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Research on regional logistics network planning and design of supply chain based on data analysis

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Abstract: The planning and design of supply chain regional logistics network is a complex task, which needs to fully consider various factors. This paper first reviews the methods of supply chain management, logistics network planning and data analysis. Then, it analyzes the application of data analysis in regional logistics network planning and design of supply chain, including data collection and preprocessing, logistics network layout optimization, inventory management and distribution route optimization, transportation capacity optimization, etc. Finally, the implementation strategy of regional logistics network planning and design of supply chain is put forward, including cooperation strategy, information strategy and risk management strategy.

Keywords: Supply Chain Management; Logistics Network Planning and Design; Data Analysis

1. Theories related to regional logistics network planning and design of supply chain

1.1 Supply chain management theory

Supply chain management refers to the coordination and integration of the activities of all links of the supply chain to achieve efficient logistics processes and optimized resource allocation. Its core theories include supply chain coordination, demand management, inventory management, logistics and transportation and supplier relationship management. Supply chain collaboration emphasizes close cooperation and information sharing among all links to improve the overall efficiency; Demand management focuses on accurate prediction and response to customer needs; Inventory management aims at balancing supply and demand and reducing inventory cost; Logistics focuses on the design and operation of logistics networks; Supplier relationship management emphasizes cooperation and win-win situation with suppliers. These theories provide a theoretical basis for regional logistics network planning and design of supply chain.

1.2 Logistics network planning and design theory

Logistics network planning and design refers to the reasonable design and layout of logistics network according to supply chain demand and resource distribution to achieve efficient logistics operation. Its core theories include: network layout, facility location, transportation path, inventory management and so on. The network layout focuses on the location and number of logistics facilities to meet the market demand to the greatest extent; The location of facilities takes into account factors such as market coverage and transportation costs; The purpose of transportation path optimization is to find the shortest and most economical transportation path. Inventory management is concerned with the balance between inventory levels and service levels.

2. Data analysis in the supply chain regional logistics network planning and design

2.1 Data acquisition and preprocessing

Data acquisition and Preprocessing is an important part of regional logistics network planning and design in supply chain. First, data such as order volume, inventory levels, and transit times are collected through enterprise information systems, supplier and customer data reports, and other channels. Then, the data is cleaned, collated and transformed to ensure the accuracy and integrity of the data. Process and analyze data using formulas and models, such as order volume calculations, inventory level calculations, transit time calculations, and data cleaning models.

2.2 Optimization of logistics network layout

The goal of optimization is to reduce transportation costs, improve distribution efficiency, and reduce the total cost. Comprehensive

consideration of suppliers, customer geographical location, market demand fluctuations, transportation mode and infrastructure construction and other factors, to develop a reasonable layout strategy. Balancing transportation, warehousing and management costs, optimizing layout can reduce supply chain costs and improve competitiveness. Layout optimization also increases flexibility, responds quickly to market demands, and improves customer satisfaction. Reasonable layout can improve transportation efficiency, reduce inventory and transportation costs, and improve competitiveness and profitability.

2.3 Inventory management and distribution route optimization

Inventory management and distribution route optimization are the keys of supply chain management. By analyzing sales data to predict demand, set safety inventory and replenishment thresholds, realize automatic replenishment and early warning, and reduce inventory costs. In terms of distribution route optimization, intelligent algorithm is used to plan the optimal route, monitor the dynamic adjustment of road conditions, and improve the distribution efficiency. Reasonable location of distribution center and optimization of vehicle dispatch, improve coverage and response speed. Take inventory, routing, center and scheduling into account to maximize supply chain efficiency.

2.4 Transportation capacity optimization

The optimization of transportation capacity is a key step in the planning and design of supply chain logistics network. By deeply analyzing data such as volume, time and cost, companies can determine the best transportation options and modes to improve efficiency and reduce costs. Considering factors such as cargo characteristics, distance, time window and cost, select the appropriate mode of transportation and the optimal route. At the same time, reasonable allocation of transportation resources, such as vehicle scheduling and cargo loading. Improve supply chain efficiency by optimizing transportation capacity, increasing efficiency, reducing time and cost. Algorithms such as linear programming, integer programming and simulation can be used to evaluate the pros and cons of the scheme and select the best scheme.Here are some examples of common algorithm code:

(1) Linear programming algorithm:

```python
from scipy.optimize import linprog
Define the objective function and constraints
c = [1, 1, 1] # Transportation cost
A = [[-1, 0, 0], [0, -1, 0], [0, 0, -1]] #Traffic volume constraint
b = [-100, -200, -150] #Traffic limit
Solving linear programming problems
res = linprog(c, A_ub=A, b_ub=b)
print(res)
```

(2) Genetic algorithm:

```python
import numpy as np
from deap import base, creator, tools, algorithms
Define the objective function and constraints
def evaluate(individual):
Calculate transportation costs
cost = np.dot(individual, [1, 1, 1])
Calculated traffic
volumes = np.dot(individual, [100, 200, 150])
Determine whether the constraint conditions are met
```

```
if volumes > 0:
return cost,
else:
return float('inf'),
Define genetic algorithm parameters
creator.create("FitnessMin", base.Fitness, weights=(-1.0,))
creator.create("Individual", list, fitness=creator.FitnessMin)
toolbox = base.Toolbox()
toolbox.register("attr_bool", np.random.randint, 0, 2)
toolbox.register("individual", tools.initRepeat, creator.Individual, toolbox.attr_bool, n=3)
toolbox.register("population", tools.initRepeat, list, toolbox.individual)
toolbox.register("evaluate", evaluate)
toolbox.register("mate", tools.cxTwoPoint)
toolbox.register("mutate", tools.mutFlipBit, indpb=0.05)
toolbox.register("select", tools.selTournament, tournsize=3)
Run genetic algorithm
population = toolbox.population(n=50)
algorithms.eaSimple(population, toolbox, cxpb=0.5, mutpb=0.2, ngen=100)
best_individual = tools.selBest(population, k=1)[0]
print(best_individual)
```

These algorithm code examples can be adjusted and optimized based on specific problems and data to get the best implementation. It should be noted that the selection of algorithms and parameter Settings need to be adjusted according to the actual situation to achieve the optimal transport capacity optimization effect.

3. Supply chain regional logistics network planning and design implementation strategy

3.1 Cooperation Strategy

In the planning and design of supply chain regional logistics network, it is very important to establish close cooperation relationship to realize efficient operation and optimization of supply chain. This cooperation strategy involves all aspects of the supply chain, including suppliers, manufacturers, logistics service providers and retailers. Through resource sharing, information sharing and risk sharing, it helps to improve the overall efficiency and competitiveness of the supply chain. The implementation of cooperation strategies can be through the signing of strategic cooperation agreements, the establishment of partnerships and other ways to jointly respond to market changes, improve the adaptability and flexibility of the supply chain.

3.2 Informatization strategy

Through the use of modern information technology and management system, we can realize the data sharing, information transmission and collaborative decision-making in each link of the supply chain. Common information strategies include the use of logistics management systems (such as TMS), warehouse management systems (such as WMS), and transportation management systems (such as TMS). These systems help improve the visibility, flexibility and responsiveness of the supply chain to better meet customer needs and improve customer satisfaction. The following are some of the data and advantages of these systems: First, logistics management system (TMS) : can help enterprises to track the status of cargo transportation in real time, optimize transportation routes, and reduce transportation costs. According to statistics, the use of TMS can improve vehicle utilization by about 10% and reduce transportation costs by about 5%. Second, warehouse management

system (WMS) : can help enterprises optimize inventory management, improve the efficiency of warehouse operations. Using WMS can improve inventory accuracy by about 20% and reduce inventory costs by about 15%. Third, transportation management system (TMS) : it can help enterprises to track the status of cargo transportation in real time and improve transportation efficiency. Using TMS can improve vehicle utilization by about 15% and reduce transportation costs by about 10%.

3.3 Risk management strategy

Since there are various uncertainties and risks in the supply chain, such as supply interruption, transportation delay, natural disasters, etc., effective measures are needed to reduce the impact of these risks on the supply chain. The risk management strategy includes establishing a risk assessment system, identifying, evaluating and grading potential risks, and formulating corresponding prevention and control measures. It is also possible to ensure the stability and sustainability of the supply chain through the development of emergency plans, the establishment of stock and backup suppliers, so as to reduce the impact of risks on supply chain operations. By establishing a risk assessment system, enterprises can fully understand the potential risks in the supply chain, and properly evaluate and grade them. According to the severity of risk, corresponding prevention and control measures can be developed to reduce the probability and impact of risk events.

4. Conclusion

The research shows that data analysis plays an important role in the optimization of logistics network layout, inventory management and distribution route optimization, and transportation capacity optimization. To realize the optimization of regional logistics network of supply chain, it is necessary to adopt cooperation strategy, information strategy and risk management strategy. In the future, with the development of big data and artificial intelligence technology, the application of data analysis in the planning and design of regional logistics networks in the supply chain will be more in-depth and extensive.

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