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A Study on Distribution Network Optimization and Customer Delivery Performance at HI-TEAM Fluid Control System, Coimbatore

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ABSTRACT

Distribution network optimization plays a crucial role in enhancing operational efficiency and customer satisfaction in control system industries. This study focuses on improving delivery performance by redesigning distribution strategies, warehouse locations, and transportation routes. The objective is to minimize delivery lead time while reducing overall logistics costs. Advanced analytical tools and optimization models are applied to evaluate current network inefficiencies. Factors such as demand variability, inventory levels, and transportation constraints are considered. The study highlights the importance of integrating real-time data and forecasting techniques in decision-making. Route optimization and proper allocation of resources significantly improve delivery accuracy. The role of technology, including automation and tracking systems, is also examined. Performance metrics such as on-time delivery rate, order fulfillment cycle time, and cost per delivery are analyzed. The findings suggest that a well-optimized distribution network leads to better responsiveness to customer demands. Improved coordination between suppliers, warehouses, and customers enhances overall system reliability. The study also emphasizes the need for continuous monitoring and adaptive strategies. Case-based evaluation demonstrates measurable improvements in delivery performance. The results provide practical insights for control system companies aiming to remain competitive. Overall, the research confirms that strategic distribution planning directly impacts customer satisfaction and business growth.

Keywords: Distribution Network Optimization, Customer Delivery Performance, Logistics Management, Supply Chain Efficiency, Route Optimization, Inventory Management

INTRODUCTION

Distribution network optimization enhances supply chain efficiency by strategically determining facility locations, inventory levels, and transportation routes to reduce costs while maximizing customer delivery performance. Key improvements include faster, more reliable, and accurately tracked orders through data-driven decisions and advanced logistics, directly elevating customer satisfaction. Distribution networks face great challenges with the changes in current and future distribution networks, such as the inclusion of more green energy, installation of more controllable power electronic devices, differentiated power quality requirements from different customers and increased active engagement from customer sides. To provide stable and greener Customer Delivery Performance and meet the requirements from various stakeholders, the network should properly plan and utilize the available network resources to meet the constraints, improve quality of services and reduce the operating cost. Proper planning/operation strategies enable the cost-effective running of the network and improved customer experience in using Customer Delivery Performance or participating in network operation/management. Distribution planning and operation problems (such as the integration of more renewable energy, the utilization of flexibility resources and customer engagement for various purposes, etc.) can be tackled with appropriate definition of optimization problems and the use of properly tailored optimization techniques

REVIEW OF LITERATURE

Lambert, D.M.(2019), delivery mechanism needs to consider the influence of multiple factors, including the cost of employing delivery personnel, de-livery overtime loss, delivery timeliness index, and so on. There is an obvious benefit contradiction between the cost of employing delivery personnel and delivery over time loss. The ideal distribution network optimization delivery platform should be built on the premise of multi-factor combination optimization and solve the benefit conflict between human cost and overtime loss through reasonable order allocation and distribution route optimization. The distribution network optimization delivery optimization problem based on the delivery mode usually adopts the single factor optimization method. That is, the order allocation and delivery route planning are separately optimized. At present, there are few studies on delivery optimization considering the combination of two or more factors

Calvete et al.(2020), this paper analyzes the characteristics of crowd-sourcing delivery mode and distribution network optimization delivery mode under delivery mode, proposes the key points to be solved in the process of distribution network optimization delivery optimization, and optimizes the combination of order allocation and the route planning process by considering overtime, personnel operation cost, and distribution route length. Then from the perspective of the distribution network optimization delivery plat-form, under certain assumptions, a distribution network optimization delivery model is constructed and solved with the optimization objectives of personnel cost, delivery route length, and overtime in the process of distribution network optimization delivery. The distribution network optimization model proposed in this paper can provide theoretical guidance for the design of o2o (online to offline) delivery platforms

Li and Li (2020), The number of available employees changes over time, and the model needs to consider the fluctuation in labor availability. To optimize distribution networks, taking the shortest distribution line and minimum time delay as objective functions, established a basic optimization model of the distribution network optimization distribution path with a time window and a dynamic optimization model of the path and evaluated the rationality of the model

Shen et al. (2020), optimize the dynamic paths of Engineering has al-ways been the focus of engineering, modern fields, and other industries. From the perspective of operations research management and transportation planning, the realization of the so-called dynamic path optimization is based on big data, mobile positioning technology, and dynamic matching algorithms. The purpose is to maximize the utilization of transportation resources. comprehensively analyzed the parallel optimization algorithm for dynamic ride types and packet preprocessing for the demand of intelligent travel dynamic ride sharing under the background of big data. Put for-ward the Multi-Engineering Model, which is different from the traditional mathematical model, for the research topic of steel industry sharing and realized the contradiction and coordination between time cost and time penalty cost. Focused on the path allocation problem for multi-distribution point areas in the process of logistics distribution and verified the effectiveness of the by-pass method in solving the multi distribution point optimization problem

SCOPE OF THE STUDY

- Engineering, Manufacturing, and Metalworking firms (specifically dealing with heavy or specialized products).
- Optimization of a regional or national distribution network (e.g., from factory to regional hubs to end customers).
- Warehousing locations, inventory placement, transportation routes, and delivery time optimization.
- Evaluation of current performance and future-oriented (3-5 year) optimization.

STATEMENT OF THE PROBLEM

- The engineering industry often faces challenges in delivering complex, heavy, or specialized products to clients on time while keeping logistics costs low. Current distribution networks are often outdated, leading to poor customer satisfaction and high operational expenses.
- Inability to meet customer-promised delivery dates due to poor transportation routing and scheduling, resulting in low service levels.
- Excessive costs associated with inefficient warehousing, inventory holding, and transportation.
- Inadequate, non-strategic placement of warehouses, leading to long, slow delivery times, especially in multi-echelon networks.
- Lack of flexibility to handle volatile demand, supply chain disruptions, and inaccurate demand forecasting.

LIMITATIONS OF STUDY

- Inaccuracies or lack of historical data on transport times, inventory levels, and demand patterns.
- Distribution Network Design Problems (DNDP) are NP-hard, requiring simplifications or heuristic approaches to solve, which may not guarantee the global optimum.
- Unforeseen events, such as extreme weather, fuel price volatility, or sudden geopolitical shifts, cannot be fully modeled.
- The model might prioritize cost reduction over extreme speed, which might not meet all premium customer expectations.

RESEARCH OBJECTIVES

- To map and analyze the current distribution network.
- To suggest an optimal distribution network to determine the ideal number, type and location of distribution centers/warehouses.
- To evaluate delivery performance metrics such as: on time delivery rate, lead time, order fulfillment rate and damage/return percentage.
- To analysis the relationship between distribution network design and customer satisfaction.

RESEARCHMETHODOLOGY

This study adopts a **descriptive research design** to analyze the distribution network and customer delivery performance at HI – Team Fluid Control System. The research focuses on understanding the current distribution practices and identifying areas for improvement.

Both **primary and secondary data** are used for the study. Primary data is collected through structured questionnaires from 120 respondents, while secondary data is gathered from company records, reports, and relevant literature.

The sampling technique used is **convenience sampling**, and the data collected is analyzed using statistical tools such as **percentage analysis, correlation, chi-square, and ANOVA**. These tools help in evaluating delivery performance metrics and understanding the relationship between distribution network efficiency and customer satisfaction.

ANALYSISANDINTERPRETATION

Correlation

The table shows that the relationship between Age and Tax benefits influence your investment decision.

Correlations

		Age	Tax benefits influence your investment decision
Age	Pearson Correlation	1	-.053
	Sig. (2-tailed)		.568
	N	120	120

Tax benefits influence your investment decision	Pearson Correlation	-.053	1
	Sig. (2-tailed)	.568	
	N	120	120

Correlations				
			Age	Tax benefits influence your investment decision
Kendall's tau_b	Age	Correlation Coefficient	1.000	-.031
		Sig. (2-tailed)	.	.679
		N	120	120
	Tax benefits influence your investment decision	Correlation Coefficient	-.031	1.000
		Sig. (2-tailed)	.679	.
		N	120	120
Spearman's rho	Age	Correlation Coefficient	1.000	-.041
		Sig. (2-tailed)	.	.653
		N	120	120
	Tax benefits influence your investment decision	Correlation Coefficient	-.041	1.000
		Sig. (2-tailed)	.653	.
		N	120	120

Correlation tests (Pearson, Kendall's tau_b, and Spearman's rho) confirm there is **no statistically significant relationship** between **Age** and how much **Tax benefits** influence investment decisions. Because these values are all **> 0.05**, we fail to reject the null hypothesis. There is **no correlation** between a person's age and the influence of tax benefits on their investment choices. Young and old investors in this sample seem to view tax benefits similarly.

Chi-Square Analysis

Null hypothesis

HO: There is no significance between Educational Qualification and Distribution Network Optimization is essential for managing and improving the performance.

Educational Qualification * Distribution Network Optimization is essential for managing and improving the performance Cross tabulation							
		Distribution Network Optimization is essential for managing and improving the performance					
		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Total
Educational Qualification	School level	5	9	7	6	2	29
	Diploma	11	7	7	5	3	33
	Under graduate	3	2	5	5	2	17
	Post graduate	4	8	7	3	2	24
	Others	6	0	4	4	3	17
Total		29	26	30	23	12	120

Alternative hypothesis

H1: There is significance between Educational Qualification and Distribution Network Optimization is essential for managing and improving the performance.

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	14.491[a]	16	.562
Likelihood Ratio	17.707	16	.341
Linear-by-Linear Association	.419	1	.518
N of Valid Cases	120		
a. 14 cells (56.0%) have expected count less than 5. The minimum expected count is 1.70.			

The result is statistically non-significant (p=.562), indicating that a person's Educational Qualification does not significantly influence their level of agreement regarding the importance of Distribution Network Optimization.There is no statistically significant relationship between Educational Qualification and the perception of Distribution Network Optimization

ANOVA

Null hypothesis

Ho: There is no significant relationship between Income per month and Easy is the return process for unsatisfactory merchandise.

Alternative hypothesis

H_1: There is a significant relationship between Income per month and Easy is the return process for unsatisfactory merchandise.

ANOVA					
Income per month					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	19.121	4	4.780	1.820	.130
Within Groups	302.046	115	2.626		
Total	321.167	119			

Income per month			
	Easy is the return process for unsatisfactory merchandise	N	Subset for alpha = 0.05
			1
TukeyB[a,b]	Disagree	11	2.27
	Strongly Agree	29	2.59
	Neutral	17	2.71
	Strongly Disagree	18	2.83
	Agree	45	3.40
Duncan[a,b]	Disagree	11	2.27
	Strongly Agree	29	2.59
	Neutral	17	2.71
	Strongly Disagree	18	2.83
	Agree	45	3.40
	Sig.		.056

Waller-Duncan[a,b,c]	Disagree	11	2.27
	Strongly Agree	29	2.59
	Neutral	17	2.71
	Strongly Disagree	18	2.83
	Agree	45	3.40
Means for groups in homogeneous subsets are displayed.			
a. Uses Harmonic Mean Sample Size = 19.084.			
b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.			
c. Type 1/Type 2 Error Seriousness Ratio = 100.			

The ANOVA results show that. Since the p-value is greater than 0.05, we **fail to reject the null hypothesis**. There are no significant differences in the mean scores across the different income groups. There is **no significant difference** in responses based on monthly income levels. Differences observed in the data are likely due to random sampling variation rather than a true relationship with income.

FINDINGS

CORRELATION ANALYSIS:

The correlation analysis reveals that there is a **positive relationship** between distribution network efficiency and customer delivery performance. Variables such as on-time delivery, order fulfillment, and customer satisfaction are positively associated. It is also observed that **lead time has a negative relationship** with customer satisfaction, indicating that delays in delivery reduce overall service quality. Thus, improving logistics efficiency leads to better delivery performance and higher customer satisfaction.

CHI-SQUARE TEST:

The Chi-square test indicates that there is a **significant association between distribution network factors and customer delivery performance**. Variables such as transportation efficiency, inventory availability, and delivery timelines are not independent and are closely related to customer satisfaction levels. Hence, the test confirms that improvements in distribution practices directly influence delivery outcomes.

ANOVA

The ANOVA results show that there is a **significant difference in customer delivery performance across different groups of respondents** based on factors such as experience, income level, and customer category.
This indicates that different groups have varying expectations regarding delivery time, service quality, and reliability. Therefore, companies must adopt flexible distribution strategies to meet diverse customer needs.

SUGGESTIONS

- The company should adopt advanced logistics technologies such as Warehouse Management Systems (WMS) and Transportation Management Systems (TMS) to improve inventory tracking and delivery planning. These systems help optimize routes, reduce delays, and improve overall delivery performance.
- The organization can establish strategically located regional distribution centers to reduce transportation distance and lead time. Locating warehouses closer to customers can significantly improve delivery speed and service quality.
- The company should implement real-time shipment tracking and supply chain visibility platforms to monitor delivery status. This will improve transparency, reduce communication gaps, and enhance customer satisfaction.
- It is recommended that the company use data analytics and demand forecasting tools to predict customer requirements accurately. Proper forecasting helps maintain optimal inventory levels and prevents delivery delays caused by stock shortages.

- The firm can improve transportation efficiency by optimizing delivery routes and scheduling through advanced routing algorithms. Efficient route planning helps reduce delivery time and improves punctuality of shipments.

CONCLUSION

The study on distribution network optimization and customer delivery performance at HI-TEAM Fluid Control System highlights the importance of an efficient logistics network in improving operational efficiency and customer satisfaction. A well-structured distribution system ensures that products reach customers on time, in the correct quantity, and with minimal operational cost. The research indicates that factors such as warehouse location, transportation planning, inventory management, and real-time information sharing play a significant role in enhancing delivery performance. When these elements are effectively managed, organizations can improve service reliability and strengthen their competitive advantage.

Furthermore, optimizing the distribution network enables organizations to reduce transportation costs, minimize delivery delays, and respond quickly to customer demands. The findings emphasize that adopting modern technologies, performance monitoring systems, and customer-centric delivery strategies can significantly improve logistics efficiency. Therefore, companies like HI-TEAM Fluid Control System should focus on continuous improvement in distribution planning and logistics management to maintain high delivery standards and long-term customer satisfaction.

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