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Blockchain Applications in Suning and PingAn

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ABSTRACT

The emergence of blockchain technology has facilitated the digital transformation of many businesses and thereby increased the competitiveness of China in the global market. As a cutting-edge technology, Blockchain has significantly influenced the practices across all business sectors. Focusing on the retail and insurance sectors, this paper analyzes the blockchain technology applications in two companies - Suning and PingAn. Success factors in blockchain implementation were discussed by using TOE framework. Similarities and differences in the implementation and development processes are compared. Features from the two corresponding industries - retail and insurance are also summarized. The major results revealed that retail and insurance industries are two of the most important application sectors of blockchain technology, and Suning and PingAn are both pioneers in blockchain technology development and implementation in their specific sectors. However, there are still distances between Chinese blockchain providers and world leading providers of blockchain, even though China has the largest number of blockchain patents in the world. The research results provide meaningful insights and practical implications to the blockchain application fields.

1. Introduction

This paper is an extension of work [1] initially presented at the conference of Artificial Intelligence and Blockchain Technology (2021). Starting from a boom in the crypto-asset speculative movement in 2017, blockchain technology has kept an ascending trend in recent years [2]. Due to the high fever of Bitcoin, blockchain as a novel technology is also gradually gaining popularity in various industries. Blockchain consists of a peer-to-peer (P2P) network, a private key cryptography, and a protocol to make transactions secure [3]. Blockchain shares some unique characters, such as decentralization, persistency, anonymity and suitability [4], and was widely applied in multiple prevalent areas [5].

Although blockchain technology has been studied in various industries, its primary applications exist in the finance industry. Due to the use of blockchain, the labor costs are significantly reduced, and information system security is substantially increased [6]. Retail industry is another industry with a higher penetration rate of blockchain, it can be used to trace veraciously transactional records [7]. Though industry papers have discussed and listed the implementation facts of both industries, little research has been done to systematically summarize the similarities and differences between the two industries, specifically with exemplary cases. With the above, this study examines the blockchain applications in these two industries and thoroughly analyzes two exemplars - Suning holdings group and PingAn insurance group. The Technology-Organization-Environment framework is also used to summarize the success factors of blockchain implementation in both companies. In sum, our paper aims to address the following research questions:

1. How do Suning holdings group and PingAn insurance adopt and provide blockchain technology in their businesses?
2. What are the similarities and differences between both companies regarding to the development and implementation of blockchain technologies? What are the common factors leading to blockchain application success?
3. How was blockchain technology developed in retail and insurance industries on a large scale?

2. Blockchain Technology

Blockchain is a system for recording information, and it is essentially a distributed ledger technology. The decentralized and immutable nature makes it difficult to disrupt. A blockchain is a chained database containing fixed-length blocks in which every

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transaction record is included. Newly generated insuppressible transactions need to be verified before being inserted into the block. Users manage the data stored in the public blockchain autonomously through a P2P network and a distributed timestamp server, they also have free access to the transactions between two parties permanently recorded in the blockchain [8].

From the perspective of information technology, a blockchain is a distributed database in the form of multiple nodes, and a complete copy is available on each node. If more than 50% of the nodes reach consensus, the chain is entirely trustworthy [9]. In addition to the transaction record and timestamp, each block contains a hash value of the previous block and a new random number that can be used to verify the hash. The hash value exists to prevent fraud caused by changes to the content stored in the blockchain, and it follows each block to change [10]. Blockchain also determines whether a block contains a valid transaction. It uses the proof of work algorithm, which empowers data stored in the blockchain to be unaffected by the collapse of one node and thus maintains the authenticity of the data. On an overall basis, such a transparent system helps record the detailed sequence of events [6].

From the perspective of business transactions, blockchain technology offers a shared ledger for all companies involved in transaction. These new ledgers can hardly result in data loss, change or deletion, and can exclude the presence of a trusted third-party company as in traditional transactions [11]. In this study, we discuss the applications of blockchain technology in the retail and insurance industries. Suning holdings group and PingAn insurance are selected in this paper as typical cases due to their pioneer positions in blockchain technology adoption and implementation. Furthermore, we extend our study and discuss the general phenomena of applying blockchain technology in retail and insurance industries. Last, the comparison of successful factors, similarities and differences between the two companies are presented, and the features of the two industries are summarized.

3. Blockchain in Suning holdings group

Suning holdings group (hereafter Suning) has been ranked as the second-largest civilian-run enterprise in mainland China. As a large ecological, platform-based company, Suning's industry chain involves retail, finance, logistics, Internet of things (IoTs), cultural creation, and sports. With an online and offline customer base of over 600 million, Suning is well-positioned to use big data to build consensus collaboration networks. A large amount of data provided blockchain technology a suitable environment. This amount of data also contributed to establish a blockchain lab by Suning Financial Research Institute in 2017, and thereupon, Suning integrated the blockchain technology into the group's business [12]. After that, Suning launched the domestic credit information transmission system, blockchain blocklist sharing platform, "blockchain + IoTs" financing platform for cars, blockchain anti-counterfeiting technology, and blockchain asset securitization service system between 2017 and 2018. After a series of practices of blockchain, Suning released the Suning blockchain white paper in July 2018. The white paper elaborated the development path and application areas of blockchain in Suning and announced Suning's prediction of the future development of blockchain [12].

A year later, Suning launched Blockchain as a Service (BaaS), a cloud-based infrastructure platform to provide developers and users with an ecosystem for creating and managing blockchain applications. The BaaS platform is also committed to provide a series of blockchain financial solutions such as data sharing, IoTs, supply chain finance, and payment settlement. In 2020, Suning launched an external empowerment plan to enhance digital and intelligent financial services, which has accelerated the research and development of blockchain technologies and expanded the blockchain application scenarios to its major partners. It is worth mentioning that Suning's financial blockchain technology has won various industry awards, including being selected for the 2020 FAT Blockchain fintech leading 100 list. These show that Suning's blockchain applications are forward-looking in the industry [13].

3.1. Suning's blockchain in Retail and E-Commerce

Suning's blockchain application in the retail industry originated from the concept of smart retailing [14]. Compared to traditional retailing, smart retailing tends to predict consumers' preferences and customize services by using big data. It involves drawing a user portrait, building a membership ecosystem, and supplying products according to market demand.

3.1.1. User portraits and member ecology

Consumers inevitably reveal their privacy when engaging in consumer behavior. To prevent user information from being leaked to third parties intentionally or unintentionally, Suning introduced blockchain technology to store users' information. Moreover, since the data in the blockchain is available to authorized users only, consumers are able to self-manage the information stored in the blockchain, thus eliminate the possibility of information leakage [15]. Suning's business involves diverse aspects of retail industry, such as clothing, food, housing, and transportation. Building a member ecology can strengthen communication and enhance the sense of user experience. The ecology enables consumers, retailers, and suppliers to join the same blockchain network to avoid the unnecessary cost due to information asymmetry.

3.1.2. Smart logistics

Smart logistics is mainly reflected in supply chain management. Most traditional supply chains use one single approach - bulk goods reach the distributors through the supply chain and are distributed to smaller sales stores [16]. However, Blockchain technology allows factories to supply according to customers' demand, eliminating the need for customers to wait for replenishment and travel to physical stores. The supply chain no longer adjusts passively based on customer demand but proactively predicts consumer demand and market trends [17].

Blockchain technology can also monitor products throughout the logistics process to ensure that goods are traceable. On one hand, real-time logistics records track each transaction and delivery environment, avoiding incidents such as goods lost or replaced in the middle of the process. It strengthens the management of employees and reduces the possibility of

corruption. On the other hand, blockchain technology can implement precise regulation of cargo transportation. All parties involved in the transportation process can exchange real-time data and electronic documents without barriers [18]. Thus, the most optimal transportation route can be filtered out. In 2018, Suning collaborated with Baidu to develop driverless delivery vans. This has made uploading logistics information to the blockchain network easier [19].

According to statistics, Suning's smart logistics network has covered 95% of the areas in mainland China. The company also plans to reach 20 million square meters storage area by 2025. In August 2020, Suning, China Logistics, and other partners jointly released the "5G smart logistics innovation demonstration white paper", in which Suning's experience in exploring smart logistics using blockchain and 5G technology was made public [19].

3.2. Suning's blockchain in financial trade

Since the invention of Bitcoin, the financial industry was the first sector to achieve a breakthrough in blockchain. Suning's blacklist sharing platform is one of the influential application areas of blockchain [12]. Traditional blacklists are used to record individuals or organizations with serious adverse credit problems, and are used mainly by financial institutions. However, most traditional blacklist data are non-public. It is thus difficult to investigate whether the other party commits credit problems before a transaction, which results in inevitable losses for both parties. Suning took the initiative to use blockchain technology to build a decentralized blacklist sharing platform. Blacklists in the industry are pooled and published to authorized organizations. This list is shared with other nodes in the blockchain network through smart contracts [12]. After one year's implementation, the platform gathered 11 million pieces of data, including 7 financial institutions on the blacklist [20]. In September 2020, Suning bank officially joined forces with Citic bank and Minsheng bank to create a blockchain consortium that used the blacklist sharing platform of Suning.

3.3. Suning's blockchain in IoT

Traditional IoTs relies on a centralized structure where all devices are authenticated by accessing a centralized cloud server. When the IoTs applications expand, it is highly prone to a system collapse, and lead to high financial and human resources costs. Meanwhile, the highly centralized nature makes all data stored in the IoTs hub. Once the hub is attacked, all users' private data will be lost or maliciously exploited [12]. Blockchain technology can solve this problem. In the following, we will introduce Suning's two applications of blockchain in IoTs.

3.3.1. Smart home

As a company that promotes smart retail ecology, Suning has taken the lead in the industry to build an ecological intelligence platform to introduce smart home applications. Suning built a Biu+ ecological system based on artificial intelligence technologies, and blockchain technology in the Biu+ smart home system realizes the goal of information interoperability [21].

3.3.2. IoTs financing platform for cars

Suning launched the "Blockchain + IoTs" financing platform for cars in March 2019. Blockchain technology solves the problem of poor credibility supervision of movable assets pledge and inventory pledge financing business. Business process data can be uploaded to the blockchain platform, while sensors can monitor the goods in the warehouse in real-time to ensure the safety of goods during the pledge period. Suning claims that using the platform, the credit volume of the inventory financing business is expected to have a tenfold increase [22].

3.4. Blockchain in culture and creativity

Cultural creation involves film and television, audio-visual, media, and craft design. The degree of copyright protection directly affects the motivation of creators. The major problem with copyright protection is that the certification mechanism is time-consuming and costly. Inspired by the feature of blockchain, Suning uploads the creators' content to the blockchain, and the generated timestamp is a unique proof of work. Subsequent modifications to the work are recorded in the block in chronological order. When the work faces the problem of copyright protection, the data in the blockchain will become a critical source to prove the originality. Meanwhile, smart contracts allow creators and consumers to transact directly without the presence of a third party (e.g., record label and broker). The privacy of the entire sales process is protected, and third-party profit sharing can be largely avoided [12].

The key milestones of the implementation process are summarized in Table 1.

Table 1: Milestones of Blockchain implementation in Suning

Time	Milestones of implementation
April 2017	Suning launched a blockchain-based Letter of the credit system (BCLC), a blockchain financial blacklist data service system.
February 2018	Suning launched the blacklist sharing platform system.
July 2018	• Suning and SAP carry out technological innovation and industry practice and promote the digital economy. • Suning officially published Suning's blockchain white paper and blueprinted different application scenarios of blockchain technology in retail, logistics, finance, culture, and creative industries. • The Suning blockchain commodity traceability platform was launched.
September 2018	Suning Bank successfully granted pledge credit to the coal of Taihe port services through a chattel pledge financing platform based on blockchain and IoTs.
March 2019	Suning finance's "Blockchain + Internet of Things" finance platform was launched.
April 2019	The Suning blockchain forfaiting platform was launched.
June 2019	Suning demonstrated its ambition for blockchain technology in smart homes by deploying Suning's Biu+ ecology.
End of 2019	Suning launched Suning's Blockchain as a Service (BaaS) cloud infrastructure platform.

Beginning of 2020	Suning financial technology launched the blockchain asset securitization service system, cooperating with the initial issuance of RMB 800 million first way asset-backed security loans.
February 2020	The Suning logistics "5G Wolong" unmanned vehicle empowered by blockchain successively completed unmanned terminal delivery deployments in Beijing, Nanjing, and Suzhou.
August 2020	The "5G smart logistics innovation demonstration white paper" that shares the strategic acumen of the combination between blockchain and 5G technology in smart logistics was jointly released by Suning and its alliances.
September 2020	• The Suning blacklist sharing platform buttressed the development and launch of the blockchain consortium, established by Suning bank, Citic bank, and Minsheng bank. • Suning was invited to be a member of the official Jiangsu Internet society blockchain standardization technical committee.
November 2020	The blockchain information sharing platform of anti-money laundering led by Suning bank started its services.

Suning has benefited from the large-scale adoption of blockchain technology. User retention has dramatically increased as a result of blockchain's utilization in user profiling, and Suning is now able to proactively predict customer demand and market trends. Meanwhile, the expenditures brought on by information asymmetry were decreased [15, 17]. Suning was able to quickly upgrade information systems and achieve 95% coverage of the national smart logistics network thanks to blockchain applications in IoT. The presence of blockchain eliminated the volatility of conventional IoT systems and decreased the expenditure on building infrastructure and maintaining systems. Additionally, Suning has been able to grow its business into industries like intellectual property protection due to the application of blockchain in cultural protection, which started in 2018 [12, 23].

As a comparison, Amazon - one of the world's best retailers in US, also has a unique insight into the expansion of its blockchain business. Its Amazon Managed Blockchain (AMB) makes it easy for clients to join public networks or create and manage scalable private networks using the popular open-source frameworks. Many famous companies in the world employed AMB services. Examples include: BWM, Sage, SonyMusic, and Nestle. AMB solutions were also used to facilitate supply chain management, international transactions, digital right protection, record keeping of all kind and more. In sum, Amazon developed a simpler and more efficient blockchain program that significantly reduces operational time and offers more than 70 solutions for customers [24]. Compared with Suning, Amazon provided more international services with a larger capacity across multiple areas to its clients, whereas Suning focuses more on the Chinese business, but still having an advantage in a wide application area of blockchain. It will take Suning a longer time to develop its blockchain technology to reach the maturity level of Amazon.

4. Blockchain in the retail industry

In the post-epidemic era, the challenges faced by retailers, such as supply chain maintenance, product sales, and employee safety, urged the development of blockchain technology in retail industry [25]. The application of blockchain technology is mainly reflected in three aspects. Firstly, it builds consumer confidence in the brand: blockchain has significantly reduced customer concerns about information security leaks. Likewise, supply chain management with blockchain participation ensures the quality of goods. Secondly, it improves the ability of suppliers to meet market demand: the supply chain under blockchain management actively adjusts the production quantity and inventory of goods according to market demand, reducing unnecessary costs. Finally, it creates additional competitive advantages for firms: customer profiling based on customer information, understanding consumer preferences, and designing products to meet market demand.

Alibaba and Jingdong are the industry leaders ahead of Suning in terms of blockchain technology applications. The blockchain competition between these three top companies started with the "618" (an online shopping festival organized by e-commerce platforms in China on June 18th) promotion in 2018. Jingdong generated CNY259.8 billion turnover, and Ali Group's Tmall reached CNY213.5 billion. The high turnover has led to concerns about the quality of goods. Using blockchain technology to trace the originality of goods became a key to solve this concern. Jingdong firstly applied blockchain technology for anti-counterfeit traceability of mother and child, global purchase, and alcohol products. It made the total number of traceable commodities increased by more than 200 times within the 18 days of the "618" campaign. The platform has also attracted more than 400 companies worldwide, which further increased the number of traceable goods to 1 billion pieces [26].

In sum, for the retail industry, the significance of blockchain mainly lies in protecting user information, anti-counterfeit traceability of products, and monitoring the logistics process. A reasonable implementation of blockchain technology can help retail merchants win customers' trust and save unnecessary costs.

5. Blockchain in PingAn insurance

Ping An Insurance Co. of China Ltd (hereafter PingAn) is a Shenzhen-based Chinese holding company engaged in insurance, banking, and financial services, with thirty subsidiaries located domestically and oversea. PingAn was ranked No. 7 on the Forbes Global 2000 list of companies in 2021 and No. 29 on the Fortune Global 500. PingAn has generated $107 billion in gross premiums as China's largest insurer in 2018 alone. In July 2019, PingAn became the second-largest insurer globally, with a market capitalization of $220 billion [27]. PingAn joined the R3 Blockchain Alliance in 2016 to collaborate with a global consortium on how to apply blockchain technology to the financial market, which was PingAn Group's first attempt at blockchain technology [28]. As a traditional insurance and finance company, PingAn aspires to be positioned more as a technology company providing cutting-edge technologies [29].

In the traditional insurance industry, policies are primarily documented in paper-based contracts, and consumers would call or meet the customer representative to finalize the contract. This process relies on manual operations and is subject to the risk of information loss, tampering, and misinterpretation. It is stated that fraud accounts for 10 percent of all property and casualty losses and creates at least $80 billion in losses in the U.S. [30]. Additionally, the lack of security, efficiency, and customer satisfaction in traditional insurance sales are issues that cannot be ignored. Blockchain technology could be an intelligent solution here [30].

Realizing the significant impact of blockchain in insurance business, PingAn increased the investment of research and development in blockchain. 2021's knowledge asset management report shows that PingAn has obtained 1,749 blockchain patent families, implying a significant increase compared to the 291 in 2019 [31]. PingAn's powerful blockchain technologies have created a new financial ecosystem covering five substantial areas: finance, real estate, automotive, healthcare, and smart cities. The blockchain system developed by PingAn has attracted 13.32 million Internet users in 2020 and reached 225 million currently [32].

5.1. PingAn's blockchain in finance

PingAn OneConnect is an associate company of the PingAn insurance conglomerate. It has perfectly solved the challenges of privacy protection and system performance with its self-developed FiMAX S3C cryptographic blockchain structure. In addition to basic blockchain application methods such as trade finance, supply chain finance, and asset-backed securities, PingAn OneConnect also offers customized blockchain solutions for enterprises. Unlike traditional blockchain nodes generated by multiple accounts, the BNaaS (Blockchain Network as a Service) platform developed by PingAn allows users to independently create and publish new blockchain networks and join existing commercial blockchain networks through the BNaaS marketplace [13].

The blockchain-enabled platform, jointly built by OneConnect and UBX Philippines, targets Micro, Small, and Medium Enterprises (MSME) banking needs. It aggregates blockchain, face recognition, micro-expression, big data, and AI technologies and covers many business finance needs. Therefore, it can integrate more MSMEs into the financial system [33]. In addition, OneConnect developed a new smart legal contracting system in 2019, and actively rolled out ALFA smart contracts. The contracts cover seven major financial sectors: banking, funds, securities, trusts, leasing, futures, and insurance across PingAn Group's various divisions. Using this smart contract, managing Asset-Backed Securities (ABS) scheme contracts that would initially take two employees two to three weeks can now be completed in half an hour. After a wide-range use, ABS assets traded through ALFA reached CNY100 billion ($13 billion). The technology has significantly reduced the contracting time by 85% [34].

5.2. Blockchain in real estate, automobile, medical care, and smart city

PingAn, one of China's largest real estate investors, spends CNY50 billion ($7.7 billion) of its annual budget on new physical asset investments, representing 10% of its total investments each year [35]. Lease transactions and property registration in the real estate business involve preserving confidential information such as property rights, management rights, and transaction prices. With the help of blockchain technology, the accuracy and efficiency of the above activities can be improved.

In the automotive industry, where PingAn is involved, blockchain technology enables the traceability of the sources of auto parts and improves operational transparency. Moreover, blockchain allows the automation of processes in car-sharing services. For instance, with the assistance of smart contracts, blockchain will help two parties create an agreement, after all the conditions of the agreement are fulfilled, this agreement will be automatically executed [36].

PingAn's healthcare ecosystem, released in 2020, contains one of the largest healthcare databases in the world. The database holds the second largest number of health technology patent applications globally, covering 30,000 disease profiles, 300 million apps, and over 1 billion medical consultation records [37]. Blockchain technology is mainly used for anti-counterfeit traceability of drugs and storage of patient electronic profiles.

PingAn signed an agreement with the Sanya city government to build a "smart city" based on blockchain, artificial intelligence, big data, and cloud computing technologies. PingAn group invested CNY30 billion（$4 billion) to construct Sanya's smart city [38]. The key milestones of the implementation process in PingAn are summarized in Table 2.

Table 2: Milestones of Blockchain implementation in in PingAn

Time	Milestones of implementation
May 2016	PingAn became the first Chinese financial services institution to join the R3 consortium.
October 2016	PingAn OneConnect successfully registered the patent for "blockchain-based transaction verification method and system", "permission control method and system based on blockchain transaction", and "blockchain-based transaction processing method and system."
January 2017 – May 2018	PingAn OneConnect successfully registered a series of patents for a Blockchain related systems and methods.
August 2018	PingAn unveiled China's first "1+N" smart city integrated platform, supported by blockchain technology.
October 2018	HKMA uses PingAn's FiMAX blockchain to establish an eTradeConnect platform for seven international banks in Hong Kong.
December 2018	PingAn Good Doctor started integrating blockchain technology in their smart severe disease monitoring system, AI-based medical system, PASS and smart medical safety monitoring platform to improve the data security of the healthcare ecosystem.
March 2019	PingAn OneConnect works with IFAB to establish a blockchain-based IFAB trade finance network for SMEs.

April 2019	PingAn OneConnect established the Tianjin port blockchain-based verification pilot project.
May 2019	PingAn OneConnect built and operated a blockchain-enabled integrated Gamma Platform, allowing clients to migrate, manage and enhance their technology infrastructure and simplify the digital transformation process.
June 2019	• PingAn OneConnect started managing the contracts by the ALFA smart contract cloud platform, which supported 1,000 standard contract templates and 80,000 tags stored in the blockchain. • PingAn FiMAX won the Best Blockchain or Distribution Ledger Technology Award from the Asian Banker, the Outstanding FinTech Achievement and the Best Application of Advanced Technology in a Product or Service from bank administration institution.
July 2019	PingAn OneConnect officially launched the Blockchain Network-as-a-Service (BNaaS) for customers to create their blockchain-based networks or take part in existing networks established by others.
December 2019	• PingAn's International Smart City subsidiary launched iShenzhen blockchain electronic license application platform. • PingAn integrated the blockchain witness function and launched the "PingAn Good Lawyer" smart legal compliance assessment systems.
April 2020	PingAn OneConnect and China merchants' port group created a blockchain-based system with Shenzhen customs to serve the Guangdong-Hong Kong-Macao Greater Bay Area.
May 2020	PingAn was one of the pioneers utilizing the blockchain technology to develop a tax-industry alliance chain for the sake of reducing tax costs and trade finance risk.
August 2020	PingAn's International Smart City subsidiary was invited to be the chief compilation team as recorded in the bluebook of blockchain application innovation in the area of Beijing government services.
October 2020	PingAn launched the intelligent transportation integration platform- "155C" to resolve traffic congestion-related issues.
November 2020	• PingAn filed the largest number of blockchain-related patents in 2020 [31]. • PingAn FiMAX was listed on the Top 30 list of the 2020 China Blockchain entities and was rewarded by 5th Golden Gyro Awards for its contribution to the Blockchain industry.
September 2021	• PingAn OneConnect had collaborated with 62 government agencies and regulators and 41 IT service providers to benefit over two million SMEs through its financial ecosystem. • PingAn's FiMax architecture has been widely recognized and won 22 technology awards [39].

In PingAn's insurance business, blockchain technology has significantly advanced the digital transformation, improved traditional insurance paper-based transactions and enhanced employee efficiency. As a result, there has been a corresponding reduction in errors and frauds previously caused by manual labor. PingAn OneConnect is also very good in developing blockchain platforms and offers blockchain services to other companies. The applications of blockchain in other areas has automated procedures and increased operational transparency in various ways. Due to the increased accuracy of confidential information and transaction efficiency, PingAn has won the trust of investors and clients [36]. Statistics show that after blockchain technology was adopted, the total number of users surged to 225 million [32].

As a comparison, United Health Group (UHG) U.S. - the benchmark for blockchain technology adoption in the health insurance sector was chosen. UHG uses the blockchain alliance the same way as PingAn. However, UHG's alliance brings together significant, industry-leading businesses from several sectors and encompasses multiple commercial relations, including suppliers and rivals. In contrast to PingAn's blockchain alliance, which is more homogeneous and is mostly constituted of insurance businesses, UHG's blockchain alliance deploys a multi-company, multi-site, permissioned blockchain. Each alliance member has the flexibility to deploy its nodes in accordance with its corporate demands. To this extend, PingAn's blockchain technology applications are yet to be as innovative and diversified as those of international leaders [40].

6. Blockchain in the insurance industry

Blockchain technology is used in the insurance industry mainly as a decentralized and shared distributed ledger to prevent the risk of fraud in the insurance business by providing immutable and time-stamped records of transactions. In recent years, insurance companies have gradually benefited from blockchain technologies in their insurance business and have significantly increased their investment in developing new models of blockchain technologies.

The insurance market size of blockchain was estimated to be $1,393.8 million by 2023, with an 84.9% compound annual growth rate (CAGR) [41]. The applications of blockchain are reflected in the following aspects: (1) fraud monitoring and risk prevention: insurance companies can keep all transaction records permanently on a distributed ledger and can use public data to predict and analyze fraudulent activities, (2) increasing customer trust in the brand: cryptographic principles in blockchain are used to authenticate customers and ensure transaction security and customer privacy, (3) claim processing: use blockchain technology to analyze data and significantly speed up claim processing, (4) smart contracts: blockchain's smart contracts automatically fulfill contracts when all conditions are met, reducing back-end

paperwork and lowering insurance company management and operating costs.

The current situation shows that insurers are more cautious in blockchain deployment compared with the retailers, and blockchain is primarily applied to prevent fraud risks and manage information. However, some start-up insurers are trying to expand blockchain operations to other areas such as accessing and auditing electronic health records and verifying settlements. These activities are expected to save costs and improve operational efficiency [36].

7. Comparison between the two cases and two industries

So far, we have introduced the implementation of blockchain technology in two companies - Suning and PingAn, and described the trend of blockchain applications in the retail and insurance industries. In this session, we will first use Technology-Organization-Environment (TOE) framework to summarize the factors leading to blockchain implementation success, and then compare the similarities and differences between these two companies. The summarized features of blockchain applications in both industries will be presented at last.

7.1. TOE framework and common factors to blockchain applications success

With the analysis of the two cases, we argue that Suning and PingAn share several commensurate characteristics that lead to their success in blockchain implementations. We draw on the Technology-Organization-Environment (TOE) framework to explicate how and why these characteristics are essential and generalizable rather than domain-specific to all industries and types of organizations.

TOE framework was initiated by Tornatzky and Fleishcer in 1990 [42], and further extended to suit different contextual and/or situational analyses. The main principle of the TOE framework advocates the contextual congruence of technology itself, organization, and external environment to the technology adoption and implementation [43]. In this paper, we draw on the TOE framework extended by [44], which is believed to be more appropriate and deliberately designed for information and communication technology studies. Further, our analysis responds to [44]'s call to examine the external support and user-centric view in different contexts [44].

In TOE, the technological context highlights not only the significant characteristics of technology but also the "compatibility" and "interoperability" elements of the current system [45]. Three sub-factors are conceptualized in the technology context, including system configuration, technology hardware readiness, and technology compatibility. Firstly, system configuration refers to the technical architecture configuration and integration of both software and hardware [44]. Suning and PingAn have done well in this aspect, evidence can be found from the different awards they have received. For example, Suning has been selected for the 2020 FAT blockchain fintech leading 100 lists. PingAn FiMAX won the outstanding Fintech achievement and the best application of advanced technology from a bank administration institution. Secondly, technology readiness refers to the maturity and capability in technology deployment [46]. PingAn has tried to integrate blockchain technology into current business practices and exercises; Suning has pioneered in transforming its businesses with blockchain. Though there might be slight differences, we believe such a difference can be attributed partially to the unique business nature. Thirdly, technology compatibility refers to how technology is perceived as consistent with the current organizational values and practices [47]. We argue that both companies did more than embracing blockchain technology alone; they tried to align it at a strategic level to explore any potential competitive advantages brought by blockchain.

Regarding to the organizational context, the organizational support to the new technologies, the readiness for the technology implementation, resource investments and supportive corporate culture can impact the success of technology implementation to a greater extent [43]. According to the TOE framework, the organizational support can be categorized into two factors: organization fit and user barrier. It is believed that Suning and PingAn's success in blockchain applications is never possible if they have not invested enough time, resources and training for all relevant users, including employees, clients and business partners. Both companies proactively distributed and shared the information with different stakeholders and invited them to get involved in their platform and ecosystem development. For instance, Suning advanced blockchain development by integrating 5G technology with allies in the "5G smart Logistics Innovation Demonstration White Paper", and PingAn developed the tax-industry alliance chain with other partners. On the other hand, we found that both companies spontaneously value users' acceptance of product and service change. They released the news about their new businesses with blockchain and benefits their customers can acquire from these new businesses through different channels such as newspapers, daily news, social media, and even state media, which have significantly cultivated customers' confidence on the new business and technologies in China.

Finally, the environmental context considers the views of external stakeholders seriously, organization should engage in the prosperity of the ecosystem with high commitment [43]. External support is the overarching factor in the organizational context of technology implementation success. In addition to clients and business allies, government plays a critical role in Suning and PingAn's success in blockchain implementation. Specifically, the Chinese central government clearly encourages blockchain industrial ecosystem establishment and blockchain industrial applications. It issued 217 policies, regulations, and program documents pertaining to blockchain technology, clarifying the legal boundary of blockchain application and implementation [48]. For instance, one of the initiators of PingAn's tax-industry alliance chain is the Shenzhen government. In short, based on the TOE framework, we argue that Suning and PingAn share some common characteristics of success in blockchain applications. These commonalities are theoretically and practically generalizable to other fields. Table 3 summarizes these common factors.

Table 3: Common factors to blockchain application success based on TOE framework

Technological context	
System Configuration	Suning and PingAn both have well-developed technical architecture and

	integration systems on both software and hardware.
Technology Readiness	Suning and PingAn both demonstrated maturity and capability in technology deployment. Correspond to different business natures, Suning focused more on blockchain adoption whereas PingAn is more on development and implementation.
Technology Compatibility	Suning and PingAn not only integrated blockchain technology into their current business coherently, but also embedded it into their business strategies.
Organization context	
Organizational Fit	Suning and PingAn's invested much time and resources to train users to process and handle the change brought by blockchain in their business. Both organizations also proactively distributed and shared the information with different stakeholders, and invited them getting involved in their platform and ecosystem development.
User Barrier	Suning and PingAn maximized the benefits from different information channels to promote their blockchain technology and related new business for the sake of aggrandizing customers' acceptance.
Environmental context	
External Support	Suning and PingAn both benefited from blockchain-related national regulations and policies as well as the collaboration with state and/or provincial government.

7.2. Similarities and differences between two companies

First, though Suning and PingAn belong to two different industries, they share some common features. The similarities are summarized in Table 4.

Table 4: Similarities between the two companies

The scale of blockchain application	Large scale covers multiple fields
Application areas	Focus on finance, real estate, supply chain, smart home or smart city, data management, and customer information management
Blockchain features used	Secure, unanimous, distributed, immutable, time-stamped
Government support	Both are based in China and strongly supported by the Chinese government [48]
Patent	Both are obtained patents in blockchain technology
Blockchain provider	Provide blockchain service (BaaS) to other companies [13]
Cooperation with other companies	Both are collaborating with other companies to develop blockchain technology
Common benefits	• Enhance information reliability • Process a large quantity of data automatically • Increase information transparency • Improve security and accountability in transaction • Reduce financial risk • Reduce labor costs
Common challenges	• Solve the relations of production but not productivity itself • Optimize algorithmic capabilities to analyze data • Prevent crime due to the anonymity of the blockchain • Expand potential uses of blockchain • Interoperability between blockchains • System performance • Ecosystem development

Second, the differences between the two companies are presented in Table 5.

Table 5: Differences between the two companies

	Suning	**PingAn**
Application areas	Retailing and retailing-related service	Insurance business and blockchain technology development (blockchain service provider)
Blockchain in IoT	Real-time monitoring of pledged goods in the warehouse and uploading business process data to the blockchain	Collecting insured vehicle data and uploading it to a blockchain-based insurance network
Independently developed cryptographic blockchain structure	FiMAX S3C [13]	No independently developed cryptographic blockchain structure
Vision	Domestic e-commerce business development	International business development
Strategic management	Establish a strategic alliance	Improve product innovation

7.3. Summarized features of retail and insurance industries

The major features of blockchain technology applications in retail and insurance industries are summarized below (Table 6.)

Table 6: Summarized features of blockchain applications in retail and insurance industries

	Retail industry	Insurance industry
Application areas	• Build customer confidence in the brand • Supply chain management • Enhancing the market competitiveness	• Fraud monitoring and risk prevention • Increasing customer trust • Customer retention • Claim processing • Smart contract
Major limitation of blockchain applications	Scalability • Difficult to store the growing amount of data • Decrease transaction processing speed [49]	Security • Inaccurate data cannot be repaired • Private keys are easily lost [50]
Compound annual growth rate	84.6% [51]	84.9% [41]
Investment Return	• Strong revenue growth: including factors that support volume and price • Better operating margins: including factors that support the selling and administrative side as well as cost of goods sold [52]	Reduction of administrative and operations cost: blockchain can deliver reinsurance industry-wide savings up to $10 billion [53]
Influence on industry	• Reduce retail costs and waste of resources • Optimize customer-retailer relationships	• Replace the role of insurance companies as intermediaries • Reduce insurance fraud losses
Outlook on next step	• Reduce the risk of data breaches • Focus blockchain development resources on use-cases with a clear path to commercialization • Push for standardization in technology, business processes and talent skill sets [52]	• Shape a stimulating and regulatory environment • Identify the challenges around blockchain's open and decentralized nature [54]

8. Conclusion

Blockchain technology has gone beyond the early hype of Bitcoin and evolved into an emerging technology commonly adopted by governments and industries with the general goal of improving productivity and reducing costs. China always keeps an open and positive attitude towards developing and using blockchain, especially in the retail, insurance, and finance sectors. Since the year of 2017, China has dominated global blockchain development market.

For the future, the data breach risks will be the main focus of the future blockchain technology development in retail. Regarding to the current cryptocurrency landscape, most retail industry employees expressed their confusion and distrust of blockchain technology. Therefore, developing a trustworthy and secured blockchain information systems will be a key priority to advance in the retail sector [55]. User or customer education is also necessary. Meanwhile, most company would like to embrace below two approaches: focusing blockchain development resources on use‐cases with a clear path to commercialization and pushing for standardization in technology, business processes and talent skill sets [54].

For insurance industry, the way forward for blockchain technology will be to shape a stimulating and regulatory environment. While blockchain technology can provide technical proofs of ownership, consensuses and responsibilities, these proofs still lack legal support. For example, smart contracts can technically bind both parties to the contract, but the law does not explicitly acknowledge the contract's legitimacy. Therefore, the next step for blockchain in the insurance industry should be establishing and implementing specific rules and regulations [56]. Moreover, collaborating with consortia, technologists, startups, and regulators to identify challenges around the open and decentralized nature of blockchain is critical to the insurance industry. The areas include: the limitations of the technology, the development of the market, data protection, and the standardization of operational requirements [54].

This paper firstly introduced the origin and background of blockchain technology and briefly described the technical characteristics of blockchain. It then analyzed the implementation of blockchain in two companies from two industries - Suning in the retail industry and PingAn in the insurance industry. We summarized the success factors of blockchain implementation by

using TOE framework. For technological context, both companies are well developed in system configuration; both of them demonstrated maturity and capability in technology deployment; and both technology deployments are compatible with the companies' long time strategic development. In terms of organizational context, both companies' blockchain developments fit their organizational development and are welcomed by their clients. At last, the blockchain technology implementations are both strongly supported by government. We also compared the similarities and differences between the two companies in blockchain applications. Both companies are pioneers in their specific domain, though sharing slightly different missions or goals in blockchain implementation and development. Compared with US firms, China's leading companies still have some distances in terms of the kind of blockchain services provided and the maturity level. At last, the summarized features of blockchain applications in two industries were presented. The investment of return and future outlook were discussed. In sum, this study provided deep insights in understanding the development of blockchain technology in China, especially in the retail and insurance industries.

Conflict of Interest

The authors declare no conflict of interest.

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