Green Supply Chain for Electromechanical Engineering of Rail Transit

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Abstract. Greening of ventilation and air conditioning systems, water supply and drainage systems, and electrical system supply chains in rail transit electrical and mechanical engineering, it can effectively reduce energy consumption and save resources to provide guarantee for the sustainable development of rail transit. This paper studies the long-term construction practice experience of Chengdu Metro in Sichuan Province, Collected and sorted out information and information on key points of energy loss and environmental protection and energy conservation. Apply case studies and survey studies for typical sites, it is concluded that there are still a lot of green space in the supply chain links of the three major systems in the rail transit mechanical and electrical engineering. Develop an optimization plan for reducing consumption in each stage of the ventilation and air conditioning system, Ways to reuse water resources in water supply and drainage systems, Methods and measures for energy saving and environmental protection in electrical systems. The viewpoint of this thesis starts from practice and has practical guiding significance for the green supply chain of rail transit electromechanical engineering. But green environmental protection is an eternal topic for human beings, with the continuous advancement of social economy and science and technology, there will be more in-depth research.

1. Introduction
As the social economy continues to grow, the population of large and medium-sized cities is becoming denser. Rail transit construction has become one of the main ways for the public to travel green. At the same time, the construction of rail transit should also be energy-saving and environmentally friendly. The electromechanical engineering in rail transit engineering is energy conservation and environmental protection, providing the most important for sustainable development. Based on the green supply chain link in the rail transit electromechanical engineering, the following three questions are raised:
First, the green supply chain problem of ventilation, air conditioning and cold sources.
Second, the green supply chain problem of water supply and drainage.
Third, the green supply chain problem of environmentally controlled power.

2. Research theory

2.1. Theory of green supply chain for rail transit electromechanical engineering
In the rail transit electromechanical engineering, ventilation, air conditioning, water supply and drainage, and electrical systems are organic wholes that cannot be completely separated from each other[1]. The application of wind, water and electricity should be embedded in the concept of environmental protection and energy conservation from the construction planning and design stage to the supply of equipment materials, engineering implementation, system inspection and acceptance, and operation and maintenance[2]. Under the premise of ensuring the normal operation of rail transit, the basic principle of not wasting energy and minimizing unnecessary energy consumption. Pursuing new energy alternative products, new construction techniques, and applying new technologies such as high-tech
predicting reasonable energy consumption, to facilitate the sustainable development of mechanical and electrical engineering [4].

The construction of a green supply chain for ventilation, air conditioning, water supply and drainage, and electrical systems in rail transit electromechanical engineering includes three components: reducing energy loss, energy reuse, and reducing environmental pollution [5]. The viewpoint of this paper is that ventilation and air conditioning are particularly important, and it is the main content of energy loss in rail transit electromechanical engineering. Second is power loss, and again the problem of low efficiency of energy recycling in water supply and drainage. In-depth study to find key points of energy consumption and develop appropriate improvement measures. Building a greener and more sustainable supply chain is the focus of this paper.

Figure 1. Rail transit electromechanical engineering green supply chain

2.2. Rail transit electrical and mechanical engineering green supply chain literature

The concept of a supply chain is around a core enterprise. Through the control of information flow, logistics, and capital flow, starting with the procurement of raw materials, intermediate products and final products, finally, the product is sent to the consumer by the sales network [6]. A functional network chain structure model that connects suppliers, manufacturers, distributors, retailers and end users into a whole. The supply chain discussed in this paper is a rail transit engineering entity finally completed by equipment raw material suppliers, equipment installation suppliers, design units, construction units, and construction and operation units [7].

The green supply chain was first proposed in 1996 by the Manufacturing Association of Michigan State University. Also known as the environmentally conscious supply chain [8]. It is based on the supply chain and incorporates a modern management model of environmental impact and resource efficiency. In the study of this paper, the green supply chain is premised on green manufacturing, and supply chain management technology is guaranteed. In the construction process of the entire rail transit electromechanical engineering, the side effects to the environment are the smallest, and the resource efficiency utilization rate is the highest [9].

The definition of energy saving and environmental protection, energy saving is just as saving water. The full name of environmental protection is environmental protection [3]. It refers to the general term for various actions taken by human beings to solve real or potential environmental
problems, coordinate the relationship between humans and the environment, and ensure the sustainable development of the economy and society [10]. Energy conservation and environmental protection in rail transit electrical and mechanical engineering is achieved through the construction of three major types of systems: ventilation and air conditioning systems, water supply and drainage systems, and power systems.

3. Research methods
The main research methods of this thesis are investigation research method and case analysis method. The case analysis method, the case analysis method, is one of the field studies. Refers to the selection of one or more scenarios as research objects, the collection of problems and data generated by the system to study the situation of a phenomenon in the actual environment. As a building entity, the rail transit construction project has the characteristics of functional applicability safety and durability and low tolerance. However, it is not completely similar to other civil construction entities. The municipal engineering construction has a small audience, professional management talents and technical personnel are few, and the number of entities built is limited. Therefore, the case analysis method is the most direct and effective research method. By analyzing the advantages and disadvantages of a completed representative site and finding out the key points of environmental protection and energy saving or energy loss, an optimization plan is obtained.

The survey research method refers to the relevant data directly obtained by examining the objective conditions, and the anatomical analysis of these materials. It is not limited by space and time, and is a research method commonly used in descriptive and exploratory research. Rail transit engineering is not completely independent in the development process. It can continuously improve the greening of supply chain by learning from and learning advanced methods and experiences at home and abroad. Therefore, the research method is also one of the research methods used in this paper.

4. Discussion analysis and results
Based on the actual construction of underground rail transit, take the Chengdu Metro in Sichuan Province, China as an example. At present, Chengdu has been running 11 main lines and extension lines and 6 subway lines are under construction. In the long-term engineering practice survey, the following cases are more representative.

4.1. Case study of energy consumption of ventilation and air conditioning cold source system and scheme for energy saving and consumption reduction
The TFGC station of Chengdu Metro Line 1 has a ventilation capacity of 2.5 times that of other similar stations. Analysis of its root causes leads to the following conclusions:

First, in the civil structure, avoid the situation that the entrance and exit are in direct communication with the station hall. Under the premise of meeting the safety evacuation, a turning aisle should be set between the subway entrance and exit and the hall floor. The entrance and exit of the through-passage hall has been completed, and an air curtain should be added to exchange airflow between the partitions to reduce the ventilation and air-conditioning and the loss of cold source in the station. Set the screen door on the platform level with conditions and seal it tightly. Airflow exchange between the partitioned tunnel and the platform floor reduces ventilation, air conditioning and cold source losses.

Second, in the design phase, all relevant professions provide heat according to the national certification inspection data provided by the equipment manufacturer. After the design units are
aggregated, the unified expansion by the designers through calculation and comprehensive consideration. The ventilation and air conditioning unit itself uses frequency conversion and first-grade energy-efficient equipment to achieve energy-saving effects. The raw materials of the duct pipe should be made of more environmentally friendly materials. Pipe size and path settings should be as short as possible, the path is short, the pipe is small, and the air volume is large.

Third, during the implementation phase of the project, Organizational management requires a clear division of responsibilities and management processes, and the supervision system is in place. Formulate a unified construction process standard to standardize all aspects of construction, Implement the model first, it can effectively avoid the difference in engineering implementation results caused by insufficient manager experience and weak construction skills. In addition, the division of primary and secondary responsibility of the interface unit is clearly defined, Avoid different construction units pushing each other when problems occur. Do not pay attention to the phenomenon of solving the problem of fundamental engineering quality.

Fourth, in the inspection and acceptance and delivery operations and maintenance phase, Although the country does not have a clear standard to measure the energy consumption of ventilation and air conditioning systems. But we should still be results-oriented, satisfy the sense of body and other facilities, not a summer resort. The operational management phase should also establish a clear maintenance process and implement regular inspections and regular maintenance, Ensure that the system is in good operating condition during its service life.

Figure 3. Ventilation and air conditioning cooling source reduction

4.2. Case analysis of environmental protection and energy conservation of water supply and drainage system and green recycling sustainable utilization plan

WJCL Station of Chengdu Metro Line 4 is located at the fourth section of Sun Moon Avenue in Chengdu, about 30 kilometers from the city center. The station's sewage lifting system uses a new type of covered steel sewage collection device. This device is lighter and more durable than ever, greatly improve the working efficiency of the hoist, Not only saves power resources, the sealed sewage collection device also protects the environmental sanitation around the machine room and achieves a win-win effect.

The station is equipped with rainwater recovery and water treatment devices. During periods of heavy rainfall, Collect rainwater to the reservoir and carry out preliminary purification to medium water, these water resources can be used for green irrigation around the site, toilet flushing and floor cleaning. At the
same time, the drainage of the sink basin in the station is also recycled to the reservoir and reused as water. Changed the use of municipal water in the past. Energy conservation and environmental protection have also eased the rainy season to a certain extent. Due to the untimely discharge of municipal water, the problem of rainwater pouring from the subway entrance and exit to the subway. The station's water supply and drainage resources are about 80% of the usage of similar sites. It is a model station that saves energy and provides sustainable resources.

Figure 4. Reuse of water and wastewater resources

4.3. Practice Survey of Power System Energy Saving and Consumption Reduction Supply Chain Greening Plan
In all rail transit electrical and mechanical engineering, the inevitable loss of electric energy is the traction loss of electric buses. Mechanical heating of power supply equipment and loss during transmission of wires and cables. Chengdu Metro summarizes past construction experience and continuously learns advanced skills of other cities. Investigating the energy saving of metro power in large cities at home and abroad: By reducing the weight of the vehicle, Field inspection of the manufacturer's manufacturing process and the raw materials used in its production. Use energy-saving transformers and power supply equipment, the wiring inside the equipment is neat and tidy. Reduce self-energy loss caused by heat and electromagnetic effects. Reasonable optimization of wire and cable design and select the range of designated environmental cable suppliers, in the contract, the project implementation unit agrees that green energy power supply chain can be greened by means of energy-saving end equipment and energy feeding devices.

Figure 5. Power system energy consumption ratio
5. Conclusion
In summary, this paper adopts the methods of selecting excellent suppliers, energy-saving and environmentally-friendly raw materials and equipment, optimizing engineering design, and standardizing construction behavior. Green ventilation, air conditioning, water supply and drainage, electrical system supply chain, so that the rail transit electromechanical project can achieve energy saving and environmental protection, Sustainable development goals for energy recovery. The solution provided in this paper is the conclusion drawn from the practical experience and in-depth investigation and research of the construction of rail transit in Chengdu, have practical and feasible. With the further development of rail transit projects and the continuous improvement of people's living standards, Greening of the electromechanical system supply chain will also place higher demands. Today, with the rapid development of high technology and new energy, we can also use computer simulation technology, VR technology, etc. to implement virtual construction of future rail transit electromechanical engineering. Calculate and test the energy consumption status, Find the key to the problem and work out the appropriate optimization measures. Therefore, it is more conducive to the supply chain greening of rail transit electromechanical engineering.

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