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Be More Specific! An Exploratory Study of 5g and Blockchain Application on Retailing Industry With Suning Limited Case

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Abstract

Currently, 5G and blockchain technologies become a pervasive topic. While lots of research are conducting a general review of their technical characteristics and proposing various application scenarios, a study that focuses on a specific industry supported with practical data is still in a paucity. This study selects Suning Limited, one of the Chinese pioneers in the blockchain and 5G technology deployment and development, as the main case to explore how the above two technologies can be applied in the retailing industry to achieve the organization goals in terms of performance effectiveness and efficiency. Meanwhile, this study introduces how 5G and blockchain as solutions to deal with some main operational and managerial challenges in the industry. The limitations and recommendations of the study are provided.

Keywords: 5G, Blockchain, Management Application, Retailing Sector

Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Introduction

Being regarded as revolutionary technologies, blockchain and the fifth generation (5G) wireless networks are attracting much attention from industry and research. As of the submission time, more than eighty thousand articles are contributing different opinions and ideas on these topics, among which more than four thousand are on business management in the database of Scopus. With the characteristics of traceability, disintermediation and immutability, blockchain is commonly utilized to effectively register, authenticate and validate assets (including digital assets), transactions, transmission and management [1]. Likewise, 5G empowers massive machine type communications (mMTC), enhanced mobile broadband (eMBB) and ultra-reliability low latency communications (uRLLC), providing a faster, more reliable, and more connected wireless service [2].

Although there is now a certain amount of literature explaining how to apply 5G and blockchain technology, the related studies about the integrated application of 5G and blockchain technologies are relatively in a paucity. The deployment and upliftment of 5G and blockchain are a challenge and how 5G and blockchain can be integrated is a worthy discussion [3]. Though some literature have started this topic, they tended to focus more on how 5G can benefit blockchain and connect with more devices [4]. For example, they may present the features and possibilities of applying 5G and blockchain technology, and highlight the potentials of 5G networks to devices-to-devices (D2D) communications on mitigating some industrial challenges. Yet, they ignore the benefits and values of the other two critical characteristics of 5G technologies including eMBB and URLLC, presenting a relatively limited but not holistic picture to the audiences. Notwithstanding that Tahir and his colleagues (2020) have noticed this problem, they are rather tendentious to interpret the review and application of blockchain technology in 5G networks, broadly discussing the solutions to the general common issues [5]. Additionally, many studies just generally reviewed 5G and blockchain technologies, commonly presenting proposals of the applications in smart city, smart home, healthcare, smart agriculture, autonomous vehicles and supply chain management [6]. Hence, a more informative and detailed study that focuses on one specific industry is needed. On the other hand, too many studies concentrate the discussion on the Internet of Things (IoT), leaving other fields inchoate [4,7,8]. Chen and his colleagues have explored applying 5G and blockchain technology for medical use, in terms of reliable communication and enhanced information security [9]. It is expected that along with the development of 5G and blockchain technology, they will exist more in both traditional and new industries, such as intelligent port, medicine, manufacturing, live streaming, VR and AR, and entertainment. Therefore, a precursor of studies is demanding and necessarily essential.

This paper is an exploratory study. By specifically focusing on the retailing industry, we aim to discover the influence and sig-

nificance of 5G and blockchain technology in this industry. By complemented with the case of Suning Limited, this paper will present how the organization has deployed these two technologies and embedded them in its organization strategy in detail, expectedly filling the blank of the research topic and contributing the managerial implications to the industry practitioners. Therefore, in other words, the research questions of this paper are:

1. What are blockchain and 5G technologies, and their benefits?
2. What are the applications of these two technologies in the current industries?
3. How does Suning apply these two technologies in its operation and solve their operational and managerial issues?

Literature Review

Blockchain Technology

In Nakamoto (2008)'s "Bitcoin: A Peer-to-Peer Electronic Cash System", the definition of 'blockchain' was put forward. A chain of digital signatures is defined as an electronic coin, and blocks consist of data sets that record transactions. They are linked together using cryptography, forming the chain. Three significant technical features are highlighted below:

Technical Features:

1. Hash Function: used to contract data of arbitrary size to fixed-size values. The new values created are irreversible hash values (cannot be calculated back to the original value). In one blockchain, data can be hashed, and the hash values can be incorporated into a transaction stored in the blockchain. Nakamoto cites the Secure Hash Algorithm (SHA)-256 algorithm designed by the United States National Security Agency (NSA) in his blueprint [10].
2. Timestamp: a sequence of characters or encoded information identifying when a particular event occurred. A timestamp server works by taking a hash of a block of items to be timestamped and broadcasting the hash [10]. This securely tracks the creation and modification time of a document. Nobody, including the owner of the document, can change it once it has been recorded, provided that it would require huge computational resources. Every timestamp includes the previous one in its hash, forming a chain.
3. Node: a point of connection in a communication network. According to Swanson [11]. a consensus mechanism was established to maintain a coherent set of facts between multiple participating nodes. Therefore new transactions are not automatically added to the chain but stored in a block for some particular time. In the case of Bitcoin, that interval is 10 minutes, and owners of the nodes are rewarded with Bitcoins for validating the blocks. And Nakamoto [10]. creates an incentive scheme, in which the first transaction in a block rewards a new coin to the owner of the block, e.g. the calculator.

The use of blockchain in the supply chain is considered valuable. Continuous real-time tracking of data is facilitated through smart contracts across the supply chain, ensuring the capability to monitor events and data associated with a product [12]. point out, in the textile and clothing industry, retailers can trace all the subsequent transactions on the blockchain by accessing the shared ledger entries and validating the authenticity of the cotton in the organic product. Another similar example is in the food industry, as Aung et al. stated, where retailers are required to have a faster response to customers to deal with food scandals and incidents [13]. High-quality traceability systems help minimise the production and distribution of unsafe or poor-quality products, thereby minimising the potential for bad publicity, liability, and recalls. Unlike the current food labelling system, which has room for falsification, a system with traceability and security can guarantee that the food is authentic, good quality and safe, to consolidate consumer confidence in quality assurance. Three pervasive benefits are highlighted below:

Traceability

Blockchain creates an everlasting means of record, which can provide a complete audit trail of data. All transactions have been publicly announced, and participants have agreed on the transactions due to the open-source and transparent feature of the blockchain system.

Disintermediation

Blockchain enables peer-to-peer interactions which can be trusted based on the digital signatures, improving transactional efficiency. When it comes to privacy, there is no trusted third-party limiting access to information to the parties involved. However, privacy can still be maintained by hiding public keys. The public can see that someone is sending an amount to someone else without information linking the transaction to anyone.

Immutability (Security)

All blockchain transactions are timestamped and tamper- proof, providing a single source of data integrity. Moreover, the timestamping scheme enables nobody, including the owner of the document, to change it once it has been recorded, provided that it would require huge computational resources.

According to Deloitte, regarding the application in the financing, it is still difficult for SMEs (Micro, Small & Medium Enterprises) to obtain loans from banks due to problems such as poor creditworthiness levels [14]. Real trading relationships between counterparties in the real economy are the basis for banks to provide financing services to upstream and downstream enterprises in the industry. However, in actual operation, data problems such as falsified trade contracts and defective ownership of pledged items pose great risks to financial institutions. If the authenticity of transaction data cannot be guaranteed and the credit risk of enterprises is difficult to assess, financial institutions are reluctant to provide loans due to risk considerations. The inability to pass on trust is another pain point in the development of traditional supply chain finance. Due to the opaque information of the whole supply chain, it is difficult to establish a credit system covering the whole supply chain, and supply chain finance can usually only serve the direct upstream and downstream of the core enterprises. Small and micro- enterprises at the end of the supply chain strip lack credit endorsement and find it difficult to self-certify. Blockchain finance is an important solution to help enterprises in a disadvantaged position solve their financing problems. The blockchain-based solution can establish a con-

sortium chain covering upstream and downstream supply chain enterprises, finance companies, financial institutions, banks and other trade finance participants, digitising assets such as accounts receivable, bills and warehouse receipts, reducing the risk of bill forgery and enhancing the credibility of trade data on the one hand, and forming detachable assets to realise trust flow and empower multi-level penetrating supplier financing on the other.

In addition, Blockchain could help fashion giants in monitoring the supply chain of goods for establishing a better foundation of trust for customers due to its distinct features. Counterfeiting has been a main problem of the fashion industry. According to Ghost Data, about 20 per cent of fashion products advertised on social media platforms are fake. And according to Statista, the fashion industry lost more than $50 billion in 2020 due to the sale of fake products [15]. Yet, blockchain can ensure that customers know where the fashion products come from. The use of unique identifiers for verifying the originality of goods is a promising benefit of traceability. The unique identifier can help find out where the product has been in its journey through the value chain. As Rascouet reports, Louis Vuitton, Prada and Cartier are joining forces to offer a blockchain solution for their customers seeking an extra seal of authenticity for the goods they're buying [16].

Limitations of Blockchain

Technical Risks: Blockchain technology is still under development, and some of the technical vulnerabilities bring risks of security and performance. Firstly, the interoperability of information and assets between different chains is low, bringing risks of usability, security and scalability across different chains; secondly, the security of private key management is a prerequisite for blockchain password security However, once the private key is lost, the account cannot be accessed anymore, resulting in irreparable losses; finally, the blockchain is exposed to the risk of network attacks [17]. In particular, a smart contract will be automatically executed to the end, making it "wrong to the end" when it is hacked.

Regulatory risks: Regulatory requirements associated with blockchain applications vary globally, and blockchain applications often involve transnational entities. In addition, legal issues are involved in smart contracts. Any minor coding error in a smart contract may result in the law being unable to determine who should bear responsibility. Therefore, dispute resolution should be clarified in advance when developing smart contracts [18].

Commercialisation risks: Blockchain technology impacts the current business processes, and brings it at risk at the same time: companies need to update their existing systems to adapt to the new business processes, and there are risks in the system interface between the new technology industry and the original system; As most of the technology comes from external suppliers, companies may be exposed to significant third-party risks; If blockchain technology is not applied properly, it can also lead to a degraded customer experience.

Expected Development & Integration With Other Advanced Technologies

Consortium Blockchain: Blockchains are difficult to simultaneously meet three characteristics of efficiency, decentralisation and security, but often sacrificing one to meet the needs of the other two. On this basis, blockchains can be divided into the public, consortium and private chains. As enterprises are more concerned about the performance, security, privacy protection, regulatory compliance and other elements of a blockchain and can compromise with decentralised performance to a certain extent, the adoption of a consortium chain will be the mainstream direction for future enterprise-level blockchain applications. Consortium chains have strong management deployment and are more dominant. In a consortium chain, only specific, licensed members can participate in bookkeeping authority and maintenance governance, which verifies the identity of participants from the source, enhances mutual trust and ensures blockchain security [19]. In terms of trustworthiness, it is more credible than private chains as industries can regulate each other. Transactions on a consortium chain only need to be verified by a few trusted nodes and do not require network-wide confirmation, which is cheaper compared to public chain transactions and ensures low latency and high efficiency. In industries such as supply chain management and supply chain finance, the dominant role of core enterprises is obvious, and the chain owners are reluctant to disclose some upstream and downstream information. Therefore it is more likely to form a consortium blockchain dominated by one chain owner (although the nodes are equal in the blockchain) with a relatively high degree of centralisation. In the future, multiple consortium blockchains led by different chain owners will likely co-exist in the same industry.

Blockchain is essentially the underlying protocol that provides trust for society. It needs to combine with other emerging technologies such as IoT, big data, artificial intelligence and cloud computing to unleash business value. For example, the integration between blockchain and IoT technology helps ensure industry chain visibility. In scenarios such as product traceability and supply chain management, it is necessary to rely on IoT technology to integrate real-time transmission of information and relevant data from the whole chain of activities using various sensors. Blockchain, on the other hand, provides a secure environment for the IoT. The simultaneous presence of both ensures timely and comprehensive monitoring of the state of the industry chain system.

Blockchain + big data release data value: On the one hand, blockchain technology solves the problem of privacy security and data untrustworthiness in data collection. At the same time, big data analysis fully exploits data value under the condition of ensuring privacy security. For example, based on logistics blockchain, it can further rely on big data capability to develop logistics finance and insurance products.

Blockchain + artificial intelligence enhances automation of business processing: Artificial intelligence has great potential to automate business relationships, such as smart contracts. By incorporating technologies such as machine learning into smart contracts and automatically optimising and iterating on the algorithm models in smart contracts, smart contracts will become

"smarter" and further improve the efficiency and accuracy of automated processing in areas such as automatic reconciliation.

Blockchain + cloud computing reduces the cost of blockchain deployment: Using the existing infrastructure of cloud computing can accelerate the blockchain development application process. In recent years, Microsoft, Amazon, BATJ and other Internet giants have launched blockchain as a Service (BaaS), which is deployed in the cloud and can be applied to scenarios such as supply chain finance and supply chain management, greatly reducing the deployment costs of enterprises. It is expected that Blockchain + Cloud-based BaaS services will be an important mode of Blockchain deployment in the future.

5G Technology

5G technology is developed based on the cellular networks which are multitudes of relay nodes that connect cellular devices to their associated base station, extendable to improve the cellular coverage and capacity [20]. The connection enables cell phones to transmit data to and from other end nodes, such as the Internet and other cellphones. As the popularity of cellular devices grew, cellular networks have become more than means of making phone calls [21]. Cellular networks are being used for primary communication in both personal use and business use. Liu et al. refer to cellular networks as high speed and capacity communication structures that augment the roaming capabilities of portable devices [21]. A new generation of the cellular network is described as an upgrade on the network specifications. The network specifications generally include the technology implemented, its frequency, bandwidth, access system and the core network; they bring significant improvements to the data transmission speed.

The implementation of the millimetre waves in 5G was a solution to the cramming problem by transmitting data on a new range of unused radio spectrums [22]. A problem the cellular network had faced was that data transmissions via the networks were spiking due to the increasing number of devices connecting to them. It was problematic and detrimental because all data transmissions were done within the same range of the radio spectrum, which causes cellular services to slow and destabilise. While some network providers operate 5G at frequencies of around 30 GHz, millimetre-wave (mmWave) is a spectrum of high-frequency radio waves ranging from 30 GHz to 300 GHz, and their waves measure from 1 to 10 mm in length [23, 24]. The mmWaves were utilised for satellites and radars before 5G, and using them to connect mobile devices with nearby base stations was cutting edge.

Utilising millimetre waves on an existing cellular network setup would be impractical and would pose more obstacles than benefits. Hence, an optimised hardware setup should be developed to enable the envisioned ultrafast 5G implementation.suggest that some of the key enablers for 5G work, include small cell networks, full-duplex technology, massive MIMO and beamforming [25].

Small Cell Networks

Millimetre waves are known for their short travel distance and cannot travel through obstacles easily [22,25]. Small cell networks could compensate for the short travel distance. Small cells themselves are compact, low power base stations that deliver high speed and low latency connection and can be placed every 100 metres to prevent mmWave signals from disconnecting within a small geographical location.

Full-Duplex

With the full-duplex implementation in 5G, antennas would be able to send and receive simultaneously on the same frequency, doubling the capacity of each antenna. A full-duplex device would be able to separate incoming and outgoing signals to avoid signal crossing.

Massive MIMO

Multiple-input multiple-output (MIMO) refers to a system that enables simultaneous data sending and receiving [22,26]. At the moment, 4G base stations have around 10 antennas for separate sending and receiving. Since full-duplex antennas could both send and receive simultaneously, 5G base stations could connect a lot more mobile devices at the same time. Massive MIMO refers to the simultaneous transmission between base stations and devices, and the interference could be minimised with beamforming.

Beamforming

Frequencies could cross and interfere with each other as the number of small cell base stations increases. Beamforming optimises the usage of massive MIMO in two facets. One, base stations plot the shortest distances to each mobile device through mass-sending data packets to reduce interference from nearby devices. Two, beamforming strengthens 5G signals and reduces interference by focusing signals unidirectionally rather than omnidirectionally.

Benefits of 5G

Some of the most significant differences between 5G and previous generations of cellular network technology would be the speed, peak capacity and latency [27]. Agiwal et al. [28]. expects that the energy consumption of the network technology would be reduced by close to 90%, which could connect up to 1000 times more devices per kilometre squared.

Speed

The 5G technology adopts a wider and higher spectrum of radiofrequency. To wireless connections, higher frequencies induce better transmission speed. In terms of speed (or bandwidth), 5G is expected to be as high as 100 times faster than 4G, going from 1Gb/s to 100 Gb/s maximum. 5G could very well begin its base measurement unit at Gb/s while 4G only roams within the Mb/s range. Duffy visualises that downloading a two-hour long movie on 4G could take up to 7 minutes while taking under 10 seconds on 5G [27].

Peak Capacity

5G is expected to offer better capacity at peak level than 4G, allowing better connection with more devices. Too many devices connecting to a few base stations within a small geographical area could cause slowing due to the 4G infrastructure, but the issue could be solved with 5G. While both support wireless con-

nection, 5G differ in utilising massive MIMO whereas 4G only supports MIMO [29]. Combining massive MIMO and beamforming, 5G signals can be sent unidirectionally towards many connected devices within the same frequency. The higher bandwidth in 5G enables more eligible devices to connect for more extended periods within an area when compared to 4G [28].
Latency

Although speed and latency are similar, they are different. Speed is the eclipsed time of a device downloading certain contents; latency is the eclipsed time between a device sending and another device registering (Duffy, 2020). 5G is projected to offer ten times less latency than 4G, going at 1 ms round-trip time [27]. Milliseconds of latency may not look impressive on small-scale transmissions. However, milliseconds count when you are transmitting and receiving huge amounts of data. This promises close to real-time data communication, enabling innovations such as cloud gaming and other massive machine type communication.

Expected 5G Applications in Industries

Considering the above-mentioned benefits, 5G is expected to enable the industry from two main categories of application: Enhanced Mobile Broadband (eMBB) and Ultra-Reliable Low-Latency Communication (URLLC).

The eMBB could fast track use cases that are reliant on 5G URLLC, such as live streaming, cloud computing and much more entertainment use cases. In the entertainment industry, the 5G network could promote reliable content access from home and office. The URLLC capability would be able to deliver high-quality, immersive content to the consumers in real- time, such as 4K to 8K streaming and cloud gaming. In business, companies could store and access a massive amount of data in the cloud via URLLC 5G. This reduces the need for expensive local data warehouses where companies could simply access a remote data warehouse locally without latency. Aside from cloud usage, 5G could revolutionise local data connectivity as well. Traditionally, office computers would require a cable connection to the network. But with 5G implemented, office computers could connect via 5G with high bandwidth, reliability and low latency. Wiring and installations could very well be a thing in the past.

The URLLC could help the manufacturers in mass-adopting machine automation. Nowadays, manufacturing companies are slowly replacing human labour with machines in production plants to improve precision and productivity. Industry 4.0 envisions smart machines to communicate and share information without human control [30]. As 5G offers a latency of 1 millisecond, most machines within a smart factory can now communicate in virtually real-time. It could improve the efficiency, productivity and precision of factories. Coupling with IoT (machines with sensors and processing ability), connected machines would predict and react to problems in real-time, improving the overall production quality and reducing production downtime.

URLLC could also help automate transportation and delivery systems. It could offer secure and reliable real-time connections within a high density of devices for analytical purposes. For deliveries, drone implementation has been a primary focus for many e-commerce businesses. Take Amazon as an example. Amazon has implemented drones in both their last-mile deliveries and warehouses. Many companies like Vodafone and Ericsson have successfully implemented 5G into drone technology [31]. 5G could help create safer drone airspace. When drone technology gets implemented widely, there will be a need for a reliable safety control system. As mentioned in previous sections, 5G offers high speed, low latency, mass connections and low-power consumption. 5G networks could enable a massive number of 5G drones to communicate with warehouses without latency at low power consumption, travelling further and safer.

Table 1: shows a short comparison between 3G, 4G & 5G

	3G	4G	5G
Frequency	1.6 – 2 GHz	2 – 8 GHz	3-30 GHz
Bandwidth	Up to 3 MB/s	100 MB/s – 1	10 – 100 GB/s
Avg Data Rate	2 MB/s	40 – 50 MB/s	50 – 400 MB/s
Core Network	Packet Internet	Internet	Internet
Technologies	WCDMA, CDMA-2000	LTE, WiMax Half-duplex MIMO Base Stations	Full duplex Massive MIMO Beamforming Small Cells

An increasing number of motorist companies are releasing smart vehicles that support autopiloting. The onboard computer systems are improving rapidly to accommodate the increasing data processing demand. Although Tesla has mentioned that 5G was not their main focus in self-driving vehicles, 5G is still a key enabler for many other autonomous vehicles. 5G could enhance the safety and reliability of autonomous vehicles. First, 5G networks could enable network-connected vehicles to respond up to 100 times faster when compared to current technology. Second, autonomous vehicles with 5G capabilities could achieve true vehicle-to- everything (V2X) communication. As IoT sensors are still imperfect, vehicles must communicate with each other and roadside objects to enhance road safety. Vehicles could then respond to changes on the road to avoid collisions in real-time.

Limitations of 5G

Technological Exclusion: 5G is a new technology, and most of the communicative devices and infrastructures in the world are currently incompatible with it. Transitioning to 5G would require a demand for it, which means a huge number of devices have to be able to support it. However, statistics suggest that around 15% of the population is expected to be covered by 5G [32]. Most current technologies cannot support 5G, it is unlikely that 5G will be immediately accessible to the public. Aside from

devices, 5G still requires proper infrastructure to support its implementation. As Chataut & Akl [25]. have mentioned, 5G signals would require small cell networks that support full-duplex technology, massive MIMO, beamforming and other enablers. For 5G to be widely implemented, a huge financial investment is needed to upgrade the current infrastructure. Local governments and businesses may have to cover high costs in adapting, especially in developing countries, which could hinder 5G expansion.

Cybersecurity Concerns: Even though 5G offers promising commercial and public usage, the technological enablers for 5G could still bring security concerns to data management. When compared to 4G, 5G has more points-of-contact for data transmissions, and more points-of- contact means routing points to gatekeep. More routing points could lead to security compromising in less guarded areas. This means the data could be compromised when a device is roaming near an unguarded end node. 5G encourages IoT, but many IoT devices are not built with cybersecurity in mind. A lack of encryption and encryption-capable devices could enable hackers to access data inside each sensor. Sensitive data could include smart device models and operating systems, which would lead to device-specific IoT cyber-attacks. While the URLLC feature could benefit service providers to monitor data traffic in real-time and stop any suspicious activities, it could also mean a faster extraction of data to the hackers. This is proving 5G data security difficult.

How Does Blockchain and 5g Tech. help each other?

5G can significantly improve the performance of the blockchain in terms of data synchronisation and transmission efficiency and network communication effectiveness. Introduced and standardised by the ETSI Industry Specification Group (ISG) in December 2014, the mobile edge computing (MEC) technology can well combine with 5G technology to not only enhance user experiences with high bandwidth, low latency and real-time communications, but also reduce delay and shorten the response time, improve data transmission in blockchain networks. This technology reduces delay and response time in decision-making computation using the edge node as local server infrastructure.

Additionally, when it comes to blockchain-related online collaborative platforms, their network architecture was composed of 5G with three layers. The first perception tracks device positioning and uses radio frequency identification (RFID), sensors, and fingerprint identification; The data processing layer provides distributed processing capability to collect and boost data processing; The edge cloud subsystem layer shares the task with core cloud computing resources and effectively improves cloud responsiveness. Finally, the data is uploaded to the blockchain platform. All the data collected in real-time can be transferred to the blockchain network for further processing. In addition, the emergence of 5G can increase the stability and capability of blockchain networks, bringing a wide coverage of network supply and stable licensed frequency bands. Developing a high-speed 5G communication blockchain will benefit in regular tracking, traceability and distributed P2P transactions for trillions of goods worldwide. In other words, with 5G the blockchain is more capable of handling a large number of transactions of data at a time, which is relatively critical in the financial sectors.

On the other hand, though 5G network can outperform earlier versions of wireless communication technology in providing diverse service abilities and encouraging full networking among countries globally, some security risks in 5G network should be taken into account [33]. For example, the emerging edge computing based on centralised service providers (i.e. Amazon cloud) reveals various security bottlenecks (Nguyen, Pathirana, Ding & Seneviratne, 2020). Instead, this kind of network has a higher chance of single-point failures, which bring threats to the availability of services. The integration of blockchain can protect the data transfer of the network. Blockchain brings the capability of storing and managing 5G data through its secure distributed ledger. A few features in blockchain enhance security, such as immutability, decentralisation, transparency, and privacy.

Case Study of Suning Holdings Group

Suning Holdings Group (hereafter Suning) is the second-largest civilian-run enterprise in Mainland China in 2020, founded by Zhang Jindong in 1990 [4]. The subsidiaries of Suning include Suning Rundong, Suning Culture Investment Management Co., Ltd., Suning Jinkong Co., Ltd., Suning Sports Co., Ltd., and Inter Milan, which was acquired in June 2016 cardinally covering e-commerce and retail, financial investment management, real estate and sports industries. With more than 300 thousand employees, Suning's revenue has reached US$104.446 billion (RMB 665.295 billion) in 2020, being the top player in the Internet retailing category [34].

Blockchain technology has been embedded in the blueprint of Suning's strategy development at the early beginning. Since 2017, Suning has gradually introduced its blockchain domestic letter of the credit transmission system, blockchain financial blacklist data service system, blockchain + Internet of Things (IoT) movable property pledge financing system platform, blockchain forfaiting systems, blockchain product traceability system, and blockchain asset securitisation service system into a different branch of businesses [35]. The first official documentation was Suning blockchain white paper published in July 2018, depicting the future organisational plan and development path about the adoption of blockchain technology in different business sectors of the organisation and the expected outcomes from retail, logistics, technology, finance, and even cultural and creative industries [36,37]. Meanwhile, Suning has undertaken the promulgation role of blockchain technology to improve the industry efficiency and close the connection between the participants in the related network via the first Suning's Blockchain as a Service (BaaS) cloud infrastructure platform. Such a platform is supposedly beneficial to developers and users with an established blockchain ecological environment and strong support services for creating and managing blockchain applications [38].

Additionally, in August 2020, Suning published a white-paper of 5G application in the retailing

industry with Nielson, introducing the opportunities brought over by 5G technology, the expectations and recognition from

the public to such technology, recommending its application in smart retailing in 5 perspectives, and sharing the case conducted by Suning. The president of Suning pinpointed the current consensus that 5G technology is the infrastructure that itself may not be too evolutionary but it brings the evolution and transformational benefits to us via facilitating the development and introduction of other technologies, such as the Internet of Things, AI, big data, facial recognition, AR and VR, communication, cloud computation and so on. Currently, Suning is embedding the 5G technology in its strategic layout from 5 perspectives: new product, new service, new experience, a new scenario, new mode. In specific, the characteristics of low latency, high bandwidth and high stability empowers the development of the smart home ecology [39]. Suning has been focusing on the application combining IoT and artificial intelligence, such as smart speakers, smart cameras, smart lockers, smart water purifiers, smart kitchen waste processors and smart washing machines. Suning also launched its smart retail restore, which integrates the technologies of facial recognition and bid data-driven customer management systems to rebuild the shopping experience. Intelligent logistics is another core area in Suning's 5G strategic layout, such that unmanned car and unmanned delivery are expected to strengthen the management, standardisation, and predictability of delivery processes and behaviours.

Applications of Blockchain

Along with the incremental raise volume of data, development of the Internet, Internet of Things, big data and artificial intelligence, the chairman of Suning, Mr Zhang, has precociously realised the need and possible actualisation of blockchain technology to customer diversification and personalisation, advocating the importance of drawing user portraits and smart supply chain and smart logistics to facilitate the core business of retailing [40].

Retailing Industry + User Portrait

When users and clients pay more and more attention to the privacy issue, collecting and using the data under deliberate and effective management by the organisation itself is much more critical. Blockchain technology helps to obtain consumer preference data and build user portraits under the protection of privacy and security from two perspectives [41] .

1. With the feature of immutability and the algorithm of delegated proof of stake, customers are more confident and willing to share sensitive data and non-private data, such as their shopping behaviours, to form user portraits [42].
2. The principle of a smart contract defining the generation, storage, sharing, and exchange of data now provides the manipulation rights with the customers themselves to avoid data disabuse and uninformed leakage [43]. It can protect the interests of both organisations and clients.

Smart Logistics

Suning has preemptively deployed the international online blockchain commodity traceability and anti-counterfeiting system in August 2018, by which all users can benefit from its distributed ledger technology in terms of easily gleaning the trustful information about a product, including its production, processing, transportation, circulation, retail and other links of the product [44]. One noteworthy characteristic of this system is its flexibility of integration in linking all industrial chains in a simple form of nodes. Take the cooperation with Suzhou Yangcheng Lake Hairy Crab Industry Association as an example; this system helps to verify the track production, processing, specification, and quality of hairy crabs from the beginning point of source and prohibit the possibility of goods replacement [45]. More importantly, the contribution of the blockchain traceability system is it empowers all members to share, collect and integrate trustful data with others. Thus, the supply chain network now can better actualise the dynamic matching of supply and demand, optimise the resources allocation and coordination between upper and downward members [46].

Smart Financing

It is noticed that a blacklist is a list of individuals or legal persons with severe negative credit behaviours in their credit records. The current problem is that the blacklist is usually stored in various lending financial institutions, credit card agencies, and corporate credit reporting agencies [47]. Since the blacklists of most institutions are not open to the public, users with credit problems can easily borrow from different institutions without being discovered in time, thus causing unavoidable losses to financial institutions. Besides, only some private institutions collect, integrate and sell at a high price currently. This centralised sharing method has led to high-risk control costs for financial institutions and delayed data updates. The security of data also relies heavily on the security protection measures of centralised operating agencies. Thus, Suning took the lead in using blockchain technology to realise a decentralised data sharing and storage solution in the industry [48]:

1. Participants in the blacklist sharing form a blockchain alliance, and the blacklist information is only shared within the alliance to resolve information disclosure.
2. Within the blockchain alliance, participants independently deploy nodes to connect to the blockchain network, store relevant blacklist information locally and share it with other nodes in the network through smart contracts to solve the problem of information insularity.
3. When the participants share the blacklist data, the one-time encryption technology is adopted to realise an anonymous and secure data sharing mode, protect users' privacy and business secrets, and solve the security and privacy issues of information sharing [49].

Through the above solutions, the Suning blockchain blacklist sharing platform provides a new effective solution to the key issues of non-disclosure, non-centralisation and high acquisition costs of data obtained from the blacklist, providing financial users and financial institutions with a new capability to reduce the high risk of data sharing.

In addition, Suning concurrently focuses on another three scenarios of the blockchain technology's applications in supply chain and trade finance, including (1) inventory pledge/warehouse financing (obtaining funds from a bank or financial institution by using the inventory as collateral with a certain value), (2) account payable (providing funds for procurement or directed payment where enterprise's line of credit is according to the upstream and downstream orders), and finally (3) establishing

domestic letter of credit alliance at bank- level [50]. By taking funder, asset side and special purpose vehicle (SPV) as the nodes in such alliance chain, authorising the sharing books with the private key to striking a balance between protecting related parties' confidential information and jointly safeguarding the data transparency and authenticity is no longer unachievable. For instance, Suning's blockchain asset securitisation service system can ensure the immutability and Traceability of the asset data in financial enterprises and reduce the threshold and issuance cost of assets backed securitisation [37].

Ip Asset Protection In The Sports Industry

The existing issues in the sports industry subsume
1) the lack of identity recognition mechanism and incentive mechanism, inability to effectively identify the value brought by the production and dissemination of information content; 2) the lack of means to display, price and estimate the IP assets in the connection among fans, producer of IP and investors [51] . Therefore, blockchain technology can be applied for:

1. Combining the smart contract and token system from blockchain technology to provide developers with a set of convenient payment settlement and application development interface protocols so that partners in the ecosystem can use sports information and the community to quickly acquire users.
2. Realising value transfer by developing related platforms for IP asset trading, promotion, and competing guessing lottery.

The characteristics of trust consensus, immutability and privacy protection of blockchain technology will effectively ensure the authentication of user identity [52]. It is also exploring and mining the potential of value flow in the process from content consumers to content producers and disseminators in the community. Additionally, it can significantly ensure and maintain high-quality content in the community via formulating an effective incentive mechanism to enable users to participate in various activities to be rewarded in the form of virtual currency. Thus, it can improve the participation and liquidity in the entire community ecology. Blockchain technology not only makes the transaction of copyright assets more flexible and transparent but also reduces transaction costs and the risk of mistrust. It eventually can make the commercial value of IP assets liquid and independent (of brokers, commercial teams, and guarantee agents) [53].

Adoption Of 5g Technology

Suning's C2M Platform

Customer to Manufactory (C2M) is the new business model proposed in these years, which advocates the eradication of middlemen and agents that customers can directly communicate and make orders with the manufacturer as well as the balance between affordability and customisation [54]. Suning is developing a C2M industrial internet platform with 5G technology and more powerful smart sensors to achieve the higher resolution of video, more agile artificial intelligence, much quicker computational analysis capability, and more obtainment to the real-time data of product, environment and customers [55]. After the analysis, the C2M platform will automatically send the feedback to the manufactory, sharply reducing the communication time and helping the manufactory satisfy customers' demands. On the other hand, customers can learn the original information of the product from the perspective of design to production.

At present, the Suning C2M platform uses mathematical statistics, machine learning and the latest artificial intelligence algorithm to realise clustering, association and prediction analysis for historical data, real-time data and time-series data [55]. Combining professional knowledge such as machinery, electronics, physics, and chemistry with the practical experience of industrial production, the C2M platform can build various models and achieve analytical applications. In addition, regarding the IaaS (infrastructure as a Service) structure in the C2M platform, the 5G technology is conducive to increasing the ability in virtualisation, distributed storage, parallel computing and load scheduling, supposedly to optimise the pooling management of network, computation, and storage computing resources. The improved computing speed brought by 5G can either improve data redundancy elimination, anomaly detection and normalisation to quickly clean original data and provide high-quality data sources for subsequent storage, management and analysis [56]. Through different data management engines such as distributed file systems, NoSQL databases, relational databases, and sequential databases, massive industrial data can be partitioned, stored, catalogued, and indexed. In other words, the 5G technology empowers the C2M platform to more quickly and accurately communicate with upstream manufacturers and downstream consumers.

Smart Retailing

Suning's Style Wall was firstly introduced in the International Consumer Electronics Show 2019, Suning's Style Wall is an offline intelligent AR (Augmented Reality) fitting technology solution. It is supported by Kinect motion-sensing hardware in 3D clothing processing and rendering and the user image processing AI to help the customers look over and try on the most fashionable new products comfortably and conveniently. Besides, with 5G, the facial recognition system can recognise and categorise the customers if they are new or loyal customers. With the smart camera, Suning can better capture customers' consumption behaviours and preference, their perceptions and knowledge about the products, thus, creating a more accurate user portrait in analysing users' consumption demands and goals as well as providing a more tailor-made recommendation [55].

Smart Supply Chain

The 5G technology provides a powerful wireless network for the current supply chain station to better deploy automatic storage and retrieval system (AS/RS), automatic mini-load system, supply chain suite (SCS) system, unmanned forklift trucks and automatic guided vehicle (AVG) system [55]. For example, 5G provides cloud computing capability for AVG systems so that vehicles no longer need to configure the minicomputer, and unmanned forklift trucks can be operated and inspected in remote locations by vision technology. Thus Suning can dramatically decrease the related cost and achieve economies of scale effect.

Prospect: Blockchain + 5g Application

In finance

Suning's blockchain + Internet of Things movable property pledge system financing platform with the unique characteristic of amalgamating the entity flow, information flow and capital flow, was developed by Suning to check the real-time warehouse records of bulk goods and support the development of moveable property pledge financing and other business via the platform [57]. In particular, such a system can solve some current knotty issues in the industry, such as determining and validating the claims of receivable accounts and receivable orders, preventing some SMEs from making false order contracts or creditor claims, and declining the duplicate financing risk.

In Retailing

the characteristics of 5G technology, including low latency, high bandwidth and high stability are expectedly empowering retailers to actualize smart retailing stores by deploying various smart sensors and real-time cloud computing. Meanwhile, blockchain technology can be integrated into the management system for customers' privacy. In specific, blockchain has the delegated proof of stake algorithm and smart contract to ensure the immutability feature and provide customers with rights to manage their data. Thus, it can avoid the problems of data disabuse and uninformed leakage, increasing customers' confidence and trust in the organisation. Now, the data collection process and requests are becoming more transparent and communicable to customers before they enter the store every time, to increase their trust and alacrity to share data [3].

In the Internet of Things (IoT)

with the advancement of network technology, IoT was a new trend in recent years, and the growth will continue together with 5G development. The 5G network can provide a great decrease in network latency which is beneficial to the communication of devices. According to research, there are about 13.8 billion interconnected IoT devices globally, predictably the amount of IoT devices will be double in 2025 [58]. It is worth noting that the IoT devices are more instrumented with open data such as locations, personal and financial information. Most of these challenges can be solved by integrating blockchain technology with 5G enabled IoT [8]. Therefore, it is deemed as a necessity to defend against hackers to get that data if we do not have other better options. In particular, 5G-enabled IoT can use blockchain to provide a data transaction more securely, identify the authenticity of different devices to prevent fake devices from invading the network. More importantly, the security mechanism of blockchain can prevent the single point failure of the whole system due to the decentralisation feature of blockchain.

In the industrial Internet

with the development of 5G technology and IoT, the volume of data is exponentially increasing, without a doubt. Being the centre for massive data collection, convergence and analysis, the industrial Internet is the cloud platform supporting the ubiquitous connection and efficient allocation based on the elastic supply and demand. Some tasks that are originally processed on the cloud can be replaced by utilising the smart contract technology from blockchain to establish the nodes in the network through an intelligent contract based on a consensus algorithm, thus reducing the bandwidth pressure from nodes to the cloud and the complexity of computing and storage control in the cloud [59]. More importantly, with the Interplanetary File System (IPFS) technology, we can store important files more safely by dispersing and encrypting files in different nodes so as to reduce the risk of leaking key files when nodes are compromised.

In logistics

use blockchain storage solutions to combine with data and the Internet of things, 5G-enabled vehicles can automatically optimise the transportation routes and schedules of goods, manage and dispatch logistics vehicles, reduce the investment of enterprises in manual scheduling, and increase the efficiency of logistics system operations. While 5G and IoT can smoothen the communication and cooperation network in the supply chain such that the analysis process can be implemented on the cloud and the related record tasks can be automatically handled by smart sensors, blockchain can be integrated into the supervision process from the supplier to the final delivery to the user, improving the service efficiency and quality, as well as ensuring the validity and immutability of the traceability function (records) [60]. In specific, with the distributed ledger technology in blockchain, we can track the status of delivery if it is either in transit or delivery; keep the valid record and documentation of the trading and transaction details; ensure the inherency of goods from outbound to inbound; better manage the life cycle of the logistics team, and strengthen the service of logistics personnel [61].

Conclusion

While the current literature either generally review the opportunities and challenges of 5G and blockchain application or overly focus on massive devices connection and speed for IoT development, this exploratory study fills the blank of the literature by proposing a new perspective on retailing, describing how Suning, a Chinese firm, deployed and embedded these two technologies in its organizational strategy and solve the operational and managerial issues. This paper expectedly makes contributions regarding creating a new perspective for the following technology application research which should strike a good balance between theoretical and practical implications. To have a cross-sectional comparison and contrast, the future study is recommended to select organizations from multiple industries. Meanwhile, a longitudinal study is also recommended to have a deeper understanding of how these applications can affect the organization in the long run.

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