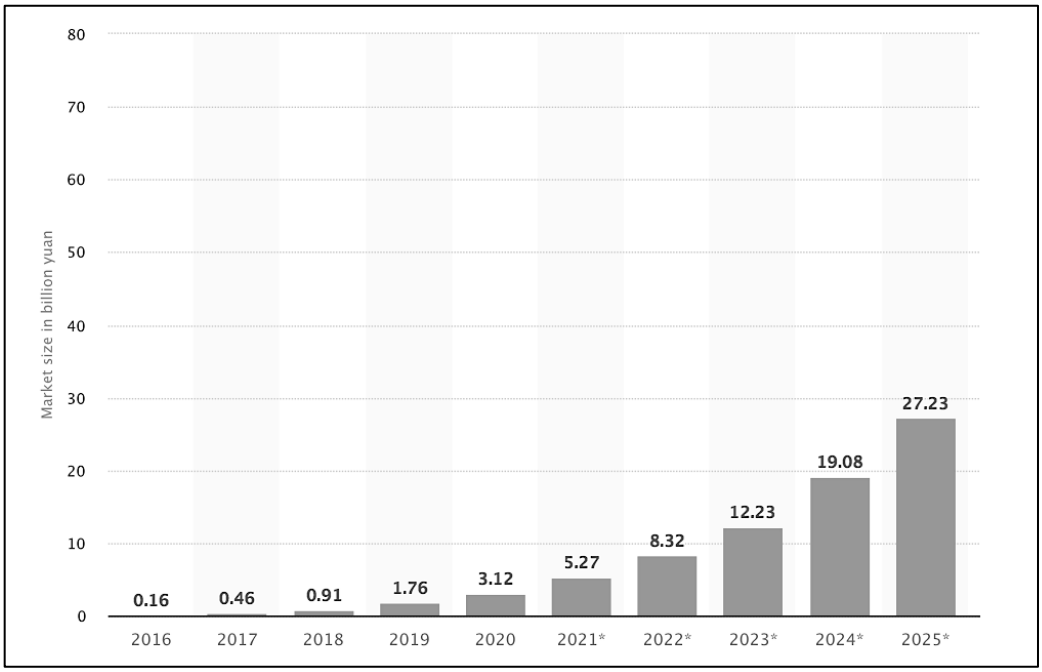
2020		2021
Beijing	25	Guangdong
Chongqing	15	Beijing
Jiangxi	12	Shandong
Fujian	12	Zhejiang
Guizhou	12	Sichuan
Shanghai	11	Shanghai
Gansu	11	Jiangsu
Guangxi	10	Hebei
Shandong	8	Fujian
Zhejiang	7	Guizhou
Hubei	7	Yunnan
Jiangsu	7	Hunan
Yunnan	6	Chongqing
Hunan	6	Henan
Hainan	6	Tianjin
Tianjin	5	Jiangxi
Ninxia	5	Guangxi
Hebei	5	Anhui
Sichuan	4	Henan
Inner Mongolia	4	Gansu
Shanxi	4	Shaanxi
Jilin	3	Hubei
Guangdong	3	Shanxi
Heilongjiang	3	Liaoning
Shaanxi	3	Inner Mongolia
Qinghai	3	Heilongjiang
Henan	3	Jilin
Xinjiang	2	Qinghai
Liaoning	2	
Anhui	1	

In spite of the above-mentioned issues affecting blockchain development and application in China, its market size is growing. By 2020, China's blockchain application market was worth more than

[79] China Academy of Information and Communications Technology, 2020, 2021; China Center for Information Industry Development, 2021.

three billion yuan. The market size for blockchain technology is expected to exceed 27 billion yuan by 2025 and over 69 billion yuan by 2030, indicating that it has enormous potential.

Exhibit 7: Market size (billion CNY) of blockchain applications in China, 2016-2030[80]



3.2.2. The emergence of blockchain as a leading accounting technology

Accounting activities are strictly related to finance, nevertheless blockchain technology application exploration and trial, research, innovation, and investment in this field are still restricted. Unlike finance, accounting is never mentioned in the data collected and analyzed above, which means that there are not many Chinese enterprises using blockchain technology to carry out their accounting activities, directing their investments towards this field, nor are there extensive exploration and trial of blockchain application in accountancy, patent applications, research papers. etc. This situation reflects the attitude of main accounting regulatory bodies such as the CICPA, which started paying attention to the combination of blockchain and accounting only in the 14th five-year period, as remarked in the first chapter. In addition, as seen in chapter two, there is not sufficient quantitative analysis of the application of blockchain in this field. As a matter of fact, specific data concerning blockchain applications in accounting activities are not widely available or accessible and for the purpose of this study the analysis of accounting-related data can only be based on the lack of it. This confirms what was concluded in the literature review, i.e. currently the accounting industry cannot

[80] Slotta, D., 2022.

effectively ‘land’ blockchain technology. 'Blockchain + accounting' is currently in the early stages of development.

However, there is some data concerning the evolving accounting landscape in China and particularly regarding the adoption of new technologies in accounting. In the 2020 edition of the Shanghai National Accounting Institute (SNAI)’s survey on the top technologies affecting accounting practitioners in China, a new category was included to learn about emerging technologies in accounting. The SNAI, a research and education center for accounting connected to the Chinese Ministry of Finance, was founded in 2000 with the goal of educating and upgrading China's accounting professionals. In addition, it provides guidance on national accounting policy. The survey has been conducted every year since 2017 and in 2020 cloud accounting, e-invoicing, big data technology (data management, analytics), digital files, RPA (robotic process automation), next-generation ERP (enterprise resource planning) systems, blockchain, mobile payments, data mining, and online audit tools are the top ten technologies, according to more than 5,300 participants. In particular, among new emerging technologies, voters selected blockchain invoicing, digital currency, Internet of Things automation, 5G, and distributed ledger as the top five. Although they haven't been widely used, these technologies are anticipated to become more significant within the next three to five years. And of these top five upcoming technologies, three are connected to blockchain technology (namely, blockchain invoicing, digital currency, and distributed ledger). This merely indicates that accounting professionals anticipate blockchain to significantly alter the accounting landscape in China over the next few years.[81]

Table 40: Top ten IT affecting accounting professionals[82]

2020 Ranking	Technology	Share	2019 Ranking
1	Cloud accounting	73.1%	1
2	E-invoicing	66.3%	2
3	Big data accounting technologies (data management analytics)	62.4%	-
4	Digital files	50.6%	6
5	Robotic process automation (RPA)	48.4%	11
6	Next generation ERP	47.9%	-
7	Blockchain	45.7%	-
8	Mobile payments	43.0%	3
9	Data mining	42.8%	4
10	Online audit	42.7%	7

[81] See Tho, A., 2020

[82] Yan, W., 2020.

Table 41: Top five new emerging technologies in accounting[83]

Ranking	New emerging technology	Share
1	Blockchain invoicing	54%
2	Digital currency	48%
3	IoT automation	43%
4	5G	37%
5	Distributed ledger	34%

[83] *ibid*.

Conclusions

The objective of this work is to understand the evolutionary path of the blockchain technology's development and application in China and in the Chinese accounting sector in relation to the Government's attitude towards this new-generation information technology. Secondary data on the Chinese blockchain ecosystem have been analyzed and interpreted in light of the policy framework that regulates the development and adoption of blockchain technology in China and in its accounting sector as well as the existing literature on the matter. The main findings are as follows.

The Chinese Government has a positive attitude towards blockchain technology and starts to actively support its development and adoption in 2016 as part of its national informatization strategy. This vigorous promotion of the blockchain technology originates from the Government's endorsement of the informatization process, especially in the industrial sector, as a crucial means towards national socioeconomic development. In this early phase, it promoted the sustainable and comprehensive development, application, and innovation of information technology, encouraging foreign direct investments in new technology and started to recognize the importance of blockchain technology, devising a roadmap for its future development and standardization.

In 2016, it becomes evident how the Government is committed to dominating in the global blockchain industry and employing this frontier technology to accelerate research and development in the big data industry. In order to create a modern IT and industry ecosystem and leverage the first-mover advantage in this industry, it is necessary to strengthen the R&D of blockchain and other frontier technologies. Furthermore, the Government planned to reach the global advanced level of innovation by 2020 in a number of fields, including blockchain. At the same time, it proves to be aware of the improvements needed to implement this strategy and promote the healthy and standardized development of the blockchain industry, i.e. making breakthroughs in the technology, deepening its integration in the real economy, further exploring its applications, cultivating digital talents, and strengthening its regulation.

Since 2021, blockchain technology is considered a key emerging industry for the implementation of the national development strategy. The Government is not merely aiming at becoming self-sufficient in key technologies, reducing the country's dependency on foreign technology in the most rapid way by intensifying existing technological innovation plans, but its stated goal is also to develop into a 'manufacturing superpower' and a global leader in crucial new sectors such as blockchain. For this reason, it sets 2025 as an approximate benchmark for creating the most sophisticated blockchain, and

2030 for further implementation, expansion of application scenarios, and integration with other frontier IT.

As for the policy framework of blockchain in the accounting sector, the technology is first included in the Informatization Strategy of the CICPA in 2021, after being adopted by some big accounting enterprises. Before that, the expansion of the accounting industry and the accountancy profession in China had been significantly fueled by information technology in general, following the need to measure up to international counterparts in terms of development of the accountancy profession. As of 2009, indeed, Chinese accountants lagged behind their international counterparts. Through the informatization of the sector, Chinese accountancy professionals increased their competitiveness and boosted firms' performances. In 2021, the focus tilted towards the high-quality development and the digitalization of the accounting sector in China and the professional accounting organization established that blockchain technology should be used to modernize the audit system at large companies and be further deployed in the accounting industry.

The literature review reveals that China's blockchain technology development and application are still in their infancy. The blockchain business is expanding, however, thanks to the Government's active promotion thereof. The majority of authors concur that blockchain technology is reshaping the established industrial system in favor of transparency, sharing, and collaboration. The ecosystem of the Chinese blockchain sector has consistently advanced. In China, there are now many more registered blockchain enterprises and blockchain patent applications than ever before, blockchain research is constantly expanding and the integration of blockchain technology with the real economy is continuously improving thanks to national policy guidance, advances in fundamental technologies, and rising demand for application fields. The main fields in which blockchain enterprises operate are IT, finance, and manufacturing but it is also expanding into areas related to people's livelihood. Among patent applicants, Alibaba is in the lead. Both public and private blockchain projects are being carried out. Two major initiatives of the Chinese government are in the infrastructure and financial sectors, namely the BSN and the digital yuan. The studies also recognize China's efforts to reduce the talent gap, which consist in building platforms of diverse networks.

However, the growth of the blockchain industry ecosystem is currently at a relatively low level, it is mostly influenced by national and local regulations (epitomizing an Asian phenomenon), and agglomerated in Beijing, South China, and the Yangtze River Delta. Strong businesses typically build blockchain alliances to construct monopolies and hierarchies. Furthermore, not all companies want to share activities to prevent data leakage. Blockchain technology also present hidden security risks due poor technical standards. Regarding funding, there were originally significant expenditures into research and development, which boosted application landings, without producing profit yet, since

not all companies are sufficiently mature to execute profitable blockchain activities and leverage the blockchain hype to attract investors. In addition, the Government and the market have overly prioritized the application landing and industrial integration of blockchain technology, ignoring the coordination of the relationship with blockchain companies. For the long-term development of the blockchain industry, China should also regulate and supervise digital tokens. In the global arena, blockchain technology presents an opportunity for China to circumvent the dollar's dominance of the current financial system and achieve relative advantage.

The use of blockchain began with cryptocurrencies and quickly spread to a wide range of contexts, including accounting, where it has a promising future. While offering significant benefits in terms of quality and efficiency in this area, blockchain technology can also potentially transform the traditional roles of accountancy and audit. On the one hand, it results in major advances in these activities, but on the other, it raises several problems that must be resolved for blockchain technology to flourish in the accounting industry.

Accounting fraud, personnel redundancy, high costs, information distortion, and assurance of the reliability of accounting information are all issues that blockchain can address. It guarantees a high level of accounting security, the unchangeability and traceability of data, and reduced enterprise costs. Thanks to blockchain technology, strategic planning and value management become management accounting's primary responsibilities rather than the provision of financial information. In audit, blockchain can both substitute it with automation and increase its independence.

The challenges faced by 'blockchain + accounting' are technical security risks, shortage of professional talents with compound knowledge in accounting and IT, and inconsistent accounting standards. For these reasons, the adoption of blockchain technology in Chinese accountancy is still restricted.

The analysis of secondary data published by government agencies and private bodies reveals that China's blockchain industry is growing but it also has to tackle some challenges.

China has a strong influence on the global blockchain industry for its share of blockchain enterprises and industry alliances. Driven by national and local policies, blockchain enterprises are increasing in number and clustering in the richest and most developed areas (i.e. Beijing, Shanghai, Zhejiang, and Guangdong) but also expanding towards central and western China. However, only a small share of enterprises have actually launched blockchain businesses and the industry's regulation has advanced mostly in Beijing and Shanghai. Most enterprises conduct only downstream operation processes, consist of small startups with a registered capital between one and one hundred million CNY benefiting from increasing foreign investments and domestic financing promoted by special policies. Enterprise investments shifted from the industrial sector to the financial one to technology R&D. More and more blockchain enterprises are also investing abroad. The industry is mainly focused on applications and

solutions, the scenarios of which are in expansion but mostly targeted at financial services. The Central Government's projects are relatively few compared to other countries, but on the provincial level there are more than ninety, mainly in government services. The innovation output is also relatively big and increasing, as China ranks first both for number of blockchain-related patent applications and research papers, but the creativity, competitivity and quality of patents may be relatively low. Most patent applications are filed by Alibaba and focus on security and smart contracts. R&D investments and industrial parks are also growing.

From this analysis, four issues emerge: the shortage of talents, the immaturity of the technology, its restricted adoption and poor regulation. The talent supply fails to meet the demand but the number of software developers with the required skills is growing. China's blockchain technology cannot cope with the increasing business volume, its contribution to blockchain open source platforms is scarce, and its reliance on commercial encryption algorithms is wide. The security incidents are still significant, especially related to fraud and phishing. Restricted adoption is due to alliance businesses' influence, poor top-level planning, scalability costs and difficult cross-chain communication. The policy output is increasing but it needs further improvements.

Despite these challenges, the market size for blockchain technology is expected to increase enormously in the next two decades.

As for accounting, the lack of quantitative data indicates that application exploration and trial, research, innovation, and investment in 'blockchain + accounting' is currently still restricted. However, blockchain is expected to become more important in the upcoming years in the accounting landscape.

In conclusion, China is using blockchain technology to achieve national socioeconomic development on the domestic level, and ensure its dominance in the global arena on the international level. Its main competitor is the US and the development of blockchain technology is a means to establishing its soft power and providing an alternative to a West-centric system. Nevertheless, foreign investments, technology, and markets still contribute to the advancement of blockchain technology and industry in China. Special policies are needed to ensure a more homogenous adoption of blockchain technology across provinces. It is necessary to continue to invest in small startups to allow them to leverage the scalability of the technology without relying on large blockchain alliances. Investments need to be directed towards profitable activities to avoid the disillusionment effect of the blockchain hype that leads to blind investments. Some measures have already been adopted to overcome the current challenges. Future development will occur in talent supply, technological breakthroughs, and extensive adoption. To reduce the talent gap, blockchain-related education and training are being provided. In the future, more blockchain-related courses will be established, and multidisciplinary education will become more popular. At the same time, collaboration between universities and enterprises will

increase. With advancements in other frontier technologies and in the software industry, blockchain technology will become more mature, innovative, and secure. Under the influence of government policies and technological improvements, the adoption of blockchain technology in various sectors of the real economy will increase further.

In the accounting sector, under policy guidance, effective measures to reduce the shortage of compound talents and technological security issues, and through the cooperation of governments, enterprises, and universities, blockchain technology will be more widely adopted and become more influential as a tool of the informatization strategy and the accounting sector will undergo further digitalization. The digital yuan will also contribute to the adoption of blockchain in accountancy. On the long term, the quality of accounting information and the efficiency of accounting and audit will improve; the accountancy profession and the audit activity will change significantly, abandoning repetitive tasks and focusing more on value-added ones.

References

"The Blockchain Report 2020: Financing, Themes, Coronavirus, & The Year Ahead", *CB Insights*, 2020.

AYSAN, Ahmet Faruk, SADRIU, Behar, TOPUZ, Humeyra, "Blockchain futures in cryptocurrencies, trade and finance: a preliminary assessment", *Bulletin of Monetary Economics and Banking*, vol. 23, n. 4, 2020, pp. 525-542.

BSN Development Association, *Blockchain-based Service Network (BSN) Introductory White Paper*, February 5, 2020, https://bsnbase.io/static/tmpFile/BSNIntroductionWhitepaper.pdf, April 15, 2022.

CAO, Shuyan; CAO, Yanan; WANG, Xiaoyu; LU, Yanqiao, "A Review of Researches on Blockchain", *The Sixteenth Wuhan International Conference on E-Business (WHICEB) - Digital Innovation*, vol. 57, 2017, pp. 108-117.

CHEN Ka-Hin, LAI Tze Leung, LIU Qingfu, WANG Chuanjie, "Beyond the blockchain announcement: Signaling credibility and market reaction", *International Review of Financial Analysis*, vol. 82, n. 102209, 2022.

CHEN Yuxue, CHEN Zihong, HU Die, "The Reconstruction of Accounting Information Disclosure System Based on Blockchain Technology", *Journal of Physics: Conference Series*, vol. 1883, n. 012085, 2021.

CHEN, Wanyi, HE, Kang, WANG, Lanfang, "Blockchain technology, macroeconomic uncertainty and investment efficiency", *International Journal of Emerging Markets*, vol. ahead-of-print, n. ahead-of-print, 2021.

China Academy of Information and Communications Technology, Trusted Blockchain Initiatives, *Qukuailian baipishu* 区块链白皮书 (White Paper on Blockchain), 1st ed., China Academy of Information and Communications Technology, Trusted Blockchain Initiatives, 2018.

---. *Qukuailian baipishu* 区块链白皮书 (White Paper on Blockchain), 2nd ed., China Academy of Information and Communications Technology, Trusted Blockchain Initiatives, 2019.

---. *Qukuailian baipishu* 区块链白皮书 (White Paper on Blockchain), 3rd ed., China Academy of Information and Communications Technology, 2020.

---. *Qukuailian baipishu* 区块链白皮书 (White Paper on Blockchain), 4th ed., China Academy of Information and Communications Technology, 2021.

China Center for Information Industry Development, *2020-2021 Zhongguo qukuailian qiye fazhan baipishu* 2020-2021 中国区块链企业发展白皮书 (2020-2021 White Paper on the Development of Chinese Blockchain Enterprises), 2021, https://docs.qq.com/pdf/DVWVtWGVjdWdFWlJn?, May 13, 2022.

China Center for Information Industry Development, *Zhongguo qukuailian chanye fazhan baipishu* 中国区块链产业发展白皮书 (White Paper on the Development of China's Blockchain Industry), 2021, https://docs.qq.com/pdf/DVXJWRWhVVExzTnRk?, May 13, 2022.

Chinese Institute of Certified Public Accountants, *Guanyu yinfa "zhongguo zhuce kuaijishi hangye xinxihua jianshe zongti fang'an" de tongzhi* 关于印发《中国注册会计师行业信息化建设总体方案》的通知 (Notice on Printing and Distributing the "Overall Plan for Informatization of China's Certified Public Accountants Industry"), Xiehui [2011] No. 115, May 4, 2012, https://www.cicpa.org.cn/ztzl1/hyxxhzl/zhidu/201210/t20121031_57024.html, August 13, 2022.

Chinese Institute of Certified Public Accountants, *Hangye Xinxihua Zhanlüe* 行业信息化战略 (Industry Informatization Strategy), 2022, https://www.cicpa.org.cn/ztzl1/hyxxhzl/, October 1, 2022.

Chinese Institute of Certified Public Accountants, *Zhongguo zhuce kuaijishi xiehui guanyu yinfa "kuaijishi shiwu suo xinxihua jianshe jiangli banfa" de tongzhi* 中国注册会计师协会关于印发《会计师事

务所信息化建设奖励办法》的通知 (Notice of the Chinese Institute of Certified Public Accountants on Printing and Distributing the "Incentive Measures for the Informatization of Accounting Firms"), Xiehui [2014] No. 48, September 11, 2014, https://www.cicpa.org.cn/xxfb/tzgg/201409/t20140911_11208.html, August 13, 2022.

Chinese Institute of Certified Public Accountants, *Zhongguo zhuce kuaijishi hangye fazhan guihua (2016-2020 nian)* 中国注册会计师行业发展规划（2016-2020 年）(Development Plan of Accounting Sector in China (2016-2020)), November 2, 2016, https://www.cicpa.org.cn/ztzl1/hyghckzl2/hyghckzl4/202003/t20200319_56901.html, August 13, 2022.

Chinese Institute of Certified Public Accountants, *Zhongguo zhuce kuaijishi hangye fazhan guihua (2021-2025 nian)* 中国注册会计师行业发展规划（2021-2025 年）(Development Plan of Accounting Sector in China (2021-2025)), April 8, 2021, https://www.cicpa.org.cn/xxfb/news/202104/W020210419511643528213.pdf, March 29, 2022.

Chinese Institute of Certified Public Accountants, *Zhuce kuaijishi hangye xinxihua jianshe guihua (2016—2020 nian)* 注册会计师行业信息化建设规划（2016—2020 年）(Development Plan for Informatization of Accounting Sector in China (2016-2020)), December 15, 2016, https://www.cicpa.org.cn/ztzl1/hyghckzl2/hyghckzl4/202003/t20200319_56902.html, August 13 2022.

Chinese Institute of Certified Public Accountants, *Zhuce kuaijishi hangye xinxihua jianshe guihua (2021—2025 nian)* 注册会计师行业信息化建设规划（2021—2025 年）(Development Plan for Informatization of Accounting Sector in China (2021-2025)), April 8, 2021, http://kjs.mof.gov.cn/zhengcefabu/202201/P020220105415523124247.pdf, April 12, 2022.

CPU, "Cambridge Advanced Learner's Dictionary & Thesaurus", Cambridge University Press, 2020, https://dictionary.cambridge.org/dictionary/english/cpu, September 27, 2022.

DALUWATHUMULLAGAMAGE, Dulani Jayasuriya, SIMS, Alexandra, "Blockchain-Enabled Corporate Governance and Regulation", *International Journal of Financial Studies*, vol. 8, n. 36, 2020.

EKMAN, Alice, "China's Blockchain and Cryptocurrency Ambitions: The First-Mover Advantage", *EUISS*, 2021, https://www.iss.europa.eu/content/chinas-blockchain-and-cryptocurrency-ambitions, April 3, 2022.

Forkast.Insights, "China Blockchain Report 2019-2020: Blockchain Is Not China's Future — It's The Present", *Forkast.News*, 2020, https://forkast.news/china-blockchain-report-pdf/, May 16, 2022.

HAN Jing, "Intelligent Data Management System and Performance Joint Blockchain Model for Commercial Bank Management Accounting", *2021 Fifth International Conference on I-SMAC (IoT in Social, Mobile, Analytics and Cloud) (I-SMAC)*, 2021, pp. 1525-1528.

HUA Xia, "Xi stresses development, application of blockchain technology", *Xinhua*, 2019, http://www.xinhuanet.com/english/2019-10/25/c_138503254.htm, September 27, 2022.

initial coin offering, "Cambridge Advanced Learner's Dictionary & Thesaurus", Cambridge University Press, 2020, https://dictionary.cambridge.org/dictionary/english/initial-coin-offering, September 29, 2022.

Institute of Internet Industry, "Zhongguo qukuailian chanye shengtai ditu baogao 中国区块链产业生态地图报告 (China Blockchain Industry Ecological Map Report), 1st ed., Tsinghua University, 2020.

Institute of Internet Industry, Institute of Social Governance and Development, Zhongguancun Big Data Industry Alliance, "Zhongguo qukuailian chanye shengtai ditu baogao 中国区块链产业生态地图报告 (China Blockchain Industry Ecological Map Report), 2nd ed., Tsinghua University, 2021.

Institute of Social Governance and Development, Zhongguancun Big Data Industry Alliance, "Zhongguo qukuailian chanye shengtai ditu baogao 中国区块链产业生态地图报告 (China Blockchain Industry Ecological Map Report), 3rd ed., Tsinghua University, 2021.

JIANG Nan, LIU Xing, XU Ming, "Measuring Technological Collaboration on Blockchain Based on Patents: A Social Network Analysis Approach", *Science, Technology & Society*, vol. 27, n. 1, 2022, pp. 66–87.

KLÖKNER, Maximilian, SCHMIDT, Christoph G., WAGNER, Stephan M., “When Blockchain Creates Shareholder Value: Empirical Evidence from International Firm Announcements”, *Production and Operations Management*, vol. 21, n. 1, 2022, pp. 46-64.

KONG Yanru, YUE Jiawu, “Game Studies on Accounting Entity Behavior Based on Blockchain Technology”, *2020 International Conference on Cyberspace Innovation of Advanced Technologies*, 2020, pp. 512–518.

LASKAI, Lorand, SEGAL, Adam, “The Encryption Debate in China: 2021 Update”, *Carnegie Endowment for International Peace,* March 31, 2021, https://carnegieendowment.org/2021/03/31/encryption-debate-in-china-2021-update-pub-84218, October 2, 2022.

LI Rensi, WAN Yinglin, “Analysis of the Negative Relationship between Blockchain Application and Corporate Performance”, *Mobile Information Systems*, vol. 2021, article ID 9912241, 2021.

LI Yishuo, “Blockchain: or will lead to disruptive changes in the accounting profession”, *China Accounting News*, vol. 8, 2016.

LI Z., ZHONG Ray Y., TIAN Z.G., DAI Hong-Ning, VATANKHAH BARENJI Ali, HUANG George Q., “Industrial Blockchain: A state-of-the-art Survey”, *Robotics and Computer-Integrated Manufacturing*, vol. 70, n. 102124, 2021.

LIU Songyue, HE Shangyang, “Application of Block Chaining Technology in Finance and Accounting Field”, *2019 International Conference on Intelligent Transportation, Big Data & Smart City (ICITBS)*, 2019, pp. 342-344.

LIU Weihua, WANG Jingkun, “Blockchain announcements and stock value: a technology management perspective”, *International Journal of Operation & Production Management*, vol. 42, n. 5, 2022, pp. 713-742.

MAI Xiaoyu, “Distributed Accounting and Blockchain Technology in Financial Accounting”, *Journal of Physics: Conference Series*, vol. 1881, n. 022078, 2021.

MANGANIELLO, Fiorenzo, *How is China Implementing Blockchain Technology?*, in “Forbes”, 2019, https://www.forbes.com/sites/fiorenzomanganiello/2019/02/06/how-is-china-implementing-block-chain- technology/#231639f541f9, August 31, 2022.

NAKAMOTO, Satoshi, *Bitcoin: A Peer-to-Peer Electronic Cash System*, “Bitcoin.org”, 2008, https://bitcoin.org/bitcoin.pdf, September 27, 2022.

NELATURU, Keerthi, DU, Han, LE, Duc-Phong, “A Review of Blockchain in Fintech: Taxonomy, Challenges, and Future Directions”, *Cryptography*, vol. 6, n. 18, 2022.

NSFC at a Glance, “National Natural Science Foundation of China”, https://www.nsfc.gov.cn/english/site_1/about/6.html, August 31, 2022.

People’s Republic of China, Ministry of Industry and Information Technology, Department of Information Technology and Software Services, *Zhongguo qukuailian jishu he yingyong fazhan baipishu* 中国区块链技术和应用发展白皮书 (White Paper on Blockchain Technology and Application Development), China Blockchain Technology and Industry Development Forum, October 18, 2016, http://chainb.com/download/%E5%B7%A5%E4%BF%A1%E9%83%A8-%E4%B8%AD%E5%9B%BD%E5%8C%BA%E5%9D%97%E9%93%BE%E6%8A%80%E6%9C%AF%E5%92%8C%E5%BA%94%E7%94%A8%E5%8F%91%E5%B1%95%E7%99%BD%E7%9A%AE%E4%B9%A61014.pdf, April 8, 2022.

People’s Republic of China, Ministry of Industry and Information Technology, Cyberspace Administration of China, *Guowuyuan guanyu yinfa “shisanwu” guojia xinxihua guihua de tongzhi* 国务院关于印发“十三五”国家信息化规划的通知 (Notice of the State Council on Printing and Distributing the “13th Five-Year Plan for National Informatization”), Guofa [2016] No. 73, December 15, 2016, http://www.gov.cn/zhengce/content/2016-12/27/content_5153411.htm, July 20, 2022.

People’s Republic of China, Ministry of Industry and Information Technology, *Gongye he xinxihua bu guanyu yinfa ruanjian he xinxi jishu fuwu ye fazhan guihua (2016-2020 nian) de tongzhi* 工业和信息化部关

于印发软件和信息技术服务业发展规划（2016－2020 年）的通知 (Notice of the Ministry of Industry and Information Technology on Issuing the Software and Information Technology Service Industry Development Plan (2016-2020)), Gongxinbu gui [2016] No. 425, December 18, 2016, https://www.ndrc.gov.cn/fggz/fzzlgh/gjjzxgh/201706/t20170622_1196824.html, August 6, 2022.

People's Republic of China, Ministry of Industry and Information Technology, *Gongye he xinxihua bu guanyu yinfa da shuju chanye fazhan guihua (2016-2020 nian) de tongzhi* 工业和信息化部关于印发大数据产业发展规划（2016－2020 年）的通知 (Notice of the Ministry of Industry and Information Technology on Printing and Distributing the Development Plan of Big Data Industry (2016-2020)), Gongxinbu gui [2016] No. 412, December 18, 2016, https://www.ndrc.gov.cn/fggz/fzzlgh/gjjzxgh/201706/t20170622_1196822_ext.html, August 7, 2022.

People's Republic of China, Ministry of Industry and Information Technology, Information Center, *2018 Nian zhongguo qukuailian chanye baipishu* 2018 年中国区块链产业白皮书 (2018 Blockchain Industry White Paper), Qifeng Finance and Economics Blockchain Research Institute, May, 2018, https://www.miit.gov.cn/n1146290/n1146402/n1146445/c6180238/part/6180297.pdf, April 8, 2022.

People's Republic of China, Ministry of Industry and Information Technology, Cyberspace Administration of China, *Qukuai lian xinxi fuwu guanli guiding* 区块链信息服务管理规定 (Provisions on the Administration of Blockchain Information Services), Order of the State Internet Information Office No. 3, January 10, 2019, http://www.gov.cn/gongbao/content/2019/content_5392298.htm, July 29, 2022.

People's Republic of China, Ministry of Industry and Information Technology, China Academy of Information and Communications Technology, *Qukuailian sifa cunzheng yingyong baipishu* 区块链司法存证应用白皮书 (White Paper on Blockchain Technology Application in Judicial Evidence Storage), Trusted Blockchain Initiatives, June, 2019, http://www.caict.ac.cn/kxyj/qwfb/bps/201906/t20190614_201169.htm, April 16, 2022.

People's Republic of China, Ministry of Industry and Information Technology, Cyberspace Administration of China, *Guanyu jiakuai tuidong qukuailian jishu yingyong he chanye fazhan de zhidao yijian* 关于加快推动区块链技术应用和产业发展的指导意见 (Guiding Opinions on Accelerating and Promoting Blockchain Technology Applications and Industrial Development), Gongxinbu Lianxinfa [2021] No. 62, June 7, 2021, www.cac.gov.cn/2021-06/07/c_1624629407537785.htm, August 6, 2022.

People's Republic of China, Ministry of Industry and Information Technology, Cyberspace Administration of China, *"Shisiwu" guojia xinxihua guihua* "十四五"国家信息化规划 (14th Five-Year Plan for National Informatization), December 28, 2021, http://www.gov.cn/xinwen/2021-12/28/content_5664873.htm, April 15, 2022.

People's Republic of China, State Council, General Office, *Guowuyuan bangong ting zhuanfa caizheng bu guanyu jiakuai fazhan woguo zhuce kuaijishi hangye ruogan yijian de tongzhi* 国务院办公厅转发财政部关于加快发展我国注册会计师行业若干意见的通知 (Notice of the General Office of the State Council on Forwarding the Several Opinions of the Ministry of Finance on Accelerating the Development of the CPA Industry of China), No.56 [2009], October 3, 2009, http://www.pkulaw.cn/fulltext_form.aspx?Db=chl&Gid=122059, August 13, 2022.

People's Republic of China, State Council, *Guowuyuan guanyu shenhua "hulianwang + xianjin zhizao ye" fazhan gongye hulianwang de zhidao yijian* 国务院关于深化"互联网+先进制造业"发展工业互联网的指导意见 (Guiding Opinions of the State Council on Deepening the "Internet + Advanced Manufactur-ing" and Developing the Industrial Internet), November 19, 2017, www.gov.cn/zhengce/content/2017-11/27/content_5242582.htm#, August 7, 2022.

People's Republic of China, State Council, National Development and Reform Commission, *Guojia fazhan gaige wei, jiaoyu bu, keji bu deng guanyu fazhan shuzi jingji wending bing kuoda jiuye de zhidao yijian* 国家发展改革委、教育部、科技部等关于发展数字经济稳定并扩大就业的指导意见 (Guiding Opinions of the National Development and Reform Commission, the Ministry of Education, the Ministry of Science and Technology, and Other Departments on Developing the Digital Economy to Stabilize and

Increase Employment), Fa gai jiuye [2018] No. 1363, September 18, 2018, http://www.pku-law.cn/fulltext_form.aspx?Db=chl&Gid=322028, August 10, 2022.

People's Republic of China, State Council, *Zhonghua renmin gongheguo guomin jingjì he shehui fazhan di shiyi ge wu nian guihua gangyao* 中华人民共和国国民经济和社会发展第十一个五年规划纲要 (Outline of the 11th Five-Year Plan for National Economic and Social Development of the People's Republic of China), 10th National People's Congress, 4th Session, March 14, 2006, http://www.gov.cn/gongbao/content/2006/content_268766.htm, April 20, 2022.

People's Republic of China, State Council, *Zhonghua renmin gongheguo guomin jingjì he shehui fazhan di shier ge wu nian guihua gangyao* 中华人民共和国国民经济和社会发展第十二个五年规划纲要 (Outline of the 12th Five-Year Plan for National Economic and Social Development of the People's Republic of China), 11th National People's Congress, 4th Session, March 16, 2011, http://www.gov.cn/gongbao/content/2006/content_268766.htm, April 20, 2022.

People's Republic of China, State Council, *Zhonghua renmin gongheguo guomin jingjì he shehui fazhan di shisan ge wu nian guihua gangyao* 中华人民共和国国民经济和社会发展第十三个五年规划纲要 (Outline of the 13th Five-Year Plan for National Economic and Social Development of the People's Republic of China), 12th National People's Congress, 4th Session, March 16, 2016, http://www.pku-law.cn/fulltext_form.aspx?Db=chl&Gid=266682, April 7, 2022.

People's Republic of China, State Council, *Zhonghua renmin gongheguo guomin jingji he shehui fazhan di shisi ge wu nian guihua he 2035 nian yuanjing mubiao gangyao* 中华人民共和国国民经济和社会发展 第十四个五年规划和 2035 年远景目标纲要 (Outline of the 14th Five-Year Plan for Economic and Social Development (2021–2025) and Long-Range Objectives through the Year 2035) of the People's Republic of China), 13th National People's Congress, 4th Session, March 23, 2021, https://www.ndrc.gov.cn/xxgk/zcfb/ghwb/202103/t20210323_1270124.html?code=&state=123, April 8, 2022.

SEE THO, Alexis, *Evolving trends in China's accounting landscape*, "FM Magazine", 2020, https://www.fm-magazine.com/news/2020/dec/china-accounting-evolving-trends.html, September 16, 2022.

SESEC, "China Blockchain Policies and Standardization", *Sesec.eu*, 2020, https://sesec.eu/2020/news-events/news/china-blockchain-policies-and-standardization/, August 6, 2022.

SHAO Huaqing, ZHANG Zongli, WANG Bin, "Research on Accounting Information Security Management Based on Blockchain", *Mobile Information Systems*, vol. 2021, Article ID 9926106, 2021.

SLOTTA, Daniel, *Blockchain market size in China 2016-2030*, "Statista", 2022, https://www.statista.com/statistics/1285636/china-blockchain-market-size/#:~:text=The%20market%20size%20of%20blockchain,69%20billion%20yuan%20by%202030., September 15, 2022.

TRAN, Sarah, *China to Dominate Global Tech Standards? Expert says 'It would be Tough'*, in "Blockchain News", 2020, https://blockchain.news/analysis/china-dominate-global-tech-standards-expert-tough, August 31, 2022.

VON CARNAP, Kai, *Unchaining Blockchain in China: From Wild West cryptocurrencies to strategic technology*, "MERICS", 2021, https://merics.org/sites/default/files/2021-03/MERICS%20Primer%20Unchaining%20Blockchain%20in%20China%202021.pdf, September 15, 2022.

WAN Yinglin, GAO Yuchen, HU Yimei, "Blockchain application and collaborative innovation in the manufacturing industry: Based on the perspective of social trust", *Technological Forecasting & Social Change*, vol. 177, n. 121540, 2022.

WANG Qiang, SU Min, LI Rongrong, "Is China the world's blockchain leader? Evidence, evolution and outlook of China's blockchain research", *Journal of Cleaner Production*, vol. 264, n. 121742, 2020.

WANG Zekai, "Block Chain + Accounting: Applications, Challenges and Countermeasures Research", *2021 7th Annual International Conference on Network and Information Systems for Computers (ICNISC)*, 2021, pp. 326-330.

WU Jiapeng, XIONG Feng, LI Cheng, “Application of Internet of Things and Blockchain Technologies to Improve Accounting Information Quality”, *IEEE Access*, vol. 7, 2019, pp. 100090-100098.

XU Jie 许洁, *2020 Nian xin jijian rencai baogao: Qu kuai lian hangye rencai xuqiu zengfu da 67% wuliu ye xinshui zuigao* 2020 年新基建人才报告：区块链行业人才需求增幅达 67% 物流业薪水最高 (2020 New Infrastructure Talent Report: The demand for talents in the blockchain industry has increased by 67%, and the logistics industry has the highest salary), in “Zhengquan ribao wang”, 2020, http://www.zqrb.cn/finance/hangyedongtai/2020-06-22/A1592816110043.html, August 31, 2022.

YAN Weiqi 颜维琦, *Shi da xinxi jishu yingxiang zhongguo kuaiji hangye* 十大信息技术影响中国会计行业 (Top Ten Information Technology Influencing China's Accounting Industry), “Guang Ming Daily”, 2020, https://app.gmdaily.cn/as/opened/n/30b890122b414d98b3c6352d84b24ac1, September 16, 2022.

YANG Jinjian, YU Haoqi, PAN Jian, “Research on Optimization of Financial System of SMEs Based on Blockchain Technology”, *2021 International Conference on Intelligent Computing, Automation and Applications (ICAA)*, 2021, pp. 623-627.

YANG Xuxin, “On the Credibility Guarantee Mechanism of Accounting Information System: Based on Block-chain Technology”, *2020 International Conference on Computers in Management and Business*, 2020, pp. 53–58.

ZHANG Hui, YI Jin-Biao, WANG Qian, “Research on the Collaborative Evolution of Blockchain Industry Ecosystems in Terms of Value Co-Creation”, *Sustainability*, vol. 13, n. 11567, 2021.

ZHANG Lan, TENG Yan, “Research on the Impact of Blockchain on Accounting Industry”, *2021 International Conference on Control and Intelligent Robotics*, 2021, pp. 726–730.

ZHANG Yingying, XIONG Feng, XIE Yi, FAN Xuan, GU Haifeng, “The Impact of Artificial Intelligence and Blockchain on the Accounting Profession”, *IEEE Access*, vol. 8, pp. 110461-110477, 2020.

ZHAO Ran, HE Jianshi, “China’s Blockchain Ecosystem: Industry Mapping Report”, *Blockchain Business Bridge*, 2020, https://www.blockchainbusinessbridge.com/wp-content/uploads/2020/07/Chinas-Blockchain-Ecosystem-Industry-Mapping-Report.pdf, May 3, 2022.

ZHAO Yan, ZHANG Weidong, HUANG Rong, “The Mechanism of Blockchain Technology Influencing Management Accounting”, *3rd Asia Service Sciences and Software Engineering Conference*, 2022, pp. 21–29.

ZHENG Ruirui, “Applications Research of Blockchain Technology in Accounting System”, *Journal of Physics: Conference Series*, vol. 1955, n. 012068, 2021.

ZHONG Mingjing, FAN Tingting, “Research on the Integration of Corporate Financial Accounting and Management Accounting under Big Data and Block Chain”, Journal of Physics: Conference Series, vol. 1827, n. 012202, 2021.

ZHOU Fenghua, WANG Xiulian, YIN Liang, TAO Lei, CHEN Danping, “Research on the Application of Blockchain Technology: From the Perspective of Audit”, *2021 International Conference on Intelligent Computing, Automation and Applications (ICAA)*, 2021 pp. 581-584.

ZHU Yangpeng, ZHAO Shumin, “A Summary of the Application of Block Chain in Accounting and Finance System”, *Journal of Physics: Conference Series*, vol. 1314, n. 012218, 2019.