Research on Electromechanical Energy Saving Technology in Aviation Logistics from the Perspective of Low Carbon

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Abstract. With the development of social economy, the consumption of natural energy is intensifying day by day, and the continuous increase of carbon emissions has caused global attention to low-carbon economic issues. Under the theory of low-carbon economy, enterprises should acquire more policy resources and market resources by adopting low-carbon development concepts, improve core competitiveness, and promote the sustainable development of enterprises. For logistics companies, adhering to the concept of low-carbon economic development is the best choice in line with the national strategic deployment of energy conservation and emission reduction. In recent years, under the background of extensive development, China's logistics industry has high costs and large carbon emissions. It is necessary to rely on low-carbon economic theory to improve the bad development situation and promote the sustainable development of China's logistics industry.

Keywords: low-carbon economy, air express logistics, supply chain theory, economic management.

1. Introduction
Air logistics is a modern logistics centered on airports, with air transportation as the main mode of transportation. The high speed and safety of aviation logistics have greatly catered to the needs of the speed economy and become an important driving force for the continued growth of the regional economy. As the central facility of aviation logistics, the airport has undergone tremendous changes in its position and function. It has become an important node of a multi-functional logistics center and global supply chain. A special functional area-the airport area. Although the concept of airport is only a few decades, it has had a very strong impact on the regional economy and the global economy.

2. Related theoretical analysis

2.1. Low-carbon economy
The so-called low-carbon economy means that under the guidance of the concept of sustainable development, through technological innovation, institutional innovation, industrial transformation, new energy development and other means, as much as possible to reduce the consumption of high-
carbon energy such as coal and oil, and reduce greenhouse gas emissions. A form of economic development that achieves a win-win situation between economic and social development and ecological environmental protection. To develop a low-carbon economy, on the one hand, it is actively taking responsibility for environmental protection and fulfilling the requirements of the national energy saving and consumption reduction indicators; on the other hand, it is to adjust the economic structure, improve energy efficiency, develop new industries, and build an ecological civilization. This is a realistic way to abandon the previous development model of pollution first, treatment first, low end second, high end first, and extensive first intensive. It is an inevitable choice to achieve a win-win situation between economic development and resource protection. The low-carbon economy is an economic model based on low energy consumption, low pollution, and low emissions. It is another major progress in human society after agricultural civilization and industrial civilization. The essence of the low-carbon economy is the issue of efficient energy use, clean energy development, and the pursuit of green GDP. The core is the fundamental transformation of energy technology and emission reduction technology innovation, industrial structure and institutional innovation, and the concept of human survival and development. Figure 1 shows the low-carbon economic model.

2.2. The core competitiveness of enterprises with low-carbon economy

The central idea of a low-carbon economy is to save energy and reduce emissions, and its purpose is sustainable and healthy development. Based on various approaches such as technological innovation, system reform, industrial optimization, new energy development, etc., the energy pressure and environmental protection pressure caused by the extraction and consumption of petroleum coal are minimized, and the economic development in which social economic development and ecological environment are coordinated is finally achieved. situation. If modern enterprises want to occupy more market advantages and obtain more economic benefits for a long time, core competitiveness is an important content that cannot be ignored. Reasonably plan the various assets, resources and organizational structure of the enterprise as a key strategic development to deal with fierce market competition. Core competitiveness is the most basic and the most critical component in business operations and business competition. Low-carbon competitiveness refers to a comprehensive ability for business operation development and compliance with the low-carbon economic situation. Under the theory of low-carbon economy, the low-carbon competitiveness of logistics enterprises can be decomposed into "resource capacity", "technical capacity", "management capacity" and "environmental protection capacity", that is, the control of resources and the use of technology under the path of economic development. Operation management and environmental awareness, environmental protection measures, etc. [1].

![Fig. 1 Low-carbon economic model](image-url)
2.3. Green logistics

On a global scale, environmental issues have received much attention as early as 1960, and the concept of green consumption has gradually spread throughout the world. The United Nations designates June 5 of each year as World Environment Day, and regularly holds international conferences on the theme of environmental protection. It also introduced a series of environmental protection policy measures, which have created a good environment for the development of green and low-carbon logistics. Green, low-carbon logistics is to develop the logistics industry on the basis of environmental protection, and give full play to the role of the most advanced environmental protection technology. In the logistics distribution process, the resource consumption must be kept to a minimum level, and the harm and pollution caused to the environment should be controlled. Minimally, Green logistics has a broader logistics base, a wide range of participants, and a wider range of activities. Green logistics is an effective practice of the sustainable development strategy in the logistics industry. Strengthening environmental awareness in production, transportation, loading and unloading and other links is the foundation of green logistics development, and it also lays a solid foundation for the construction of a low-carbon economy.

3. The key points of the integration of the aviation logistics service chain in the comprehensive experimental zone of the airport economy

The integration of the aviation logistics service chain belongs to the external supply chain integration in the supply chain integration. The external supply chain integration mainly includes the integration of the external supply chain process and the integration of the external supply chain information. External supply chain process integration refers to the design and optimization of business processes between enterprises that cross enterprise boundaries in the supply chain to reduce non-value-added activities, eliminate waste, and realize the optimal integration of resources between enterprises. The result of External supply chain information integration is the use of information technology to achieve the integration of information and knowledge resources between enterprises.

3.1. Cooperation between node enterprises

There are three operating modes for cooperation between supply chain node enterprises: center dependent type, strong combined type and symbiotic network type. The latter two forms of driving mode are unclear and the effect is not ideal. The center dependent type is the most effective mode. The center-dependent type is based on an enterprise as the core, and other enterprises are independent units around the core and follow the central enterprise to operate. The effect of cooperation between node companies depends largely on the influence of core companies. At present, although major projects such as the UPS project, Sinotrans, and the DHL base project have successively settled in the airport area, the airport area has not yet formed a clear concept of the core enterprise of aviation logistics.

3.2. External environment of aviation logistics

In order to promote the development of modern logistics industry to a new level and further promote the overall development of the economy, China has successively formulated a series of modern logistics industry development policies. It provides policy guarantee for the development of modern logistics from the aspects of land supply, tax collection and management, fee reduction and exemption, and government subsidies, but in general, the policy support system is not yet perfect.

3.3. Integration of aviation logistics information

The airport area has always put informatization construction as the top priority. In aviation logistics informatization construction, it has put forward the policy of strengthening network construction and promoting logistics technology innovation, but in the specific construction, a more practical and integrated platform model is needed as guide. From the above analysis, we can see that the three key points of the integration of the aviation logistics service chain in the comprehensive experimental area of the airport economy are: the determination of the core enterprise, the construction of the external...
environment for the development of aviation logistics and the construction of the aviation logistics information data center, as shown in Figure 2.

![Fig. 2 Key points of aviation logistics service chain integration](image)

3.4. Participants
In the process of transporting goods from the supply place to the receiving place in air logistics, we provide customers with high-quality value-added services and improve transportation efficiency through air transportation and other related services. Air logistics cannot only depend on air transportation services, it also needs other high-quality and comprehensive logistics services. The main body of enterprises involved in the process of aviation logistics operation is more complex and more in number. Among them, the main service bodies are airports, cargo agents and airlines. These bodies are mainly responsible for ground and air logistics operations. In addition, there are participating parties such as the government, cargo owners and other ground transportation companies. As shown in Figure 3.

![Fig. 3 Multi-participated aviation logistics operation process](image)

Table 1 is the relevant data of China's air logistics and freight. Taking this table as an example to study the status of each value-added link of air logistics in the air logistics value chain.
Tab. 1 Partial income statistics of China's civil aviation enterprises from 2011 to 2015

| Years | Air freight | Proportion (%) |
|-------|-------------|----------------|
|       | Revenue (ten thousand yuan) |                      |
| 2010  | 5281291     | 74.33           |
| 2011  | 5666710     | 65.54           |
| 2012  | 8367925     | 72.73           |
| 2013  | 8151031     | 64.26           |
| 2014  | 11682546    | 69.1            |
| 2015  | 13339549    | 63.99           |

| Years | Airport services | Proportion (%) |
|-------|------------------|----------------|
|       | Revenue (ten thousand yuan) |                  |
| 2010  | 525994           | 7.4            |
| 2011  | 685819           | 7.81           |
| 2012  | 1925091          | 16.73          |
| 2013  | 1242009          | 9.79           |
| 2014  | 1633394          | 9.67           |
| 2015  | 2088840          | 10.02          |

It can be seen from Table 1 that from 2000 to 2015, the total data of air transport revenue, air transport revenue and airport service revenue all showed continuous growth, but at the same time, the proportion of air transport revenue in total revenue has decreased, And the proportion of airport service income has increased relatively. It can be seen from this that air transportation and airport services are indispensable value-added links in the air logistics transportation value chain, while other types of services are limited by factors such as route resources and freight equipment.

4. Low-carbon operation mode of aviation logistics

The low-carbon logistics operation method requires reducing redundant or repeated logistics operations and the number of logistics activities, so as to achieve the purpose of reducing carbon emissions. In view of the actual situation of the air express logistics enterprises in the Airport Economic Zone, this model is mainly applicable to the delivery and delivery links of main roads.

4.1. Dynamic centralized mode of receiving and dispatching

The dynamic centralized mode of receiving and dispatching means that different express logistics companies serving the same e-commerce platform, with the help of intelligent information systems, through resource integration and scale advantages, change the traditional mode of random delivery of e-commerce sellers from the receiving link, namely: The dynamic centralized mode takes cities with distribution centers as the unit and a fixed time period as the statistical interval. According to the real-time statistical data displayed by the intelligent information system, each seller of the e-commerce platform chooses to send to the destination city within the time period of the largest express delivery logistics company. The dynamic centralized mode of delivery is suitable for areas with large express logistics business volume, many express logistics enterprises and high concentration. The airport economic zone has such characteristics and requirements. The essence of this model is to integrate the originally independent express logistics companies into a large dynamic system in substance rather than form with the support of intelligent information systems, according to the specific conditions of the actual business under the e-commerce platform in different time periods Collaborate with division of labor in different regions.

4.2. Trunk Road Scale Transportation Mode

With the construction and improvement of airport hardware facilities and the popularization of online shopping, the airport air express business volume has shown a continuously increasing trend. In order
to improve the timeliness of stopovers or transit services, express delivery companies such as SF Express, Zhongtong, and Yuantong have or will build warehousing or logistics transit centers at airports. Therefore, the main road refers to the main line between the logistics center of each express logistics company in the core area of the airport and the logistics center located near the high-speed rail or highway of the surrounding city, mainly including railways and highways [2].

The main road scale benefit model refers to the integration of express delivery by express companies on the railways and road transport lines connected to the airport, mainly the transportation method of large cargo vehicles, and changing the existing repeated, scattered, random transportation methods. This model is premised on the implementation of the dynamic centralization model, which is essentially a continuation of the dynamic centralization model, and together form the economies of scale in transportation. On the one hand, by integrating and optimizing the trunk transportation market, trunk line transportation can play a role in reducing transportation costs, because logistics companies under the same e-commerce platform business have completed the express delivery at each timing based on the dynamic centralized mode of receiving and dispatching. The time period is according to the regional concentration, so the entire vehicle on the transportation trunk line can be undertaken by the express delivery company with the largest freight volume in each time period, which can fully play the role of scale economy; Load or no load. At present, the airport area has shown a trend of large freight volumes from the airport to surrounding cities, but insufficient return traffic, resulting in huge and unbalanced transportation costs. The main road transportation mode based on dynamic concentration has changed from a dozen of courier companies in the two cities to deliver at the same time, and now it has been concentrated to one or two packages, which greatly provides the return vehicle full load transportation the possibility. For third- and fourth-tier cities with insufficient business volume, the scale advantage under this model is more obvious.

5. Aviation logistics enterprise economic maximization model

As we all know, the profit of a commodity depends on the sales volume and price of the commodity. If the price of a commodity is too high, it will inevitably lead to a decline in its sales volume; conversely, when the price of a commodity falls, the sales volume will increase, which means that to promote sales, it is necessary to lower the price as a means. The profit of an enterprise is equal to the total sales of products produced by the enterprise minus the total cost of producing these products, so the net profit of a commodity is roughly expressed by a mathematical formula as $R = (PC)Q$, where $R$ is the profit of the commodity, $P$ is the price of the unit commodity, and $C$ is the cost of the unit commodity. $Q$ is the sales volume, and the sales volume $Q$ has a certain relationship with the price $P$ to a certain extent $R = (P-C)P$, so $C$, the goal of the manufacturer is to determine the price $P$ reasonably, so as to maximize the profit $R$. The following discusses the issue of optimal prices for logistics enterprises from shallow to deep.

Generally speaking, the price obtained when the marginal income of a logistics manufacturer is equal to its marginal cost is the optimal price for the product to obtain the maximum profit [3]. From the perspective of economics, the following three examples are used to briefly analyze the product pricing problem when logistics companies supply and demand commodities.

(1) It is assumed that the entire logistics service process of the logistics enterprise represents the sale of logistics goods, and the cost of each logistics product is $c$, and it is assumed that the demand for logistics goods meets $f(p) = a-bp(p,a,b > 0)$. According to the theory that the marginal benefit is equal to the marginal cost:

$$d[pf(p)]/dp = a-2bp = df(p)/dp$$

Solutions have to:

$$p = (a+b)/2b = a/(2b) + c/2$$
Therefore, it can be seen that the optimal price of logistics products is composed of two parts: part of the price is half of the cost \( c \) of each logistics product, and part of the price is half of the ratio of the absolute demand quantity \( a \) and the logistics price change coefficient \( b \). This is the simplest price model, indicating that logistics companies can make optimal pricing from the two parts of cost and logistics demand parameter values.

(2) It is assumed that the unit cost of logistics goods (i.e., logistics services) and the logistics demand function are the same as I above, but the additional conditions: assuming that the total logistics time is \( t \) and the number of logistics services during this period is \( m \), then the logistics enterprise The optimal price model is

\[
p = \frac{(a * t - m) / (b * t)}{a / b - m / (b * t)}
\]

The model shows that the optimal price of logistics products depends on the logistics demand function \( (a, b) \), the logistics service time \( t \) and the quantity of logistics services \( m \), and has nothing to do with the cost of logistics products \( c \). This is an ideal situation, considering that logistics services are relatively less costly due to technological innovation.

(3) On the basis of the above two points, it is now assumed that due to factors such as freight and logistics losses in the logistics distribution process, the cost \( c \) of each logistics commodity is variable, and its growth rate over time is \( r \), and supplement the initial cost is \( C_{0,t} = 0 = C_{0} \), and the situation becomes more complicated. The optimal price model is:

\[
p = \left( \frac{a * t - m) / (b * t) - C_{0} \cdot [(1 + e)_t - 1]}{2t + C_{0} \cdot t / 2} \right)
\]

When \( t \) is relatively small, \( (1 + e)_t \rightarrow t \), then there is

\[
p = \left( \frac{(a * t - m) / (b * t) - C_{0} \cdot t / (2t) + C_{0} \cdot t / 2}{(a * t - m) / (b * t) + C_{0} \cdot (t - 1) / 2} \right)
\]

It can be seen from equation (4) that the optimal price of logistics goods consists of three parts: the first part is inversely proportional to the change in logistics demand, positively related to the absolute logistics demand, and negatively related to the quantity of logistics; the second part is related to the initial cost of logistics It has an exponential positive correlation and is inversely proportional to the logistics time; the third part is the half of the cost required to complete the entire logistics service under the condition that the initial unit cost of the logistics remains unchanged, namely \( C_{0} \cdot (t / 2) \). It can also be seen from equation (5) that when the entire logistics process time is relatively short, in addition to the first part of the optimal price composition being unchanged, the second and third parts can form a linear part, that is, logistics cost and logistics time factors: \( C_{0} \cdot (t - 1) / 2 \). Among them, the logistics optimal price must increase with time.

6. Relevant strategies for the development of aviation logistics in the Airport Comprehensive Experimental Zone

6.1. Construction of aviation logistics information data center

Air logistics can be divided into land processing and air transportation, which generates two parts of information flow. At present, air logistics has not well-connected land information and air transportation information, resulting in low information collection efficiency, high error rate, and operational errors. High-rate results. The airport area attaches great importance to the construction of informatization, and proposes the idea of actively constructing an information network system and a modern logistics public information network platform. Effective and high-speed connection; realize
airport logistics park (center) management, information connection between park (center) enterprises, and enterprises and the outside world. The construction of aviation logistics data center is the first step to construct a logistics public information network platform. The main task of the air logistics data center is to integrate land logistics information and air logistics information. Land logistics mainly involves three node companies: air freight forwarding companies, transportation companies and airport cargo stations. Air transportation mainly involves airlines, as shown in Figure 4, an aviation logistics data center. Accordingly, the aviation logistics data center consists of the following parts:

6.1.1. Air freight forwarding enterprise database. On the one hand, the database can record the initial information of the goods when the freight forwarding company accepts the customer's commission, including size, weight, special properties, transportation requirements, etc., and at the same time the goods are transferred, the information is transmitted to the transportation company database. On the other hand, while receiving the goods, the database stores relevant information from the transportation company database to provide support for terminal delivery.

6.1.2. Transport enterprise database. The database also serves the aviation logistics process in two directions. On the one hand, when the transport enterprise receives the cargo from the air freight forwarding enterprise, it stores the cargo information from the database of the air freight forwarding enterprise. At the same time, it updates in real time according to the transportation situation and transfers the goods. At the time, the information is transferred to the airport cargo station database; on the other hand, when receiving the cargo from the airport cargo station, the corresponding supporting information is stored and updated in real time during transportation.

6.1.3. Airport cargo terminal database. The database stores the information from the transportation company database when receiving the goods from the transportation company, and updates it during the integrated packaging process, and transmits the information to the airline database at the next cargo handover link; when receiving the goods from the airline, store the corresponding supporting information, and update the information during the cargo sorting process, and then send it to the transportation company database along with the cargo transfer [4].

6.1.4. Airline database. The update of the database information is synchronized with the flow of goods, storing the information from the origin airport cargo station database, performing real-time updates during the flight, and transmitting the updated complete information to the destination airport cargo station database.

Fig. 4 Aviation logistics data center
6.1.5. Aviation logistics data center. The above four databases are all connected to the aviation logistics data center, integrating cargo information and updating in real time, realizing the integration of aviation logistics information management, the openness and transparency of aviation logistics operations and the electronification of logistics transactions.

6.2. The company should formulate a performance evaluation system for various stakeholders
Green supply chain management environmental performance evaluation is to establish a continuous monitoring system for important environmental parameters under comprehensive consideration of other indicators, compare the evaluation results with benchmarks, and then communicate with various stakeholders. It is a procedure for measuring and evaluating the environmental performance of enterprises, and it is a continuous (including past, present and future) information collection work. Constructing a performance evaluation system can enable all stakeholders in the supply chain of an enterprise to understand the environmental risks of the enterprise, judge the pros and cons of investment, and also assist the enterprise operator in environmental management. The construction of a green supply chain performance evaluation system can be carried out from the following three aspects: From a strategic perspective, the focus should reflect green supply in terms of depth of information sharing, organizational learning and innovation capabilities, member stability, and green environmental protection of products. The development capability and potential of the chain and the ability to evaluate; from the perspective of the results, the evaluation system should link green supply chain management with corporate finance. The supply chain performance can be evaluated from the aspects of the supply chain’s financial returns, asset operations, and sustainable development capabilities. Figure 5 shows a schematic diagram of three-dimensional emission reduction measures for aviation logistics enterprises.

6.3. Build a high-quality hardware platform
Innovation of logistics equipment and technology is the foundation. First, low-carbon logistics should be achieved through the application of advanced technologies. Without the development and application of advanced low-carbon logistics technologies, there will be no practical application of low-carbon logistics in related social fields. Low-carbon logistics is centered on the development and application of energy consumption technologies, renewable energy technologies, and greenhouse gas emission reduction technologies. These technologies can be hardware conditions such as equipment, venues, and logistics facilities, as well as management concepts, management methods, and professionals. Wait for soft conditions. The hardware conditions mainly include the use of logistics equipment with greater work capacity and lower energy consumption, such as high-throughput forklifts, automatic guided trucks, robots and other highly efficient mechanized operations to replace...
the traditional small-capacity push car. Another example is the use of integrated transportation vehicles such as forklifts, pallets, and shelves in the process of loading and unloading, which enables logistics companies to reduce inefficient handling, improve loading and unloading efficiency, and reduce the pressure of logistics on the environment. Low-carbon operation and operation specifications and methods, scientific and efficient logistics operation process, etc. The specific contents of these soft technical condition indicators are different in different operation links. Low-carbon logistics requires the development of corresponding standards for different logistics function links and unified coordination to improve the low-carbon management level of the logistics system.

6.4. Unified standards in the logistics industry to train excellent talents
Due to the late start of development and long-term extensive development, China's logistics industry still lacks standardized operating procedures, and the level of logistics supporting measures is low, which has affected the modernization of the logistics industry. From the point of view of standardization development, the current container usage standards for railway transportation and land and sea transportation in China are inconsistent, which makes it difficult to coordinate the land and sea and railway transportation modes. Work efficiency has a serious impact. As another example, there is no uniform standard for the specifications of domestic pallets, which has seriously affected its versatility. Whether it is mechanization or automation, there is no unified standardization. The low level of standardization indicates that the domestic logistics industry is struggling to achieve automation and mechanization [5].

In recent years, although the number of professional logistics talents trained in China has increased year by year, and the number of people who have obtained professional qualification certificates is still unable to meet the needs of talents in the logistics market, the professionalization and comprehensive quality of talents are insufficient. Is lacking. For any industry and enterprise, talent is an important manifestation of competitiveness, and the quality of the logistics industry directly depends on the number of talents. Through the integration of the two methods of introducing and going out, the cultivation of low-carbon and logistics technology compound talents is achieved. In addition, through effective inter-regional exchanges, it provides a platform for the cultivation of low-carbon and logistics technology composite talents, conducts remote cooperation and training methods, strengthens the cooperation between enterprises and universities, and integrates green logistics management concepts into teaching and business practices. Among them, it can effectively improve the core competitiveness of logistics enterprises.

7. Conclusion
In the context of a low-carbon economy, Chinese companies should take the implementation of green supply chain management as their own conscious action. At the same time, the Chinese government should also increase the construction of laws and regulations on green supply chain. With the implementation of the green supply chain in China, it will definitely achieve a "multi-win" situation of economic, social and environmental benefits.

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