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Review Article

A STUDY ON THE LOCATION SELECTION OF LOGISTICS DISTRIBUTION CENTERS BASED ON E-COMMERCE

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Abstract

With the rapid development of e-commerce, the importance of selecting optimal locations for logistics distribution centers has become increasingly prominent. This paper systematically analyzes the primary factors influencing location selection in the context of e-commerce, summarizing the methods and steps involved. Practice has proven that rational location selection can effectively improve logistics efficiency, reduce operating costs, and enhance competitiveness. Future developments should continue to focus on these issues, making optimal decisions based on the enterprise's development strategies and market environment.

Keywords: E-commerce; Logistics distribution center; Location of warehouse; Efficiency; Data

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Factors Influencing the Location of Logistics Distribution Centers in the E-commerce

Customer Demand

In e-commerce, customer demand is becoming increasingly diverse. To meet the different needs of customers, logistics distribution centers need to have the ability to respond quickly and adjust flexibly. Therefore, when choosing a location, geographic location and traffic conditions should be fully considered to respond quickly to customer demands.

Distribution Efficiency

The location of logistics distribution centers should be conducive to improving distribution efficiency, reducing transportation time, and lowering costs. The convenience of geographic location and traffic conditions are important factors affecting distribution efficiency.

Operational Costs

In e-commerce, logistics costs have become an important part of a company's core competitiveness. The location of logistics distribution centers needs to consider factors such as land rent, labor costs, and facility equipment costs, which can effectively reduce transportation and storage costs and improve the economic benefits of the enterprise.

Supply Chain Coordination

In e-commerce, logistics distribution centers should establish close cooperation with manufacturers, suppliers, distributors, and other entities to form an efficient and smooth supply chain system. Therefore, when choosing a location, full consideration should be given to coordination with all parties in the supply chain to achieve information sharing and resource integration[1].

Methods and Steps for Selecting the Location of Logistics Distribution Centers

Demand Analysis

The selection of logistics distribution center locations should consider the company's development strategy and clarify the service area, service targets, and service needs to provide a basis for location selection.

(1) Clarifying the Service Area: The size of the service area directly affects the location and scale of the center. By analyzing the service area, the necessary infrastructure, human resources, and transportation capacity can be determined.

(2) Clarifying the Service Targets: Understanding the characteristics and needs of the service targets is key to location selection. Through in-depth analysis of the service targets, a better understanding of their delivery needs, time requirements, and types of goods can be obtained, providing targeted information for the location selection.

(3) Clarifying the Service Needs: Service needs analysis mainly involves customers' expectations regarding the service quality, timeliness, and reliability of the logistics distribution center. Understanding these needs can help optimize the layout of the distribution center's facilities, operational processes, and transportation strategies to meet customer expectations[2].

Data Collection

Selecting a location for a logistics distribution center requires collecting data related to geography, transportation, infrastructure, communication, environment, and other relevant factors, followed by detailed analysis and research. (1) Geographic Data: Geographic location, topography, geological conditions, and other geographic data are essential for evaluating land suitability, construction difficulty, and potential risks from natural disasters. Geographic Information Systems (GIS) can be used for visual analysis of geographic data, facilitating a better understanding of the area's characteristics and potential issues. (2) Transportation Data: This includes data on the transportation network layout, road conditions, and traffic flow. These data help assess the development level of the transportation network, transportation efficiency, and the connectivity between the distribution center and external transportation networks. Traffic simulation software can be used to model and analyze transportation data, predicting

traffic conditions and transportation efficiency under various scenarios. (3) Infrastructure Data: Data on water supply, electricity, communication, and other facilities are crucial. These data help assess the completeness and reliability of the infrastructure and whether it meets the operational needs of the distribution center. Communicating and cooperating with local governments or relevant agencies to obtain the latest and most accurate infrastructure data is vital. (4) Market Data: This includes data on market demand, competitor status, and industry development trends. These data help evaluate market competition, growth prospects, and the positioning and development potential of the distribution center within the market. Market research and industry reports can be used to gather market data, followed by in-depth analysis and forecasting. (5) Environmental Data:This includes data on regional environmental quality, air pollution index, noise levels, and other environmental factors. These data help assess the environmental impact and potential environmental risks associated with the distribution center. Environmental data can be obtained from environmental protection departments or professional agencies, and environmental impact assessments and sustainable development analyses should be conducted.

Screening of Alternative Locations

Based on the results of the needs analysis and data collection, alternative locations that meet the criteria are screened. During this process, Geographic Information Systems (GIS) and other technical means can be used for spatial analysis and data processing, allowing for a more scientific evaluation of the advantages and disadvantages of the alternative locations. Through this screening, several potential locations that meet the criteria can be preliminarily determined, providing a basis for subsequent location decisions.

Establishing a Mathematical Model

After the preliminary screening, a mathematical model is established to analyze all the selected alternative locations in detail. This paper uses a saving genetic algorithm to obtain a comprehensive score for each alternative location[3]. Based on order data, the distribution needs of customers are determined, and the straight-line distance between two customers (represented as a two-dimensional array) and the distance from each customer point to the distribution center are calculated. A list in Python is used to sort the N customers and generate Q arrays, where the length of the array should be at least N, represented as 0, 1, ..., (N-1). A fitness function is used to evaluate the fitness of each individual. In the context of path and distance metrics, if the shortest path D is the standard responding to the fitness function, the following situation occurs: the larger D is, the smaller the fitness function is; the smaller D is, the larger the fitness function is. The genetic algorithm can continuously optimize the quality of the solution during iterations by selecting new individuals in each generation based on the fitness function. In the genetic algorithm, new individuals are generated through crossover; therefore, we randomly select individuals that need to be crossed and divide them into two groups, X and Y. These two groups serve as parents for the crossover operation, generating two new offspring, X′and Y′. The expression for this operation is:

$$X = 123|4567$$

$$Y = 765|4321 \qquad (1)$$

The expression for the new offspring after the crossover operation is:

$$X' = 123|4567$$

$$Y' = 765|4321 \qquad (2)$$

Mutation is another crucial operation in genetic algorithms, used to increase population diversity and avoid local optima. Mutation operation typically involves randomly changing some gene values in a small portion of an individual's genes to generate new individuals, maintaining population diversity. In the genetic algorithm process, selection, crossover, and mutation operations are repeatedly performed until the preset termination conditions are met. By reasonably arranging and combining these three operations, a complete genetic algorithm expression can be formed:

$$B = \frac{XY}{D \cdot pm}(N \cdot pc) \qquad (3)$$

The savings genetic algorithm is a method for solving the vehicle routing problem by obtaining the optimal solution through repeated selection, crossover, and mutation operations. After analyzing each candidate location using the savings genetic algorithm, the optimal route for each location is determined, thereby developing a location selection plan that meets multiple objectives[4].

Continuous Optimization

Given that market conditions and customer demands may change, it is necessary to continuously reevaluate and adjust the site selection plan. (1) Real-time Monitoring of Operational Data: By collecting and analyzing operational data such as order volume, delivery timeliness, and costs, we can understand the performance of the distribution center and identify any issues. This data helps to uncover potential areas for improvement and optimization. (2) Formulating Optimization Measures: Based on the analysis of operational data, corresponding optimization measures should be developed to address identified problems. If high delivery costs are found in a certain area, it may be necessary to replan delivery routes to improve efficiency. If there are increased customer complaints, this may be due to delivery timeliness issues, potentially requiring an increase in delivery personnel or adjustments to delivery times. Significant fluctuations in order volume may necessitate adjustments to inventory strategies or enhanced market analysis for more accurate demand forecasting. (3) Ongoing Improvement: Through continuous monitoring, analysis, and improvement, the site selection plan can be made more adaptable to market changes and customer demands, thereby enhancing the operational efficiency and customer satisfaction of the distribution center.

Conclusion

The site selection for logistics distribution centers in an e-commerce environment is a complex and crucial task. By defining selection goals, collecting and analyzing data, performing initial screenings, establishing mathematical models, evaluating and selecting, and implementing and monitoring, the rationality and effectiveness of site selection can be significantly improved. Proper site selection for logistics distribution centers helps companies

enhance logistics efficiency, reduce operational costs, and improve customer service levels, thereby standing out in the competitive market.

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