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**RESEARCH ARTICLE**

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# Research on the Application and Benefits of IoT Technology in the Real Estate Financing Model of Supply Chain Finance: Analysis Based on Multiple Cases

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**Abstract:** This article aims to explore how IoT technology can reshape the traditional movable property financing model and solve its long-standing pain points of "difficult management of goods, difficult financing of funds, and high risks". By reviewing the theoretical foundations of the Internet of Things, supply chain finance, and movable property financing through literature review, and combining typical cases such as JD Technology, Qingdao Free Trade Zone Digital Warehouse, and Tianqi Lithium Battery Recycling, this paper deeply analyzes the business process innovation, risk control optimization, and comprehensive benefit improvement of movable property financing under the integration of "Internet of Things+blockchain" technology. Research has found that IoT technology can greatly improve the accessibility of financing, reduce financing costs, and create new business growth points for financial institutions by achieving real-time, visual, and traceable digital supervision of movable property (inventory, warehouse receipts). Finally, the paper summarizes the challenges faced by the current model and provides prospects for future development directions.

**Keywords:** movable property financing, supply chain finance, case study

## 1. Introduction

### 1.1 Research background and significance

In January 2024, the National Development and Reform Commission (NDRC) officially released the first batch of "14th Five-Year Plan" research topic collection announcement for 2024. One of the key topics is "Research on the Changing Trends of Global Industrial and Supply Chains and Their Impacts on China", which indicates China's high attention to the development of supply chains.

However, the sound development of supply chains cannot be separated from capital financing. Therefore, the in-depth integration of finance and supply chains is an inevitable choice for China to respond to changes in global industrial and supply chains. Supply chain finance is still in the initial stage of development in China. Nevertheless, benefiting from the continuous development of accounts receivable, commercial notes and financial leasing markets, it has developed rapidly. Domestic supply chain finance is concentrated in industries such as computer communications, power equipment, automobiles, chemicals, coal, steel, pharmaceuticals, non-ferrous metals, agricultural and sideline products, and furniture manufacturing. The competition in the supply chain finance industry involves various participants including commercial banks, core enterprises, logistics enterprises, and e-commerce platforms.

By the end of 2024, the total ending balance of the three major basic assets (accounts receivable, advance payments, and inventory) in China's corporate supply chains reached 107.6 trillion yuan, continuing to expand compared with 99.9 trillion yuan in 2023. However, small and medium-sized enterprises (SMEs) are facing severe difficulties in financing and high financing costs. The development

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of traditional movable property financing is restricted due to problems such as information asymmetry, high supervision costs, and repeated pledge risks.

Therefore, as a key component of financial technology, how the Internet of Things (IoT) technology solves the above problems through "movable property digitalization" is of great significance for improving the efficiency of financial services for the real economy and promoting industrial digital transformation.

### 1.2 Relevant theories

In the Transaction Cost Theory, Coase and Williamson pointed out that enterprises will face transaction costs such as search, negotiation, contract signing, and supervision when conducting transactions in the market. Establishing stable supply chain relationships or introducing financial intermediaries (such as banks and core enterprises) can reduce these costs.

In the Credit Rationing Theory, Stiglitz and Weiss pointed out that due to information asymmetry, banks may not simply balance supply and demand by raising interest rates, but adopt credit rationing. That is, some enterprises cannot obtain loans even if they are willing to pay higher interest.

The Liquidity & Asset Transformation Theory points out that financial institutions can realize the effective allocation of funds by converting illiquid or low-liquidity assets (such as inventory) into more liquid financing instruments (such as loans, factoring, warehouse receipt financing, etc.). For example, inventory financing and warehouse receipt pledge financing in movable property financing convert the inventory or warehouse receipts held by enterprises into working capital, thereby improving the efficiency of asset utilization.

Therefore, based on the above theoretical discussions and combined with the current research status of IoT technology application in the financial field, this paper conducts in-depth comparative analysis on multiple cases and industries.

### 1.3 Research content and methods

This paper analyzes the business model of iot movable property financing, evaluates its application benefits, and discusses the challenges it faces. At the same time, this paper adopts the multi-case study method, combined with detailed cases for in-depth analysis.

## 2. Pain Point Analysis and Model Innovation of IoT-based Movable Property Financing

### 2.1 Pain point analysis of traditional movable property financing

#### 2.1.1 Information silos

A supply chain is inherently a complex, multi-party ecosystem. However, critical business data—such as purchase orders, logistics records, and invoice verification—is often trapped within the isolated internal systems (e.g., ERP, WMS) of each participant, including core enterprises, SMEs, logistics providers, and financial institutions. These information silos create a significant barrier to transparency. Financial institutions, as capital providers, find it costly and inefficient to cross-verify the authenticity of trade backgrounds. This lack of trusted data sharing prevents the strong credit of core enterprises from being effectively and securely passed down to multi-tier suppliers and distributors. Consequently, financing support is often restricted to first-tier partners directly dealing with the core enterprise, leaving the more remote but needier SMEs on the chain financially excluded and stifling the overall vitality of the supply chain.

#### 2.1.2 High regulatory costs

Effective monitoring of the pledged movable assets is the cornerstone of risk management. The traditional approach, however, relies heavily on manual, on-site physical checks and paper-based documentation. This method is inherently flawed: Firstly, it is highly inefficient, requiring business operations to halt during lengthy inventory counts, which is incompatible with modern, fast-paced supply chains. Secondly, it is prone to inaccuracies due to human error, misrecording, and delays in data entry. Thirdly, it creates significant supervisory gaps, as the status of goods between physical inspections remains a "black box" for lenders. The inability to implement round-the-clock, real-time supervision

drives up operational and risk management costs for financial institutions. These high costs either deter banks from engaging in movable asset financing altogether or result in higher risk premiums passed on to borrowers, increasing the cost of capital.

**2.1.3 Lack of trust and performance risk**

The absence of reliable technological safeguards leads to critical vulnerabilities. Warehouse receipts, the primary instruments in this field, suffer from low standardization, making them susceptible to forgery and alteration (Wang Guoyin, 2025). This environment fosters two major risks: the risk of duplicate financing, where a dishonest borrower pledges the same batch of goods to multiple lenders by exploiting information asymmetry, and the risk of unclear title, where the ownership of goods becomes ambiguous during complex transfer processes. This state of weak rights confirmation undermines the very foundation of trust necessary for financing activities. It amplifies moral hazard and creates significant apprehension among financial institutions, thereby stifling the growth of a large-scale, liquid market for movable asset financing.

**2.2 Mode innovation enabled by internet of things technology**

**2.2.1 Digitization of movable property**

IoT technology acts as a critical bridge between the physical and digital worlds. By deploying a network of smart devices—such as electronic fences for geofencing, high-definition cameras for visual verification, GPS trackers for real-time location data, and weight sensors for quantity monitoring—the physical status of goods (their location, quantity, and environmental conditions) is continuously and automatically captured. This real-time data stream is then cryptographically hashed and recorded on a blockchain or distributed ledger, creating an immutable and auditable digital twin of the physical asset (Li, Qu, Shao & Tang, 2025). This process achieves the crucial "integration of the four flows", ensuring that the information flow (data on the asset) is perfectly synchronized with the commercial flow (the transaction), logistics (the movement), and capital flow (the financing). This digital representation transforms previously opaque and illiquid inventory into transparent, verifiable, and bankable collateral (Zheng & Wu, 2025).

**2.2.2 Risk control reconstruction**

Traditional risk management, reliant on sporadic manual inspections, is inherently flawed, creating windows of high risk and inefficiency (Hu Xingxing, 2025). IoT technology enables a fundamental reconstruction of this model. Digital equipment provides 7*24 unmanned supervision, eliminating the gaps inherent in human-dependent processes. More importantly, the combination of IoT and blockchain technology creates a "trustless" environment—not meaning a lack of trust, but one where trust is engineered into the system itself. The IoT data ensures factual accuracy of the asset's status, while blockchain's immutability guarantees that this data cannot be altered or repudiated, effectively mitigating moral hazard (Guan Xiaoning, 2025). This dual layer of technological assurance drastically reduces the need for physical audits, lowers operational risks, and significantly enhances the overall credibility of the financing arrangement for all participants, especially lenders (Xie & Tan, 2025).

**2.2.3 Business process optimization**

The availability of trusted, real-time data enables the automation and streamlining of entire business workflows. The entire process—from warehousing operations and rights confirmation (e.g., generating a digital warehouse receipt) to financing application and approval—can be executed fully online without manual intervention. Technologies like Programmable Logic Controllers (PLCs) automate physical operations in warehouses, while smart contracts on the blockchain can auto-execute financing agreements upon meeting pre-defined conditions (e.g., goods entering a designated area). This end-to-end digitization eliminates redundant paperwork, reduces human error, and accelerates decision-making. As reliable data indicates, such integrated technological solutions can increase operational efficiency by over 50%, slashing the time required for financing from days or weeks to mere

hours or even minutes, thereby dramatically improving capital availability for businesses.

## 3. Case Studies

### 3.1 JD Technology's intelligent warehousing and movable property financing

#### 3.1.1 Background and challenge

JD Technology as a supply-chain-based technology and service enterprise, possesses a deep understanding of the challenges within retail supply chains. A primary pain point for its vast network of suppliers, particularly SMEs, is the capital immobilization caused by inventory, making it difficult to access timely and affordable financing based on these "static" assets.

#### 3.1.2 Solution: The "Dual-Chain Linkage" model

JD Technology's core innovation is the strategic integration of its "Digital Intelligent Supply Chain" with its "Supply Chain Finance" capabilities. This "dual-chain linkage" model creates a virtuous cycle:

(1) Goods Management via Digital Intelligent Supply Chain

JD leverages its advanced IoT sensors, AI, and big data analytics to transform its own and partners' warehouses into "intelligent" facilities. This system monitors inventory levels, location, and condition in real-time, ensuring the authenticity, transparency, and controllability of the goods. This solves the fundamental problem of "how to manage goods" credibly without constant physical checks.

(2) Funds Access via Supply Chain Finance

Based on this trusted, real-time view of the inventory, JD designs flexible financial products. Suppliers can pledge their goods stored in a JD-cooperative digital warehouse to obtain a flexible financing line. Crucially, the model moves away from rigid "one pledge per item" approaches, allowing suppliers to dynamically finance portions of their inventory as needed.

#### 3.1.3 Value and outcomes

(1) For Suppliers: They gain access to a revolving line of credit that greatly improves capital flexibility. By leveraging JD's credit enhancement and the credibility of IoT/blockchain-monitored goods, SMEs have seen their annual financing costs reduced by 3%-6%.

(2) For JD and Financial Partners: The "unmanned" monitoring significantly lowers post-loan management costs and risks. The entire process, from inventory monitoring to loan disbursement and repayment, is automated and data-driven, enhancing efficiency and scalability.

### 3.2 Digital warehouse public service platform of Qingdao free trade zone

#### 3.2.1 background and challenge

The bulk commodity trade industry has long suffered from a "black box" problem in warehousing. Information asymmetry, difficulties in verifying the existence and ownership of goods, and risks of fraudulent warehouse receipts have hindered financing and increased transaction costs.

#### 3.2.2 Solution: building a trusted digital infrastructure

This platform acts as a neutral, public infrastructure that integrates IoT and blockchain to bring transparency to the entire warehousing process.

(1) IoT for Physical-to-Digital Conversion: Sensors and monitoring devices in cooperating warehouses track goods from the moment they enter until they leave.

(2) Blockchain for Immutable Record-Keeping: All data from these IoT devices—along with key documents and transactions—is recorded on a blockchain, creating immutable and traceable Blockchain Electronic Warehouse Receipts (BEWRs). This ensures clear, undisputed ownership of the goods at every stage.

#### 3.2.3 Value and outcomes

(1) Process Efficiency: The need for manual paperwork and repeated verifications is drastically reduced. The platform has compressed the product warehousing and delivery process by an average of 3-5 steps, and improved audit efficiency by over 50%.

(2) Financial Innovation: The BEWR, being a trusted digital asset, becomes a credible basis for pledge financing. This provides a new, secure financing channel for SMEs in the bulk commodity

sector, unlocking capital that was previously inaccessible due to trust issues.

### 3.3 Integrated platform for lithium battery recycling of Tianqi Co., Ltd.

#### 3.3.1 Background and challenge

The lithium battery recycling industry involves numerous small, dispersed recyclers who lack credit history and substantial collateral. They operate in a cash-intensive model, needing to pay for used batteries upfront but facing long cash conversion cycles, creating severe working capital pressures.

#### 3.3.2 Solution: A data-driven financing model

Tianqi, a leader in battery recycling, built an integration platform that shifts the basis of credit from collateral to real-time, verifiable operational data.

(1) Rights Confirmation via Remote Detection: When a recycler collects batteries, IoT devices (e.g., smart scales, unique identifiers) immediately verify the type, quantity, and status of the goods. This data is instantly recorded on the platform, effectively creating a digital proof of a valuable asset.

(2) Progressive Financing: Based on this verified data, the platform can advance a portion of the payment to the recycler immediately. As the batteries move through the logistics chain to Tianqi's facility, their progress is tracked, triggering proportional payments at each stage.

#### 3.3.3 Value and outcomes

(1) For Recyclers (SMEs): This model alleviates acute working capital pressure by providing funding aligned with their actual business activities, not based on fixed assets. It significantly enhances their bargaining power and financial stability within the value chain.

(2) Industry Paradigm Shift: This case demonstrates a breakthrough in credit investigation logic. It proves that reliable, real-time data on business operations can be a more powerful and inclusive tool for credit assessment than traditional collateral, paving the way for financing models in other asset-light industries.

## 4. Comprehensive Benefit Analysis and Challenges

### 4.1 Benefit analysis

(1) From the enterprise level, the Internet of Things technology directly enables the survival and development of enterprises. For the majority of small and medium-sized enterprises, first of all, it has significantly improved the availability of financing (Lin Xinwei, 2025). The Internet of Things technology has transformed the inventory, materials in transit and other movable property that were "invisible and uncontrollable" in the eyes of financial institutions in the past into transparent and controllable qualified collateral, greatly expanding the financing channels (Li & Li, 2023). Then it effectively reduces the comprehensive financing cost, that is, the due diligence, supervision and risk cost of financial institutions, while saving valuable financial expenses for enterprises; Finally, the cash flow management of enterprises is optimized. The dynamic financing mode based on the Internet of Things (such as floating inventory pledge) allows enterprises to obtain financing while maintaining normal production and operation, realizing a more efficient matching of capital flow and logistics, and improving the efficiency of capital use.

(2) From the industrial level, the transparent environment constructed by the Internet of Things enables core enterprises to more clearly grasp the operation status of upstream and downstream enterprises, thus improving the visualization level of the supply chain. Credit transmission based on trusted data enables more small and medium-sized participants in the supply chain to obtain financial support, which stabilizes the weak links of the supply chain and reduces systemic risks caused by partial capital chain breakage. In the end, a supply chain with abundant capital and blood and smooth information can intrinsically improve its overall response speed, collaborative efficiency and anti-risk ability (Liu & Yu, 2025).

(3) From the macroeconomic level, the movable property financing of the Internet of Things has effectively promoted the transformation of financial

resources from "from real to virtual" to "from virtual to real", and guided funds to the basic fields of the national economy such as manufacturing and circulation industry. This process not only improves total factor productivity, but also stimulates the micro vitality of the market by supporting small and medium-sized enterprises, the main force of innovation and employment, and provides solid financial infrastructure support for the optimization and upgrading of industrial structure and high-quality economic development.

### 4.2 Challenges

#### 4.2.1 Technology costs and standardization challenges

The implementation of Internet of Things solutions requires the deployment of a large number of hardware devices (sensors, gateways, cameras, etc.) and software systems, with high initial investment costs, which constitutes a certain threshold for small and medium-sized enterprises and financial institutions with thin profits. More importantly, there is currently a lack of unified standards for device interfaces, data formats and communication protocols in the industry. This "fragmentation" situation leads to difficulties in interconnection between different systems and data sharing and integration, forming a new "iot data island", which hinders cross-platform and cross-institution business collaboration and makes accurate and unified model replication face great challenges (Ni, Li, Liang & Guo, 2024)

#### 4.2.2 Challenges of data security, privacy protection and adaptability of legal regulation

Internet of Things devices continuously collect massive sensitive data of enterprise production and operation 7*24 hours a day. The collection boundary, storage security, use authority and compliance of these data are facing severe tests. Once leaked, enterprise trade secrets and even national security may be endangered. At the same time, the pace of development of legal and regulatory frameworks has not fully kept pace with technological innovation. Key issues such as the legal attributes and real right effectiveness of blockchain digital warehouse receipts, the judicial execution of smart contracts, and the ownership definition of data assets still exist in vague areas in the existing legal system, which brings uncertainty to the compliance development of business and inhibits the enthusiasm of financial institutions to participate deeply.

#### 4.2.3 Business model sustainability challenges

The supply chain structure, goods circulation characteristics and financial needs of different industries (such as bulk commodities, Fconsumer goods and high-tech products) vary greatly, which is difficult to be simply applied by a universal financing model of the Internet of Things. How to design a business model for a specific industry that can reasonably balance the interests of core enterprises, upstream and downstream smes, financial institutions, technology platforms and other parties, and ensure that all parties have the motivation to participate in and benefit from it, is the key to determine whether the model can be sustainable in the long term. At present, most successful cases are still focused on specific industries or regional pilot, and it is still a topic that the whole industry needs to continue to tackle to explore a set of sustainable business logic that is universal and replicable on a large scale.

## 5. Conclusions and Prospects

### 5.1 Research Conclusions

IoT technology, by realizing the digitalization, transparency, and controllability of movable property, is the key to solving the core pain points of movable property financing. The technology integration model of "IoT + blockchain" builds a credible business environment and represents the mainstream development direction of future movable property financing. This model has successfully achieved a win-win situation for enterprises, financial institutions, warehousing and logistics, and other parties.

### 5.2 Future Prospects

In the future, supply chain financial systems still need to deepen technology integration. Combining with AI, they will realize intelligent risk early warning and automatic asset value assessment, and develop from a single link to a full-chain digital

ecosystem covering "procurement-production-warehousing-logistics-sales". At the same time, it is appealed that regulatory authorities introduce more supportive policies and promote legislation related to digital assets, thereby realizing a green and sustainable financing model.

**Conflict of Interest**

The author declares that she has no conflicts of interest to this work.

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