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A Study on Inventory Planning and Distribution Network Optimization in Electronic Retail at Reliance Digital

Amogh Pravin Unde
Student, MBA- Operations and Supply Chain Management,
School of Business,
Indira University,
Pune, India 41103
amoghpunde@gmail.com

Dr. Manisha Maddel
Associate Professor & Guide, School of Business,
Indira University,
Pune, India-411033
manisha.maddel@indiraisbs.edu.in
ORCID: 0009-0008-1720-2959

Dr. Hetal Bhinde
Associate Dean Ph.D. Programs,
School of Business,
Indira University,
Pune, India-411033
hetalb19@gmail.com
ORCID: https://orcid.org/0000-0002-6435-5113

Abstract **- The focus of this study is on inventory planning, distribution center (DC) performance and network optimization in the field of consumer electronics retailing using the national network of 25 distribution centers for Reliance Digital. The research looks at product availability, ageing of stock, slow moving stock and regional demand patterns, using transaction level data from enterprise resource planning systems (SAP) and field data from the primary distribution centre (Bhiwandi). The results show that nodes vary widely in inventory velocity and that slow-moving inventory is very localized by Stock Keeping Unit (SKU) combination. Structured inter-DC stock redistribution presents a more capital efficient solution than cut orders or markdowns that dilute margins. Moreover, the multi-criteria candidate screening reveals that the addition of strategic candidate nodes – Ahmedabad (West zone) and Bhopal (Central zone) – to the current 8-DC network would further increase store coverage, provide optimum delivery radius and save line haul transportation costs and order lead times. The paper offers practical solutions to reduce the working-capital lock-up, avoid stock-outs, and make optimal decisions throughout the supply-chain in multi-echelon retail systems by creating a data-driven analytical framework that incorporates fixed warehousing costs and variable logistics costs.**

Keywords: *Inventory Planning, Distribution Network optimization, Supply Chain Management, Consumer Electronics Retail, Inventory Ageing, Inter-DC Stock Redistribution, Demand Forecasting, Multi-Criteria Decision Making, Logistics Cost Optimization, Reliance Digital.*

I. INTRODUCTION

The research paper introduction is included in three distinct paragraphs as follows, according to the content provided:

Consumer electronics retail industry is booming in India due to rising consumer demand, technological innovations and consumer policy support including Production Linked Incentive (PLI) scheme. However, it brings tremendous complexity to the supply chain with short product life cycles, fast obsolescence, and the business's high level of uncertainty of demand, in addition to the extreme competition it faces in both physical and digital channels. To be profitable, there is a delicate balance between product availability, inventory holding cost, transportation cost and lead time. In this context, the inventory level is not necessarily the most critical component to be effective in a supply chain – the inventory level must be accurate and be placed in the right location and at the right time to meet the customer's demand (Availability > Quantity). For modern electronics retailers, it is therefore essential to optimize their inventory planning and configuration of the distribution network, so as to reduce the costs of logistics, and improve the satisfaction of customers.

This research paper emphasizes a practical study and analysis of the planning of inventories and optimization of distribution network at consumer electronics retail format of Reliance Retail, i.e. Reliance Digital. The project investigates operational processes like Purchase Orders (PO), Stock Transport Orders (STO), Goods Receipt at Distribution Centre (GRDC), Minimum Display Quantity (MDQ) and Stock Keeping Unit (SKU) management in addition to analytical assignments in Telecom Enhancement and AIoT product categories. Assessment includes evaluating sales levels, inventory levels, ageing inventory, and slow moving products in the Reliance Digital's 25 distribution centre (DC) network. In addition, branding specific evaluation was done for JBL (existing 8-DC network) and Reconnect (evaluating the network by recommending six new DCs). Also, an industrial visit was made to the Bhiwandi Distribution Centre to observe the operations of inbound, outbound and reverse logistics of the company.

The main goal of this study is to analyse the distribution performance in the area of DC coverage, identify their structural limitations and make data-driven recommendations for the expansion and positioning of these DCs. The paper highlights the compromises between store coverage, lead time, transportation costs, and inventory holding costs and shows how strategic decisions on DC location and effective DC-to-DC inventory flow can reduce inventory-

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related costs and minimise stock-outs. Finally, the study provides a structured and data-driven method of supply chain decision making, moving beyond operational and reactive solutions to more holistic, root cause analytical solutions to improve overall operational efficiency and working capital utilisation at Reliance Digital.

II. LITERATURE REVIEW AND THEORATICAL BACKGROUND

A. Literature Review

The research literature on supply chain management (SCM) in the high-tech consumer electronics retailing sector makes it clear that a balancing act exists between product availability and the financial risks of having too much and too old inventory. Product life cycles and technological changes are rapid, leading to high volatility and risk of obsolescence. Some inventory models, such as Economic Order Quantity (EOQ), are not suitable for dynamic retail settings. The need for incorporating predictive demand forecasting with adaptive inventory control model is stressed in modern research (Ashaduzzaman et al., 2025; Bardaki et al., 2007; Beutel & Minner, 2012). But stock velocity alone cannot prevent ageing of stocks, as the accurate forecasting of the stock velocity at the specific SKU-DC combination is essential to avoid capital lockup and stock obsolescence (Kar et al., 2024; Tadayonrad & Ndiaye, 2023).

Distributing products over a large retail network requires a multi-echelon distribution system for managing product availability; lateral transshipments (or inter-DC stock redistribution) can be effective risk-pooling mechanisms. The idea is to adjust the stock level at nodes between regions to meet local demand peaks in the region when demand varies from one region to another, rather than placing new orders and applying markdowns that reduce margins (Qu et al., 2022; Govindarajan et al., 2020). In addition, distribution network design aims to find the number and location of DCs that minimizes the fixed warehousing cost, variable transportation cost, lead time and number of stores covered. Research has indicated that models that consider only historical sales data for DC selection result in sub-optimal and high cost supply chains, while the selection of locations using multi-criteria decision making models that take into account factors such as the density of demand, transit lead time, freight tariffs, and the proximity of stores makes it possible to optimize logistics in a sustainable way (Malik & Vidyarthi, 2022; Rashid et al., 2026; Snoeck et al., 2023).

Although there has been extensive work in the field of inventory optimization and network location algorithm, there is still a lack of empirical work in multi criteria research for a large scale consumer electronics retail outlet in emerging markets. However, most studies are based on idealized mathematical models that do not consider possible operational constraints such as Minimum Display Quantities (MDQ), Stock Transport Order (STO) workflows, and localized SKU-DC velocity variations (Mohammed et al., 2026; Singh, 2026). It addresses that gap by using Multi-criteria network design and inter-DC stock redistribution ideas on the 25-DC national footprint of Reliance Digital, and hence, the connection between theory and practice in retail operations.

B. Thereotical Background

The theoretical background of this study is based on the fundamental concepts of Operations Management, Inventory Management, Logistics, and Distribution Network Optimization and combines those concepts as a chain of planning: converting demand into forecasts, using those forecasts to position inventory, using the forecasts to schedule store replenishment and using the sales data to feed into the next planning cycle. The framework is intended to provide the appropriate product, right product, right quantity, right place, right time, right total cost. One of the theoretical conclusions that have been drawn from this theory is that stock levels are not the most important aspect of a supply chain, rather, the availability of the product at the point of customer demand is what has the greatest impact on customer satisfaction.

To make this framework work, important quantitative and analysis concepts were assessed from the perspective of the retail operations. Mathematical models like "EOQ"=√(2DS/H) are the building blocks of Inventory Holding Cost, ABC Analysis, and Economic Order Quantity (EOQ) analysis, which explain the principles underlying the analysis of trade-offs between ordering frequency and carrying cost. For example, a very high order quantity will lead to high average inventory and holding costs, which will directly increase the stock ageing. Moreover, historical sales trend analysis, seasonality, safety stock and lead-time optimization are used as concepts in the operational evaluation of inventory movement between distribution centers.

In the end, network design theory makes it clear that there are trade-offs to consider in all decisions regarding a supply chain. Increasing the distribution network (including candidate DCs for brand portfolios such as JBL, Reconnect) will shorten lead times and shorten transit distances, but will add a fixed cost to the warehouse and hold costs. This of course requires a root cause analytical approach that takes a holistic view of all factors affecting inventory, such as transportation, lead time, inventory holding and availability..

III. MATERIALS AND METHODS

The research design used in this study is a combination of empirical research design in which quantitative analytical modeling and qualitative operational field observations are carried out. The quantitative phase drew transaction-level secondary data from enterprise resource planning (SAP) systems across a 25-distribution center (DC) national network, including sales information, inventory stock positions, age-bucket distributions and DC metrics. The Telecom Enhancement and AIoT categories got the lion's share of the primary focus while specific brand-level supply chain assessments were conducted separately for JBL and Reconnect. Various analytical tools were used to assess network efficiency, such as ABC classification, multi-criteria decision matrices, demand mapping (North, South, East and West) and comparative modelling of lead-time and freight costs. Along with quantitative analysis, an operational field study has been conducted at an industrial site visit at the primary distribution facility in Bhiwandi to analyze the inbound, outbound, put-away and reverse logistics workflows.

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A. Research Objectives

This study aims to identify the following issues in the light of the operational environment of the supply chain of Reliance Digital:

- To review inventory planning and performance at the distribution centres throughout the Reliance Digital network, including looking at sales, stock levels, ageing stock, poorly performing stocks, coverage in stores and regional demand.
- To assess the current distribution network of chosen brands, focusing on JBL and Reconnect, and see how it can be optimized by analyzing the performance of the distribution centres, demand, store coverage, transportation costs and lead time.
- To find opportunities for inventory-related cost reduction and logistical cost reduction without compromising product availability by improving inventory positioning, DC-to-DC movement and distribution planning.
- To create data-driven suggestions as to how to improve inventory availability, ageing and slow moving inventory and optimize DC coverage which will enable cost-effective decision making in the supply chain at Reliance Digital.

IV. DATA ANALYSIS AND DISCUSSION

TABLE I. COMPREHENSIVE INVENTORY AGEING & SLOW-MOVING PERFORMANCE ACROSS 25-DC NETWORK

Age / Movement Bucket	Regional Concentration	Primary Risk Profile	Strategic Action
0–30 Days (Fresh)	West / South	Minimal	Regular Replenishment
31–60 Days (Normal)	North / West	Low	Normal Monitoring
61–90 Days (Attention)	East / Central	Moderate	Sales Velocity Review
91–180 Days (High Risk)	East / North	High	Targeted Promotions / Markdown
>180 Days (Critical)	East	Severe	Inter-DC Transfer / Liquidate
Slow-Moving (SKU-DC)	Regional Outliers	Working Capital Lockup	Root-Cause Analysis

To evaluate the existing distribution network of selected brands, particularly JBL and Reconnect, and identify opportunities for network optimization through analysis of DC performance, demand, store coverage, transportation cost, and lead time.

TABLE II. COMPREHENSIVE BRAND NETWORK PERFORMANCE SCORECARD & CANDIDATE SCREENING

Age / Movement Bucket	Regional Concentration	Primary Risk Profile	Strategic Action
0–30 Days (Fresh)	West / South	Minimal	Regular Replenishment
31–60 Days (Normal)	North / West	Low	Normal Monitoring
61–90 Days (Attention)	East / Central	Moderate	Sales Velocity Review
91–180 Days (High Risk)	East / North	High	Targeted Promotions / Markdown
>180 Days (Critical)	East	Severe	Inter-DC Transfer / Liquidate
Slow-Moving (SKU-DC)	Regional Outliers	Working Capital Lockup	Root-Cause Analysis

To identify opportunities for reducing inventory-related and logistics costs while maintaining product availability through better inventory positioning, DC-to-DC movement, and distribution planning.

TABLE III. ROOT-CAUSE MATRIX & OPTIMIZATION TRADE-OFF ANALYSIS

Optimization Area	Root Cause Identified	Operational Impact	Recommended Intervention	Expected Savings / Gain
Inventory Positioning	Regional Demand Mismatch	High Stockouts in North; Stagnation in East	Inter-DC Redistribution	Reduced Holding Cost & Lost Sales
Slow-Moving Stock	Inappropriate SKU Allocation	Working Capital Lockup >90 Days	Dynamic Re-allocation	Lower Obsolescence & Markdown
Freight Cost Overhead	Sub-optimal DC Catchment Radii	Inflated Long-Haul Transport Expense	Network Expansion to Ahmedabad/Bhopal	Decreased Line-Haul Freight Expense
Order Fulfillment Time	Centralized Warehousing Bottlenecks	Extended Lead Times to Tier-2 Stores	Decentralized Node Activation	Improved Stock Availability & On-Time Delivery
Procurement Splintering	Siloed Replenishment Triggers	Excessive Safety Stock Creation	Integrated Planning (Data-Driven)	Inventory Holding Cost Reduction

To develop data-driven recommendations for improving inventory availability, reducing ageing and slow-moving inventory, optimizing DC coverage, and supporting cost-effective supply-chain decision-making at Reliance Digital.

TABLE IV. DATA-DRIVEN DECISION FRAMEWORK MAPPED TO NETWORK PERFORMANCE OUTCOMES

Analytical Phase	Data Inputs	Analytical Method	Strategic Output	Core Value Contribution
Data Collection	SAP ERP Extracts, Sales & Inventory Records	Data Sanitization & Cleaning	Structured Operational Baseline	High Data Integrity & Visibility
Classification	SKU Velocity, DC Sales, Zone Mapping	ABC/XYZ & Ageing Bucket Matrix	Granular SKU-DC Segmentation	Targeted Inventory Management

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Diagnostic Evaluation	Ageing Logs, Slow-Mover Movement Logs	Root-Cause Logic Trees	Corrective Action Protocols	Capital Lockup Prevention
Network Optimization	Lead Time, Freight Costs, Demand Volumes	Multi-Criteria Weighted Scoring	Optimized 25-DC Node Allocation	Lower Logistics Costs & Fast Service
Decision Execution	Target Metrics, Service Level Agreements	Periodic Review & Dynamic Replenishment	Operationalized Supply Chain Strategy	Balanced Availability & Cost Control

Transforming raw transactional data into actionable supply chain strategies further proves the value of data-based decision making in retail. It creates an end-to-end solution from data ingestion and validation from ERP, through multi-criteria network scoring, away from the intuitive method of inventory allocation. The detailed SKU-DC velocity mapping coupled with root cause diagnostic protocols eliminates needless purchasing and alleviates stockouts in the right areas. Moreover, using a combination of logistics factors such as transportation charges, service areas, and regional demand aggregations can help management optimally plan warehouse facilities. As a last resort, this systematic approach is a competitive attribute, allowing products to be available in stores and line hauls and carrying costs to be managed.

V. FINDINGS,CONCLUSIONS AND SUGGESTIONS

A. Findings

The findings of the study reveal that optimizing retail supply The results of the study demonstrate that optimizing the performance of a retail supply chain in the 25-distribution-center (DC) network of Reliance Digital cannot be achieved based on a single criterion, such as total sales volume or total inventory levels, but must apply a multi-criteria approach, taking into account inventory velocity, regional demand characteristics, and logistics cost trade-offs. The inventory ageing and velocity analysis revealed that slow moving inventory is concentrated on specific SKU-DC combinations, which means that working capital lockup can often be overcome through intelligent stock transfer between different DCS instead of proactively reducing procurement or lowering the price. The brand-specific assessments for JBL and Reconnect identified major gaps in current 8-DC coverage, which means that 17 DCs are not directly used for brand supply and also lead times and outbound freight costs are higher for tier-2 markets. The findings of the multi-criteria candidate screening clearly indicated that strategically increasing the brand fulfillment to candidate nodes (Ahmedabad (West zone) and Bhopal (Central zone)) could provide a significant boost to store coverage, optimize delivery radius and minimize line haul transportation costs. In addition, root-cause analysis revealed that many inefficiencies in the operation are due to the initial misallocation of stock, and not to product defects. Overall, the study highlights the value of moving from an intuitive allocation approach to a more analytical and data-driven approach, allowing the organization to optimize inventory levels for products while also minimizing transportation expenses, improving overall network performance, and maximizing capital utilization.

B. Conclusions

The study finds that managing the supply chain in retail requires much more than using aggregated sales data or local inventory levels to position inventories and structure the supply chain network. To address inventory holding costs and avoid working capital lock-up, it is necessary to identify slow-moving products, SKU-DC level, and addressing it with inter-DC stock redistribution often makes more sense than making early inventory decisions on product procurement or price deductions that impact the bottom line. Furthermore, the study of brand distribution networks, such as JBL and Reconnect, reveals the strategic network expansion into strategic nodes (such as Ahmedabad and Bhopal) that was able to create successful strategies for fulfilling the brand in unserved areas, with the aim of minimizing delivery lead time and limiting long haul transportation costs. Finally, an important aspect of improving the performance of the supply chain is to strike a balance between the level of fixed warehousing cost and the variable logistics cost and service level goals. A systematic and data-driven approach can turn the data generated by a retail business into valuable replenishment actions, resulting in improved in-store product availability, more efficient capital use and increased operational resilience.

C. Suggestions

To optimize network efficiency and enhance stakeholder Reliance Digital needs to put in place a flexible, data-driven supply chain management mechanism to maximize the efficiency of the network and improve the value proposition for the stakeholders:

- Inventory Managers & Logistics Teams: Define automatic stock transfer rules between DCS according to SKU-DC Velocity tracking. Redistributing low velocity stock to hotspot areas reduces the need to make needless procurement commitments and the amount of working capital locked up.
- Network Strategists: Phased roll out for brandfulfillment in Ahmedabad and Bhopal with strategic activation of candidate nodes with JBL and Reconnect. This fills in some of the unserved regional markets to significantly lower delivery lead times and line-haul freight rates.
- Store Managers & Vendors: Use a demand sensing solution to give both parties visibility of the amount of goods being consumed by customers and reconcile this with the current production schedule; thus reducing safety stocks and improving product availability.

D. Implications of the study

Cost-effective distribution, optimization of fixed warehousing costs and transportation savings and highest level of service throughout the journey is achieved with the adoption of this integrated approach. Strategic and operational implications include immediate actions by major stakeholders in the retail

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value chain: Supply Chain & Inventory Managers: From aggregate tracking to SKU-DC level monitoring enables the team to act proactively when it comes to positioning inventory, and making strategic decisions to liquidate slow moving inventory through inter-DC transfers rather than margin-diluting markdowns. Direct expansion of brand fulfillment (e.g. JBL & Reconnect) to strategic candidate nodes such as Ahmedabad or Bhopal can help achieve significant order lead time and line-haul freight cost reduction, optimizing delivery radius, for Network Strategists & Logistics Operations. Store Managers & Retail Staff: This additional geographic coverage provides product availability at the store level to minimize risk of stock out and enhance customer satisfaction.

E. Future Scope of the study

In this paper, a solid foundation is provided for the optimization of networks at Reliance Digital, providing several avenues for future research and operational expansion:

Advanced Predictive Analytics & AI Integration – future research could leverage machine learning algorithms and predictive AI models for hyper local seasonality, promotional effects, and macroeconomic trends at the store level in demand forecasting.

Sustainability & Green Logistics: Research can involve assessing the environmental consequences of network expansion, including modelling the carbon footprint savings that can be generated by reducing transport distances, optimising routes and fleet electrification.

Further future directions of study could involve the use of retail stores as micro-fulfillment centers (ship-from-store and click-and-collect) in addition to the 25-DC network, which could help to further shorten last-mile delivery times.

Expanding this framework to include other consumer electronics product categories would permit the possibility of creating multi-echelon inventory optimization models for central, regional and forward-stocking hubs.

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