

# On Warehouse and distribution operation optimization of electric power materials

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**Abstract:** *With the wide application of emerging technologies in the supply chain, logistics, as a part of the supply chain, faces both opportunities and challenges of intelligent transformation. With the rapid development of electric power logistics industry, logistics distribution business is an important part to ensure the operation of electric power enterprises. With the continuous expansion of the scale of the power grid, the rapid growth of the types and quantities of power engineering materials has brought great challenges to warehouse management and distribution, increased the operating costs of the power grid companies, and deviated from the requirements of lean development of the logistics industry. Combined with advanced technology and intelligent concept, this paper puts forward suggestions to optimize and solve the problems of warehousing and distribution operation of power grid materials, promote the key management and control of warehousing and distribution links of power grid companies, and promote the digital operation of intelligent logistics warehousing and distribution mode.*

**Keywords:** *Electric power materials; operation optimization; warehousing and distribution*

## 1. Introduction

With the wide application of emerging technologies such as artificial intelligence, blockchain and the Internet of Things in the supply chain, intelligent supply chain has been paid more and more attention in both theoretical research and practice. As a part of supply chain, logistics is faced with opportunities and challenges of intelligent transformation. In the development of Chinese electric power enterprises, logistics and distribution service is an important part of ensuring the operation of electric power enterprises. As the turnover center of logistics activities, warehousing integrates storage, classification, storage, processing, transfer and other functions, which is the key to determine the efficiency and quality of logistics distribution business. However, with the rapid development of electric logistics industry, it also faces some problems. For example, with the continuous expansion of the scale of the power grid, the rapid growth of the types and quantities of power engineering materials has brought great challenges to warehouse management and distribution (Liu Dong, 2018). In order to cope with the pressure of warehousing and distribution, power grid companies have to add a large number of business outlets and purchase distribution vehicles. These measures greatly increase the operating costs of power grid companies and deviate from the requirements of lean development of logistics industry.

In 2016, the National Development and Reform Commission issued the Opinions on the Implementation of "Internet Plus" Efficient Logistics, proposing to build a logistics information interconnection and sharing system, improve the intelligent level of warehousing and distribution, and develop a new mode of efficient and convenient logistics. In order to implement the requirements of the document and promote the effective application of modern information technology such as "Cloud Big Material moving Intelligence" in warehousing and distribution business, power grid companies should improve the quality and efficiency of intelligent logistics and distribution of power enterprises (Dong Wei, 2018), achieve cost reduction and efficiency increase, and use digital technology to drive the transformation of warehousing and distribution business.

Huang Yuyan (2022) explored the optimization plan of electric power supplies distribution, analyzed the existing problems in storage management and distribution management, and proposed an optimization plan for the measures of building a storage pool according to demand and establishing a rotation and balance mechanism to clear the overstock. Yang Shaokui (2021) discusses framework measures for the application of intelligent management and distribution system of electric power materials, and aims to improve the level of intelligent management of electric power materials by means of modern means, so as to improve management efficiency and distribution speed. Zhou Pei (2022)

Optimize and adjust the logistics distribution mode and management process of electric power enterprises. Yue Heng and Luo Guorong et al. (2020) explained the deficiencies in the distribution of electric power materials in China, organically combined the Internet of Things, big data, cloud computing, artificial intelligence and other advanced technologies, and proposed the realization path of intelligent distribution of electric power materials[1-3].

This paper analyzes the problems existing in the warehousing and distribution business, combines advanced technology and intelligent concept, supports the information technology and intelligent hardware technology such as "Big Cloud material moving intelligence side chain", and puts forward suggestions for optimizing the operation of the warehousing and distribution of power grid materials, which helps to promote the deep integration of modern information technology and warehousing and distribution business of "Big Cloud material moving intelligence". Improve the quality and efficiency of power grid logistics, warehousing and distribution.

## **2. Analysis of warehousing and distribution problems of power grid materials**

### ***2.1 The warehousing and distribution process can be seen***

Grid material supply is demand-oriented "on-demand" mode, and material inventory resources and distribution information are independently dispersed in material departments, professional departments and suppliers. The distribution process not only requires the monitoring of material personnel on board the car, but also needs to handle paper handover procedures after the arrival of materials. The whole procedure is complicated and the asymmetry of supply and demand information leads to the supply is not timely, the inventory is overstocked and the distribution efficiency is low.

At present, the storage and supply pressure of warehouse is increasing day by day, and there are many problems to be solved urgently. The visualization development of material volume measurement is not perfect, and the material department has not yet met the demand for the volume measurement and visual display of power supplies, resulting in the lack of data storage of power supplies. The input and input routes have not been visualized, and the power supplies are mainly infrastructure engineering materials, which are operated in the mode of direct delivery by suppliers to the places of demand. As a result, transportation personnel cannot provide the shortest input and output routes according to the visual effect. Inventory counting and logistics visualization facilities are not complete, construction standards, operation specifications, management requirements have not been unified.

### ***2.2 Intelligent management of warehousing and distribution***

In order to further improve the intensive control level of materials, the construction of the deployment center is carried out, and the standardized management is realized through the handover, acceptance and other business links in the process of contract performance, so as to strengthen the application of mobile terminals and improve the efficiency of contract performance. It has become the management requirement of contract performance and the inevitable trend of the development of The Times to complete the related business of warehousing and distribution by means of intelligent operation. However, at present, there is a lack of APP and other operation terminal equipment to realize the one-click code scanning of related operations, which makes it difficult to verify the receipt and delivery of materials, the system automatically checks business documents, material identity information, material supply planning, etc., which affects the efficient development of warehousing and distribution business.

Warehousing operation vouchers lack of standardized arrangement, the construction of electronic materials vouchers standardization system is insufficient. It is urgent for the warehousing of electric power materials to truly transfer electronic certificates in the form of online. Some new technical means such as handwriting pad, electronic signature and fingerprint identification are used to construct electronic files of warehousing documents, so as to ensure the paperless office of warehousing operations. We use fingerprint delivery to strengthen the control of materials, strictly control risks, so that the material settlement link has a paperless office, intelligent analysis, automatic disposal of leading management. Obviously reduce the contract performance and settlement period, really improve the efficiency of material supply management.

At present, there are various distribution modes of electric materials, different types of distribution vehicles, and the lack of unified management. The distribution time of materials is generally determined by the distribution experience of managers or distribution personnel, which will lead to the phenomenon

that the demand point of electric materials waits for the arrival of the distribution vehicle or the distribution vehicle waits for the unloading point of electric materials. Although the electric materials distribution vehicle is equipped with the global positioning system, it lacks management norms, and there are problems such as low standardization, imperfect distribution management system and backward distribution infrastructure. As a result, the information of the distribution vehicle cannot be matched with the distribution management information system, and the distribution vehicle cannot be monitored and tracked in real time. It is difficult to trace the responsibility when the electric materials have problems[4].

### **3. Suggestions on optimization of power grid material warehousing and distribution**

#### ***3.1 Optimize the operation mode of warehousing and distribution***

##### ***3.1.1 Strengthen process management***

Strengthen the acceptance of incoming materials, check and accept according to the distribution list provided by the supplier and the relevant requirements of the acceptance of incoming materials, that is, to check the variety, specifications, quantity and appearance. For special materials or important equipment, organize the demand department, professional management department, material distribution personnel, suppliers, etc., to jointly check and accept.

To strengthen the quality inspection and sampling inspection of incoming materials, make overall arrangements for sampling and submission plans and work implementation, expand the scope of sampling inspection, increase input in sampling equipment, and enrich sampling inspection means. Deepen the quality control mechanism, establish a cooperation mechanism, strengthen work linkage, strengthen responsibility implementation, implement closed-loop management, and ensure the quality of power grid construction.

Use information technology to improve the efficiency of inventory management. The Internet of Things technology and the concept of "Internet +" are used to establish the identity of the physical state of materials, which is combined with the material information system platform. Automatic identification information and supply chain tracking information are input into the system to ensure that the information of the whole process of materials is fed back to the information platform in real time, improve the reliability of the material account and reduce the repeatability of the work of business departments as far as possible. By bar code scanning, can trace to each link of the handler and the responsible person, if the financial account card inconsistent situation, the responsible person will assume the consequences for recovery, but also in a timely and effective way to control all the information of materials outside the account[5].

##### ***3.1.2 Establish a reserve quota management mechanism***

Through the construction of the dynamic inventory adjustment model of material demand plan, combined with the procurement and consumption data of revolving inventory materials over the years and the forecast results of material demand of annual project plan, the inventory level was analyzed from multiple aspects such as material categories, material consumption, equipment stock and inventory turnover, referring to seasonal cyclical factors. Establish a scientific, perfect and accurate classification forecasting and analysis mechanism for inventory material demand, transform static inventory control into dynamic inventory control, achieve the goal of optimizing inventory reserve quota threshold and reducing the amount of physical reserves.

The focus of the management of reserve quota is to determine the structure, quantity and inventory way of inventory materials. The goal is to establish the inventory list and quota management mechanism, and improve the rationality of inventory structure and quota. "Quota reserve, dynamic replenishment" greatly reduces the material supply cycle, reduces the material backlog, effectively clears the inventory, and improves the comprehensive inventory turnover rate.

##### ***3.1.3 Activating the profit warehouse to reduce the amount of inventory***

Comb through the backlog of materials. Organize warehouse management personnel to clean up and take stock of inventory materials, focusing on sorting out materials that have not moved for many years and those that have exceeded their service life. The backlog of waste materials in the warehouse shall be cleaned up and recorded, and the key tracking management shall be carried out.

Carry out technical evaluation of overstocked materials. Organize the professional management department to carry out the technical appraisal and scrap approval of inventory resources. The

overstocked materials identified as unusable shall be declared for centralized disposal of waste materials in time, and the disposal progress of waste materials shall be accelerated.

Implement the main responsibilities of the Lichu work. In accordance with the principle of "whoever forms the inventory shall be responsible for the withdrawal of the inventory", the recycling of retired assets and stored materials shall be carried out for the excessive storage of production operation and maintenance materials, materials returned for new projects, materials temporarily stored for too long, assets to be retired and used materials to be scrapped.

Strengthen the profit of project approval and design stage. The responsible department of Treasury shall take the initiative to consider the utilization of stock materials when applying for the approval of capital construction and technical renovation and overhaul projects. In the development of waste materials dismantlement plan, the first consideration of decommissioned materials reuse channels. In the project commissioned design stage, the design unit is required to take the initiative to use inventory materials. At the end of the project drawing review, declare the inventory material demand voluntarily.

#### ***3.1.4 Construction of intelligent distribution system***

The distribution system is gradually transformed to simplify the supply mode, open the selection authority, unified platform monitoring, transparent process tracking, optimize service means, etc. The logistics scale economy is improved through centralized reserve and unified distribution, and the supply efficiency of materials is improved through instant delivery of third-party logistics.

First, demand instant confirmation. Provide inventory resources visualization platform, demand units can real-time, online query demand material inventory quantity. Second, orders are placed with one click. Using mobile APP, the project unit can place orders online based on the inventory information, and maintain distribution location, delivery time, handover person, contact information and other information. Third, on-demand active distribution. According to the scheduled delivery demand time, organize the carrier to arrange the delivery of materials, real-time monitoring of the whole process of materials transportation.

In addition, according to the type of materials, choose different distribution modes. Among them, the material needs of power infrastructure projects are clear, and the warehouse only plays the role of temporary storage and transition, thus reducing the demand for storage resources. For production, operation and maintenance materials with unclear demand and high service level, inventory accumulation of different degrees can be achieved through regional and turnover warehouses, so as to reduce the overall inventory level on the premise of ensuring the service level. For scrap materials whose current demand has disappeared, effective resources can be freed up to serve core materials through rapid disposal.

#### ***3.2 Real-time monitoring to enhance the visualization of warehouse allocation***

To realize the visualization of warehousing and distribution, the Internet of Things technology should be used. The RFID technology should be used to obtain dynamic warehousing data in the warehousing link, and the real-time information such as distribution route, road condition information and power production situation should be analyzed in real time in the distribution link. The collection, processing, analysis and application of real-time information mainly involve GIS and GPS. Through the deep application of the Internet of Things technology, it can provide strong and high-quality material service support for the construction of the grid material warehousing and distribution business, realize the visualization of the warehousing and distribution process, give full play to the efficiency of materials, and contribute material wisdom.

##### ***3.2.1 Real-time storage service management***

Based on the big data perspective analysis, the Internet of Things technology and intelligent terminal equipment are used to connect the system end and the large screen end, and the operation process in the warehouse is visualized, including the field operation and equipment operation and maintenance status. In field operation, the application of handheld terminal equipment and RFID technology. Identify target objects and obtain relevant data through radio frequency signal, and record and upload the data of material import and export and inventory operation in real time. Combined with warehousing visualization technology, the system dynamically transmits to related components of visualization platform after real-time acquisition, storage and processing. In the aspect of equipment operation and maintenance, the sensor technology is used to realize the visualization of equipment operation and maintenance. By installing the Internet of Things equipment for warehouse equipment and facilities, monitoring and collecting the real-time status parameters of the equipment, and uploading them to the

central control room of the warehouse for centralized monitoring, fault diagnosis and deterioration trend prediction, and obtaining the possible fault risks of the equipment at present.

### ***3.2.2 Real-time control of distribution process***

GIS has powerful graphical expression ability. Before the distribution of electric power materials, the charts used in the process of logistics distribution can be changed into spatial network graphics by GIS technology. The service area is turned into a topographic map, which can be transmitted back via GPS. When materials are distributed, GPS technology can be used to conduct real-time monitoring in the process of distribution of electric power materials, and provide the location data of vehicles at any time to understand the driving condition of vehicles. Subsequently, logistics managers can take the processing point, storage point and disaster relief point of the delivery of goods as a network node, and the distribution route as a network connection, thus forming a spatial network diagram. Finally, GIS analysis and decision making ability is utilized to make the distribution center layout and location selection more reasonable. In addition, in the process of logistics distribution, it is inevitable that there will be some problems and emergencies that do not conform to the expected plan. For example, if a certain distribution point is temporarily added or cancelled, the original driving route must be changed in order to save costs. These problems are also spatial decision-making problems, which can be solved by GIS technology.

In addition, the deep visualization development of warehousing and distribution can realize the information sharing and electronic signature of suppliers, material management departments, carriers and material demand departments through the application of APP, so as to ensure the safety, appearance, quantity, timely and efficient warehousing and distribution of materials. Promoting visual development can improve the working efficiency of warehouse management, improve the information transparency of the distribution process of power materials, and truly realize the paperless office.

### ***3.3 Promote intelligent power grid through micro-application***

Based on the characteristics of simple, convenient and fast development, micro-application can make comprehensive use of the Internet capabilities, positioning capabilities and mobile communication capabilities of mobile devices to provide effective solutions to the multi-link information interaction problems existing in the storage and distribution of power grid materials. With the rapid development of the mobile Internet, the logistics mini program is conducive to the innovation of the information management mode of the warehousing and distribution business, so that the supply side and the demand side can quickly find each other, and effectively solve the problem of information asymmetry. Compared with the traditional warehousing and distribution mode, the small program based on the mobile Internet is more convenient, more timely and more accurate. It is helpful to realize the electronic management of warehousing and distribution operation vouchers and realize the paperless office of warehousing and distribution, which is the main direction of the future development of warehousing and distribution information[6].

In the process of daily warehousing and distribution, including daily material distribution business, emergency material distribution business and non-logistics distribution business, it is necessary to choose appropriate third-party logistics enterprises to cooperate with according to the actual situation of the business. It is necessary to comprehensively consider the selection of vehicles, whether the supporting loading, unloading and handling service is complete and reasonable, and historical cooperation records. Combine reasonable route planning, make cost budget.

In warehousing, the small program can transform the original PC-based services to the mobile end, providing a more convenient mobile management system for field operators, suppliers and partners. The warehouse keeper can check the transportation information of the goods and understand the specific situation of the goods to be received through the small program of warehousing and distribution, so as to conveniently ascertain the type, nature and characteristics of the materials to be received, reasonably arrange the personnel, materials and operation tools required, and ensure the smooth completion of the receiving work. When carrying out warehousing operation, micro application can help warehouse management personnel to conveniently confirm the matching results of material preparation and check material information online. During maintenance, the micro application can facilitate warehouse staff to record daily inspection, maintenance, organizing and cleaning work, greatly improving the efficiency of warehousing operations.

In terms of material distribution, the distribution personnel of electric power materials can use small programs to coordinate the information of carriers, vehicles and cost budgets related to distribution business in real time according to the needs of work tasks, make cost budgets in real time based on the

actual distribution location, assist in reasonable planning of distribution schemes, save the time cost of communication and confirmation, and greatly improve work efficiency. It can also provide route planning for distribution business through small programs to understand the real-time location of distribution vehicles, real-time positioning and tracking, and monitor the real-time status of equipment. Since trucks are the main media for the distribution of power grid resources, it is not feasible to require truck drivers to use computers to carry out related business operations considering that they travel between transportation lines for a long time and their education level is limited. However, if we can make full use of the characteristics of mobile network and micro-application for drivers, we can communicate with truck drivers anytime and anywhere. In the process of cargo transportation, the driver can give feedback at any time on the small program platform according to the transportation task and the actual situation. During the transportation of goods, truck drivers can feed relevant information to the platform, which is processed by background personnel.

The effective application of the mini program platform in the material storage and distribution of the power grid is helpful to improve the efficiency of the material storage and distribution department and meet the specific information needs. In fact, the traditional application means and methods can only meet the business information needs after the event, while the small program platform combined with advanced network communication technology, database technology and other technologies to achieve real-time information communication, installation and use are relatively convenient, to ensure the whole process of warehousing and distribution of regulation and timeliness.

#### 4. Summary

This paper explores intelligent warehousing and distribution technology, integrates advanced information technology, manufacturing technology, automation technology and artificial intelligence technology, carries out intelligent application, optimizes and upgrades the identification, handling, storage, sorting and management system of material warehousing and distribution business of power grid companies, promotes the internal information sharing of warehousing and distribution links, and promotes the transformation of power grid companies to intelligent logistics warehousing and distribution business.

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