Research on Inventory Management of Electric Power Infrastructure Materials in Supply Chain Environment

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Abstract. The material management of power infrastructure projects is an important task in the construction of power companies. By introducing the idea of supply chain, it is possible to systematize material management within the enterprise, emphasizing the coordination of finance, technology and production, for the entire supply chain. It has strengthened the "cooperation and win-win" with suppliers, realized the coordination and coordination of logistics, capital flow and information flow, and promoted the specialization of business management and the intensification of resource allocation. In the electric power infrastructure project, the infrastructure materials often include the connection and supply relationship of the upstream and downstream enterprises under construction. By arranging the construction process and using the MRP management of the materials, the relationship between the supply chain enterprises can be improved, and the inventory cost of the power enterprises can be reduced. Form a material management system with full process control and full coverage.

1. Introduction

In recent years, the speed and scale of power grid construction have gradually increased, especially the construction of UHV power grids and future operation and maintenance. It has put forward new requirements and challenges for the cost control of purchasing equipment materials and their storage, maintenance and supply. If there is a problem in this respect, then whether it is normal operation or construction, it will expose the problem and involve the harmony and stability of the society. The power system reform has been continuously promoted and the pace of market has accelerated. The quasi-construction of the electricity price market allowed the social capital to enter the placing electricity business. The sales company was established in large numbers, and the power monopoly will be gradually broken. The existing business model of the grid company will be greatly affected. With the gradual advancement of the power reform, the influence and competitiveness of different ownership enterprises in the power industry will inevitably be gradually reflected, which also proposes the operational efficiency and cost control of the grid company. Higher requirements. Based on this, from the perspective of supply chain, it is of great significance to carry out relevant research on the procurement management of grid companies [1].

In view of the problems in the procurement management and inventory management of a power grid company, in order to better provide material supply guarantee for power construction, research on the
premise of bidding for power grid materials, and conduct supplier consignment model based on
agreement inventory procurement, discussed The necessity and significance of personification, supplier
consignment materials, supplier consignment regional plan, division of responsibilities, supplier
consignment business process and related requirements. Through these optimization strategies,
procurement efficiency is improved, enterprise inventory management is strengthened, inventory costs
are reduced, inventory capital usage efficiency is improved, inventory turnover rate is improved, and
procurement cycle and procurement cost are shortened.

2. Inventory management of infrastructure materials based on supply chain
Supply chain management is an integrated management idea and method that performs the planning and
control of logistics from the supplier to the end user in the supply chain. Supply chain management is a
management model that integrates suppliers, manufacturers, distributors, retailers and end users into a
whole through feed-forward information flow and feedback material flow and information flow [2].
Supply chain management is guided by an integrated production plan, supported by various technologies,
especially based on Internet/Intranet, and is implemented around supply, production operations, logistics
(mainly manufacturing processes), and meeting demand. Supply chain management mainly includes
planning, cooperation, and control of materials (parts and finished products, etc.) and information from
suppliers to end users. The goal of supply chain management is to improve customer service levels and
reduce overall transaction costs, and to strike a balance between the two goals.

2.1. Power infrastructure construction supply chain management and structural model
Combined with the definition of the supply chain of the power infrastructure project, the following
figure gives a typical construction supply chain model from the perspective of the participants in the
construction process. The main stakeholders involved in the construction supply chain: owners, general
contractors, design subcontracting Business, engineering subcontractors, material suppliers, labor
subcontractors, equipment leasing companies, and each subcontractor has its own suppliers. Numerous
participants have increased the complexity of the building supply chain.

In Figure 1, the material flow is ultimately flowed to the owner by the equipment material supplier,
labor subcontractor and equipment leasing company, and the direction of the capital flow is exactly the
opposite of the material flow. The information flow includes feed forward information flow and
feedback information and flow. The feed forward information flow is information about the flow of
demand to the supply side, such as engineering contract, order (processing) contract, purchase order,
etc.; feedback information flow refers to the demand side of the supply side. Supply information flow,
such as bill of lading, warehouse receipts, completion reports, etc [3].

![Figure 1. Typical architectural supply chain model](image)

2.2. Supply chain power infrastructure materials inventory management and traditional material
inventory management comparison
Power infrastructure construction supply chain management starts from the system idea, all activities (logistics, information flow, capital flow) and participants involved in the production process of electric power infrastructure products (owners, general contractors, design subcontractors, engineering subcontracting) Businesses, material suppliers, labor subcontractors, etc.) Take the owner as the core enterprise and conduct integrated management and control through an effective management system [4]. The power infrastructure construction supply chain management emphasizes the inter-departmental integrated management within the enterprise, and emphasizes the integrated management of the company's external cross-company. By establishing common strategic goals among enterprises, perfect trust and cooperation mechanisms, collaborative work patterns and information sharing mechanisms, we can improve corporate performance and respond quickly to customer needs, thereby enhancing our core competitiveness. Power infrastructure construction supply chain management is a modern power infrastructure management thinking method, which is very different from the traditional power infrastructure management method. The following table is a simple comparison of traditional power infrastructure management methods and supply chain management methods.

| Management object          | Building supply chain management method | Traditional building management method |
|---------------------------|----------------------------------------|---------------------------------------|
| Management goal           | Aiming at improving owner satisfaction  | Meeting the requirements of the contract |
| Management integration    | Project life cycle management          | Independent design and construction stages |
| Degree of cooperation     | Establish long-term strategic partnerships | Emphasize contractual requirements and focus on competition |
| Information flow situation| Transparent sharing of information      | Information hiding                    |
| Capital flow situation    | Instant payment, minimizing capital costs | Deferred payment                     |
| Material flow situation   | Transported to the construction site in stages by schedule | All materials are shipped to the construction site in advance |
| Delivery lead time        | Short cycle and strong stability, short lead time | Uncertain supply, long lead time |
| Resource allocation range | Resources are configured on the supply chain | Resources are configured within each enterprise |
| Management method         | Flexible management                    | Rigid management                      |

3. There is a problem with the current inventory management of power infrastructure materials

3.1. The supply chain system is not integrated enough
The traditional transaction-based supplier and customer's single point connection, small communication channels, fragile relationship, large cooperation resistance, easy to be destroyed by competitors and is not conducive to further development. Through the integration of supply chain integration, the relationship between suppliers and customers will be based on “maximizing the value of end consumers”. The goal of the company is to increase market share, that is, maximize customer satisfaction, pursued by suppliers and customers. It is a long-term interest. The pressure generated by this goal is two-way or multi-directional. It will encourage suppliers and customers to cooperate with each other to reduce transaction costs, improve quality, coordinate production planning, improve logistics distribution
efficiency, etc., so that single-point connections transform into a multi-purpose connection and build a successful supply chain strategic alliance [5].

3.2. Despise infrastructure inventory management

For power infrastructure companies, material procurement generally uses a combination of volume ordering and discounting to control procurement and inventory costs. Over the years, suppliers have not promoted the development of power infrastructure enterprises. The important reason is that enterprises have problems in the management model of procurement and inventory. It is necessary to coordinate and cooperate with supply chain related enterprises to optimize the overall cost of the supply chain instead of optimizing the cost of a supply chain node. Electric power infrastructure enterprises are currently in the traditional inventory management state. Warehouse supply is generally passive acceptance of materials. Many stocks can not only generate new value, but also may deteriorate due to long storage time. Finally, warehouse space is in short supply; safety stock level is set. Too high, inventory costs take up too much cost. The main problem is that the cooperation between enterprises in the supply chain is not strong enough. Each department is only a separate one. Only the supply chain management method can solve the problem.

4. Inventory management of power infrastructure materials in the supply chain

4.1. Establishing a joint inventory management model for infrastructure materials

The construction party's demand rate for building materials varies with each order quantity. In order to analyze the inventory situation of the construction party, it can be illustrated by the legend: in the range of period i, the order quantity of the construction party is 3, and the demand rate is different within the scope of the construction party. In addition, the specific order quantity of the construction party is not fixed [6].

![Figure 2. Stock level of the construction party](image)

After detailed analysis of the previous section, the following table can be used to detail the inventory accumulation and consumption of the construction side. The area of the peripheral step type area is the accumulation of the construction side inventory, and the area of the gray area is the consumption of the construction side inventory. Therefore, the average inventory level per unit period of the i-th week of the construction party is the white step-shaped area $S_i$, minus the area of the shadow step area $D$. 
There are many investments in power grid projects, such as a large amount of engineering, scattered points, urgent requirements for construction period, more types of materials, and comparison of delivery time. There are obvious seasonal characteristics. For example, during the spring inspection and autumn inspection, there are more concentrated operations. Both lead to more uncertainty. In order to ensure the supply of grid materials under limited time and capital conditions, it is necessary to make a comprehensive forecast of the annual agreement inventory demand plan for grid materials through statistical analysis of historical data, joint operation, maintenance, and maintenance. In the case, the grid company built a mathematical model based on historical data in the past three years, compiled a grid material plan forecast, and prepared for the grid material inventory bidding and supplier consignment [7].

The actual consumption list of grid materials in the past three years is derived from the ERP system, and the Brownian exponential smoothing method is adopted to improve the accuracy of the prediction. The calculation formula is: demand forecast value = a × actual demand of the most recent year + (1-a) × actual demand two years ago, (a takes the value of 0.6). Take the three-year demand for 10kV overhead insulated wires as an example.

| Demand measurement table |
|--------------------------|
| project | 2015 | 2016 | 2017 |
| Annual usage (km) | 1832 | 2355 | 3256 |
| Forecast usage in 2018 | | | 3663 |

4.3. Strive for zero inventory in the context of the supply chain
As a relatively mature management method, zero inventory management has been widely used by many units in the field of material supply. It has achieved obvious economic benefits and reversed the contradiction between material demand and supply for many years. Zero inventory management has flexible and diverse application methods, which can be applied separately for different situations. (1) Manufacturers or distribution units that provide materials for the production of power companies for a long time, in accordance with the company's own needs and varieties, long-term storage in the warehouse of the materials department, and regular payment after use. Mainly applicable to long-term materials. (2) Some of the second and third types of materials with sufficient market resources can be used according to the unit's required plan, and can be delivered with the purchase or by the designated unit according to the plan, achieving a complete “zero inventory”. (3) For some products produced by the third industry organization within the unit, the advantages can be utilized, how much, how much, and directly sent to the user, and finally settled. (4) For materials with strong consumption laws and normal supply channels, the futures contract supply method can be used to reduce reserves.
5. Conclusion
The power infrastructure and materials department is an important department of pipe and pipe management. How to play a good role in enterprise inventory management, reduce enterprise inventory and reduce material procurement costs has always been the focus of power infrastructure construction enterprises, and is also an important aspect for enterprises to achieve sustainable development. Inventory management is not only the management of physical objects, but more importantly the management of planning, procurement and follow-up processes. Inventory management is not only the work of the material department, but should be upgraded to the entire company level. Carrying out inventory management based on the concept of supply chain management will inevitably bring higher competitiveness to enterprises.

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