1. Introduction
Since Nakamoto introduced a peer-to-peer electronic cash system to the world, the blockchain technology gained increasing interest among industries. So it is with the logistics industry. Compared to the study on the blockchain application to other industries, the study on blockchain to port and shipping field in China is still limited. China’s shipping industry has been long facing the problems like too much paper documents, long industrial chain, long transportation time, complex ecological chain (Shen, 2018). It was believed that blockchain can improve the communication between shipping agent and carrier and freight forwarder in the shipping field (Xu, 2016). Furthermore, the operating efficiency can also be improved, thus reducing management cost and increasing competitiveness (Tang, 2019). Empowered by smart contract, blockchain made it possible to build a decentralized supply chain system in which all participants worked together with mutual trust. All the transactions were recorded and updated accordingly. And other participants could also reach such information, enhancing the flexibility of supply chain governance (Weber, Xu & Riveret, 2016). Blockchain technology protected the product information from abused, thus reducing the cost in product tracing (Toyoda, Mathiopoulos & Ssase, 2017). Under “the Belt and Road” initiative, Chinese scholars studied the applicability of blockchain technology in logistics service, and pointed out that it had the theoretical applicability; however, a successful application requires for government’s support, a well-built platform and a great number of talents (Wang & Liu, 2018), as well as the support and help from AI, 5G, IOT and chips etc (Xiang & Wang, 2019).

In recent years, blockchain technology has aroused great interest in logistics industry. The following examples shows the current application of blockchain technology in logistics industry. In 2016, Maersk, an integrated logistics company, initiated a study to optimize the document process, cooperated with Copenhagen IT University. In the same year, Maersk worked together with IBM and Schneider Electric to explore the application of blockchain in tracing products. In 2018, Maersk and IBM established a DLT platform, greatly improving the blockchain application for the supply chain that...
involved port, customs and bank. In 2018, American President Line, one of the world’s leading ocean carriers and part of the CMA CGM Group, managed to test the blockchain solution in tracing products in collaboration with Ab Inbev, Accenture, DXC and European customs.

In Asia, since 2016, Fresh-Turf, a Singapore company aiming at solving logistics problems, has started its collaboration with IBM Garage team to build the first prototype of decentralized network of storage lockers, powered by blockchain. Singapore’s Pacific International Lines and Port of Singapore Authority sign an MOU with IBM to promote blockchain technology in the supply chain business network. In August 2017, leading enterprises in shipping industry announced their moves with blockchain. Fourteen enterprises in Japan, including Mitsui OSK, Nippon Yusen Kaisha and Kawasaki Kisen Kaisha, jointly created a trading data sharing platform based on blockchain technology. Jingdong.com(JD), which is China’s largest e-commerce company by revenue and a member of the Fortune Global 500, has core businesses in retail, digital technology and logistics. In 2018, JD called for companies and partners who were interested in joining its blockchain platform for tracing products. In one year, more than 400 brands have registered, covering over 12000 types of commodities and contributing more than one billion pieces of product tracing data.

In conclusion, blockchain has made achievements in academic research as well as in the application in logistics and shipping industries. However, at present, there is no case study on the implementation plan of blockchain technology in specific port. This paper is an example analysis on how Hainan FTZ applies blockchain technology.

2. Current Situation of IT Application in Hainan FTZ’s Ports

2.1. About Hainan FTZ
Hainan island is a part of Hainan Province, the southernmost province in China. Backed by the mainland and facing the Pacific Ocean, Hainan Island has a great location to connect China with southeast Asia and other regions. It is also China’s biggest tropical island, with an area of 34,000 square kilometers and a population of 8 million. In China, Hainan Island is known by its richness in natural resources and its eco-friendly living environment. Nevertheless, for the past decades, the GDP generated by Hainan has long been in the bottom group. It caught the government and scholars nerves to speed up the economic growth while maintaining the features of Hainan.

To deepen reforms, in April 2018, China announced the transforming of the entire Hainan Island into a pilot free trade zone as well as a free trade port. On Oct 16, 2018, the State Council issued the General Plan for China (Hainan) Free Trade Pilot Zone, introducing a great number of new policies to encourage overseas investment in Hainan FTZ. To accelerate the establishment of an open, ecological and service-oriented industrial system in line with advanced international standards, Hainan FZT is constructing comprehensive logistics parks, bonded zones, bonded ports, and export processing etc., which all crave for technology innovation and application. Nevertheless, the development of hardware and software in Hainan logistics industry is out of sync. Currently, Hainan stays at the phase of building network facilities, while the construction of spatial database and core database lags behind. And the data from different cities and areas are not well collected and connected.

2.2. About the Ports in Hainan FTZ
Hainan Island has experienced a growth in cargo throughput for the past decade as shown in Tab.1. From the charts below, the total cargo throughput of Hainan Island increased by 22% from 2010 to 2012 and then dropped by 14% in 2013. From 2013 to 2017, the total cargo throughput grew with an annual rate of 16% and reached 185 million tons in 2017. The volume of freight handled in Haikou Port, Yangpu Port, Basuo Port and Sanya Port accounted for 99% of the that of Hainan Island. However, a huge gap existed between the total cargo throughput of Haikou and Sanya Port.
Table 1. Volume of freight handled in ports from 2010 to 2017 (10,000 tons)

| Year | Port | Total | Haikou | Sanya | Basuo | Yangpu |
|------|------|-------|--------|-------|-------|--------|
| 2010 |      | 9662  | 5700   | 200   | 893   | 2825   |
| 2011 |      | 10905 | 6549   | 204   | 997   | 3101   |
| 2012 |      | 11792 | 7271   | 215   | 1068  | 3225   |
| 2013 |      | 10130 | 5424   | 140   | 1685  | 2880   |
| 2014 |      | 14164 | 8915   | 226   | 1400  | 3525   |
| 2015 |      | 15356 | 9204   | 402   | 1767  | 3901   |
| 2016 |      | 16390 | 9952   | 595   | 1516  | 4058   |
| 2017 |      | 18473 | 11297  | 667   | 1605  | 4285   |

To make the increasing trend in freight volume keep going, logistics and shipping industry need support from government and from technology. Fortunately, central government is taking actions in reducing redundant work for companies in cross-border trades. For example, nowadays, all the seaports and airports and even the customs special surveillance area in Hainan Island have equipped with the standard version of China International Trade Single Window. "Single window" aims to break through the data barriers of cross-border trade and port management and provides one-stop services for enterprises. It mainly covers the following nine core applications: declaration of goods, declaration of manifest, declaration of means of transport, handling of enterprise qualification, declaration of license, certificate of origin, payment of taxes, export tax refund, inquiry and statistics. In Hainan, more functions were added on to this system, such as duty-free, entry of yachts and cross-border e-commerce.

Moreover, government is encouraging logistics enterprises to co-work with IT companies to build comprehensive systems or to upgrade the existing system. Hainan Big Data Administration offers free consultancy and offer financial support for companies that are willing to develop a information platform managing the flows in labor, goods and capital, with the hope to promote the integration of information and efficiency and serving the industrial upgrade and people’s livelihood.

2.2.1. Haikou Port Hub. Haikou Port is one of the most important hub port of the Belt and Road initiative. Guiding by “one port three districts” development policy, Haikou Port consists of three districts: Xiuying, Macun and Xingang, mainly serving for containers, bulk cargo and passenger cargo, cruise and the transportation of oil and chemical products. Compared to Singapore Port, which can handle thousands of trailers daily with an accuracy of 99.99%, Haikou Port remains poor in the application of IT and performance in accuracy, thus increasing the overall logistics cost. Local logistics companies are also considered less competitive in data planning and processing, in providing value-added service. In order to offer modern comprehensive logistics services, Haikou Port requires for more efforts in logistics information sorting and analyzing.

2.2.2. Sanya Port Hub. Sanya used to have only one port, which is close to the downtown area, suffering from traffic problems. In December 2005, Sanya municipal government initiated a "separation of three ports" project, namely the separation of old port into three by functions. Sanya Port was divided into Nanshan Port for cargo, Yazhou Port for fishing and Fenghuangdao Port for passenger. On May 31, 2018, the first phase of Nanshan Port finished, and the second phase is still under construction. At present, Sanya Nanshan Port has not applied much information technologies, not to mention an information platform to connect agents, transportation companies and logistics providers. Sanya Nanshan Port has an urgent need to establish a modern logistics system that is embedded with an information platform processing data in administrative management, qualification and information inquiry, shipping agency and freight forwarding etc.

3. Case Study Based on Port Hubs in Hainan FTZ

In applying information technologies to port logistics in Hainan FTZ, it is necessary to actively and rationally promote the development of blockchain technology in industry, so as to seize another strategic high point of China's international competition in the era of digital economy. This paper took
the two port hubs, Haikou Port and Sanya Nanshan Port, as an example. The application of blockchain technology in Hainan FTZ can be carried out from the following four aspects: product tracing, shipping, warehousing, and logistics financing, as shown in the Figure 1.

![Figure 1. Applying blockchain technology to the logistics hubs](image)

### 3.1. In Product Tracing
With time stamp, distributed storage, asymmetric encryption and other technologies, blockchain can form untamable records of all links of commodity production and circulation. Therefore, it technically guarantees that the data recorded is accurate and valid. Sanya, taking advantage of its geographic location, has frequent transactions with southeast Asian countries. It is always a demanding job to collect and deliver the data covering production, transportation, packaging, customs clearance, third-party inspection and other information, as well as the whole processing information of the country of origin, country of sale, loading port, transport vessel, import port, bonded warehouse inspection and quarantine number, customs declaration number and so on. Blockchain technology can make this procedure easier and faster by keep the data untamable and traceable. For example, Nanshan Port is serving the cargo for several national industrial parks and research centers in Sanya, including a breeding research center. During a cross-border transshipment of rice seeds, blockchain technology can be applied to the platform recording upload, track and verify the logistics information.

### 3.2. In Shipping
In the past, the transportation was from port to port. However, nowadays, people anticipated for a more convenient experience in goods shipping, which is from door to door. To reach customers’ expectation in convenience, more steps and more participants are involved, which may increase the risk in poor connection. At present, in Haikou Port, ten pieces of documents are required for exporting a container. The following Figure 2. shows how the documents were delivered between parties.

To guarantee the accuracy, shipping system is required to update every changes in the process. Once blockchain technology was applied to the procedure, the supply chain procedure would look much different. With the support of distributed ledger technology, each node on the blockchain will record and store the changes synchronously. Therefore, once the status of the goods in transit changes, the shipping system embedded with blockchain technology will update accordingly. Moreover, cargo information is open and accessible to all shipper, carrier and other relevant personnel during the whole delivery process, thus ensuring the security and accuracy. We can create a paperless working environment for a simplified procedure with better port service.
3.3. In Warehousing

Warehouse played an important role in logistics. An efficient warehouse management is crucial to the commodity in transit. Due to the complexity in standards and interface, the existing RFID and sensor technology became less efficient in forming a unified interface while connecting with the existing electric business logistics system. However, blockchain technology provides a lightweight unified interface, which is independent from other systems. Moreover, with the help of mobile edge computing (MEC), the intelligent management of cargo information can be realized in the transportation terminal as Figure 3.

Using blockchain technology combined with RFID, GPS, sensors, bar code and other technologies, it is reducing time and cost in finding, identifying and tracing certain product. To carry out intelligent management of e-commerce logistics warehousing, can achieve effective real-time monitoring of goods out of the warehouse and into the warehouse, so as to reduce the labor cost and time cost of finding, identifying and tracking goods. The cargo management personnel of Hainan port can track the information of lockers and the transportation status of goods through the block chain system, and intercept the goods in the first time when there is a problem batch. Shippers can connect exclusive containers based on distributed ledger technology and track and query the storage information of goods through mobile devices. In short, making full use of blockchain technology in the storage link can increase the transparency of the whole process.

3.4. In Logistics Financing

As a combination of logistics and finance, logistics finance can not only improve the service capacity and operating profit of logistics enterprises, but also help enterprises expand financing channels, reduce financing costs and improve the efficiency of capital usage. In China, due to the imperfect credit system, small and medium-sized enterprises have limited financing channels. For the existing financing channels, enterprises have to confront with longer background investigation compared to that of other giant companies.

This situation can be changed by applying blockchain technology to logistics finance. With symmetric encryption algorithm, digital signature and zero-knowledge verification technology, blockchain protects the security and privacy of user data, and ensure that the data referenced by financial
institutions when granting credit is accurate and effective. Since the transaction information of each transaction participant is timely and accurately recorded by the block chain, the distributed ledger data will be more transparent to avoid risks caused by forged credit records. By recording real-time information of all the participants on the chain ledgers, it would save banks and other financial institutions’ time to know their customers, creating an efficient, safe, transparent and trusted financing environment. For example, Sanya RGRH, a shipping agent, would like to build its own dock in Nanshan port. It has to get a permission from the port office first. After a month, or even months, of evaluation, it managed to get a permit. Then, it would turn to the bank for a loan. And it probably means another month of waiting. Once there is a system or platform connected the company in need and the government department and the bank or financial institutions, the history of transactions as well as other information about Sanya RGRH would be easier to obtain. And most importantly, this system or platform is supported by blockchain, namely those information shared are trustworthy, shortening the time in background checking.

4. Summary
The purpose of this paper is to discuss the possibility and feasibility of applying the blockchain technology to the logistics hubs in Hainan FTZ. We believe four areas in the logistics, namely product tracing, shipping, warehousing and financing, would benefit most from blockchain technology. In product tracing, blockchain technology can make the procedure easier and faster by keep the data untamable and traceable. In shipping, as blockchain technology synchronously updates changes, it enables a paperless working environment for a simplified procedure with better port service. In warehousing, blockchain technology empowers a more efficient and transparent intelligent management of cargo information. In financing, blockchain protects the security and privacy of user data, creating a safer and trusted financing environment. Currently, we believe four platforms empowered by blockchain would be more workable; however, building an all-in-one system with blockchain technology in logistics industry is under future discussion.

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