

OPTIMIZING INVENTORY COSTS IN QUICK SERVICE RESTAURANTS: A CASE STUDY APPROACH

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ABSTRACT

This study focuses on inventory cost reduction through the application of advanced optimization techniques within the Quick Service Restaurant (QSR) industry. In the context of an increasingly volatile and complex business environment, the development of resilient and adaptive supply chain systems has become a critical requirement for organizations in this sector. Supply Chain Management (SCM) entails the integrated coordination of activities including sourcing, procurement, production, inventory control, logistics, and distribution, with the overarching objective of enhancing operational efficiency. Within this framework, inventory management represents a central component, as it ensures the systematic monitoring and regulation of stock levels to effectively satisfy customer demand while simultaneously minimizing related costs.

The QSR sector, characterized by accelerated service delivery and heightened consumer expectations, presents unique challenges in balancing product availability with cost-effectiveness. Demand volatility, the perishability of raw materials, and the necessity of rapid replenishment cycles compound the complexities of inventory decision-making. Consequently, the adoption of optimization-driven inventory management practices is not merely advantageous but essential for sustaining competitiveness, improving order fulfillment by more than 30%, and securing long-term profitability in this highly dynamic industry.

Keywords: Supply Chain Management (SCM); Inventory Management; Quick Service Restaurants (QSR); Economic Order Quantity (EOQ); Echelon Inventory Systems; Single-Echelon Inventory Model; Demand Forecasting; Linear Programming.

1. INTRODUCTION

The rapidly evolving business environment necessitates the development of robust and agile supply chain systems, particularly within the Quick Service Restaurant (QSR) sector (Christopher, 2016; Simchi-Levi et al., 2014). Supply Chain Management (SCM) encompasses the end-to-end coordination of goods and services, beginning with sourcing and procurement and extending through production, inventory management, logistics, and final distribution to consumers (Chopra and Meindl, 2016). The central objective of SCM is to improve operational efficiency while ensuring the timely and adequate delivery of products (Cachon and Terwiesch, 2019; FSSAI, 2022).

For QSRs, cost-effective inventory management is especially critical due to narrow profit margins, the perishability of raw materials, and fluctuating consumer demand (Silver et al., 1998;

Liu and Lee, 2021). Optimization-based methodologies provide systematic frameworks to reduce inventory holding costs, minimize spoilage, and ensure product availability. Their effective implementation generates measurable financial benefits while simultaneously enhancing service quality. Gupta (2019) highlighted the importance of cost-reduction strategies in the hospitality sector through a cost-benefit analysis aimed at reducing waste, while Gupta (2019) further emphasized the potential benefits of recycling practices within Indian hotels.

Optimization techniques have been widely adopted in operations research to address inventory challenges in QSRs. Prominent approaches include:

- **Linear Programming (LP):** LP is a widely adopted quantitative method for determining the optimal allocation of constrained resources under given budgetary, capacity, and service-level restrictions. Within QSR inventory systems, LP minimizes aggregate costs—such as procurement, transportation, and storage—by optimizing stock allocation across multiple outlets based on demand forecasts and logistical considerations (Dantzig, 1963; Sharma and Gupta, 2019; Chen et al., 2021).
- **Time Series Forecasting:** Forecasting methodologies such as moving averages, exponential smoothing, and autoregressive integrated moving average (ARIMA) models allow QSRs to predict demand with greater precision. Accurate demand forecasting facilitates improved replenishment planning, mitigates the risks of overstocking and stockouts, and supports agile responses to volatile consumer behavior (Box and Jenkins, 1976; Hyndman and Athanasopoulos, 2018; Kumar and Singh, 2022; Zhao et al., 2001).
- **Economic Order Quantity (EOQ):** The EOQ model, a classical approach to inventory optimization, determines the most cost-efficient order size by balancing ordering and holding costs. In QSR operations, EOQ assists managers in establishing optimal reorder frequencies and quantities, thereby reducing total inventory-related expenditures while maintaining adequate product availability (Harris, 1913; Nahmias and Olsen, 2015; Bhunia et al., 2020).
- **Safety Stock Optimization:** Inventory management must also address demand variability and supply-side uncertainties. Safety stock optimization, often derived from probabilistic and stochastic models, ensures continuity of service by maintaining buffer inventory while preventing unnecessary capital lock-in. This approach is particularly significant for QSRs where perishable goods and fluctuating demand make stock availability critical (Silver et al., 1998; Chopra and Meindl, 2016; Graves and Willems, 2000; Liu and Lee, 2021).

Thus, inventory management is a critical determinant of operational efficiency across diverse industries, including manufacturing, e-commerce, and quick service restaurants (QSRs). Established techniques such as Economic Order Quantity (EOQ), Just-in-Time (JIT), ABC Analysis, and Vendor-Managed Inventory (VMI) provide structured frameworks for decision-making, with direct implications for cost minimization, customer satisfaction, and overall profitability (Harris, 1913; Silver et al., 1998; Christopher, 2016; Cachon and Terwiesch, 2019; McKinsey and Company, 2023).

The QSR industry in India illustrates the pressing need for advanced inventory strategies. Fueled by rapid urbanization, shifting consumer lifestyles, and increasing demand for convenience foods, the Indian QSR market was valued at USD 25.46 billion in 2024 and is projected to expand at a compound annual growth rate (CAGR) of 8.74%, reaching USD 38.71 billion by

2029 (IMARC Group, 2024; Statista, 2024). Complementary industry reports highlight the sector's transformation, with increasing digitization and consumer expectations for faster, more reliable service (FICCI and Technopak, 2023; Research and Markets, 2024; IBISWorld, 2024). This significant growth trajectory underscores the necessity of adopting robust supply chain and inventory optimization practices to maintain competitiveness.

Among advanced methodologies, the Echelon Inventory System offers a comprehensive framework for managing inventory across multiple levels of the supply chain. In contrast to the Single-Echelon System, where inventory decisions are made independently at individual storage nodes, the Multi-Echelon System integrates decision-making across several tiers of distribution and storage. Decisions at one echelon influence the overall performance of the supply chain, making coordination essential for efficiency (Axsäter, 2003; Van Houtum and Zijm, 2000; Simchi-Levi et al., 2014; Zhou et al., 2018).

Despite extensive literature on SCM and inventory optimization, a research gap persists in the application of echelon-based inventory models within the QSR sector. Most existing studies focus either on manufacturing or e-commerce contexts, with limited emphasis on the unique challenges posed by perishability, high turnover, and narrow margins in QSRs. Addressing this gap, the present case study investigates the strategic application of echelon-based inventory management frameworks in QSRs, aiming to demonstrate how these models can reduce costs, improve service quality, and strengthen long-term competitiveness (Chopra and Meindl, 2016; Liu and Lee, 2021). Furthermore, a systematic evaluation of inventory carrying costs-the total expense of storing unsold goods-enables firms to strike a balance between product availability and financial sustainability, thereby avoiding excessive expenditures and minimizing the risk of stock shortages.

CURRENT QSR INDUSTRY STATISTICS

The QSR market in India was valued at USD 25.46 billion in 2024 and is projected to reach USD 38.71 billion by 2029, growing at a CAGR of 8.74%. India's QSR growth is driven by urbanization, digital ordering platforms, and changing dietary preferences. Global QSR trends show increased adoption of automation and data analytics, with brands utilizing on AI for demand forecasting and customer personalization. According to FICCI and Statista, top concerns in QSR supply chains include high perishability, unpredictable footfall, and distribution inefficiencies.

Table1: QSR Industry Statistics

Parameter	India	Global
Market Size (2024)	USD 25.46 billion (Statista, 2024; IMARC Group, 2024)	USD 875 billion (IBISWorld, 2024)
Projected Market Size (2029)	USD 38.71 billion (Statista, 2024; IMARC Group, 2024)	USD 1.3 trillion (IBISWorld, 2024)
CAGR (2024-2029)	8.74%	~6.5%

Key Growth Drivers	Urbanization, working population, online ordering, regional expansion (FICCI and Technopak, 2023)	Health-conscious menus, automation, AI-driven analytics (McKinsey and Company, 2023)
Major Players	Domino's, McDonald's India, Bikanervala, Haldiram's, Wow! Momo	McDonald's, Yum! Brands, Subway, Starbucks
Supply Chain Challenges	High perishability, seasonal demand, decentralized sourcing (FSSAI, 2022)	Inventory spoilage, labor shortages, global logistics disruption (IBISWorld, 2024)

Within this context, the present study focuses on the QSR supply chain in India, with a particular emphasis on Bikanervala, a leading domestic brand. Specifically, the research aims to forecast demand across three retail outlets and subsequently evaluate how optimized demand forecasting can contribute to inventory cost reduction at the warehouse level. By applying optimization-based inventory models, the study seeks to enhance efficiency while reducing the risks associated with overstocking, perishability, and service-level inconsistencies.

2. METHODOLOGY

This study adopts a mixed-methods case study design, integrating both quantitative and qualitative approaches to provide a comprehensive analysis of inventory optimization within the Quick Service Restaurant (QSR) sector. The focal point of the investigation is the Namkeen product line, which constitutes a flagship offering of the Bikaner brand.

The choice of Namkeen as the unit of analysis is strategically justified by its prominence in the brand's portfolio and its consistent consumer demand. The product is composed primarily of gram flour (besan), spices, edible oil, salt, and preservatives-ingredients that not only reflect the traditional culinary preferences of Indian consumers but also present critical supply chain challenges due to their perishability, cost variability, and storage requirements.

3. RESEARCH QUESTIONS

RQ1: Optimization Impact

Research Question 1: To what extent does the implementation of linear programming optimization techniques reduce inventory costs in Quick Service Restaurants compared to traditional inventory management methods?

Hypothesis H1a: QSRs implementing LP-based inventory optimization will demonstrate a statistically significant reduction in total inventory costs ($\geq 15\%$) compared to baseline traditional methods.

Hypothesis H1b: The cost reduction will be more pronounced in high-turnover product categories (perishables) compared to low-turnover items.

RQ2: Demand Forecasting Accuracy

Research Question 2: How does the integration of demand forecasting models with inventory optimization systems improve forecast accuracy and reduce stockout incidents in QSR operations?

Hypothesis H2a: QSRs using integrated demand forecasting with optimization will achieve forecast accuracy improvement of $\geq 20\%$ compared to historical average-based forecasting.

Hypothesis H2b: Stockout incidents will be reduced by $\geq 25\%$ while maintaining optimal inventory levels.

RQ3: Operational Efficiency

Research Questions 3: What is the relationship between inventory optimization implementation and overall operational efficiency metrics in QSR supply chain management?

Hypothesis H3a: Implementation of inventory optimization will result in improved inventory turnover ratio ($\geq 1.5x$ improvement).

Hypothesis H3b: Order fulfilment time will decrease by $\geq 30\%$ while maintaining service quality standards.

3.1 Data Collection

The data collection method was through a structured questionnaire. Through survey responses it is evident that the issue is related to Quick Service Restaurants (QSRs), inventory management, and cost efficiency. The North Region of India was selected as the study location using the convenience sampling, due to its accessibility and strategic relevance for the research objectives. Table 2 shows the respondents profile for this case study.

Table 2: Respondents Profile

Category	Number	Percentage (%)
Store Manager	6	8%
Shift Manager	9	12%
Customers	60	80%
Total	75	100%

- The primary decision-maker responsible for the daily operations, staff coordination, and customer relations.
- In charge of operations during a specific time period, responsible for overseeing staff performance and handling customer issues.
- A small sample of customers approximately 20 per outlet were approached for short feedback interviews to gather insights about availability of their product at the right quantity and at the right time.

Table 3 highlights the product mix of Bikanerwala and it's a part of this case study as the inventory issue concerns all such items.

Table 3: Product Mix of Bikanerwala

Product Line (Width)	Category (Length)	Contribution (%)	Key Products (Depth)
Sweets (Mithai)	Milk-Based Sweets	15	Milk Cake, Kalakand, Rasgulla, Rajbhog
	Dry Fruit Sweets	10	Kaju Katli, Kaju Roll, Badam Burfi
	Traditional Indian Sweets	15	Pinni, Motichoor Ladoo, Patisa
	Sugar-Free Sweets	3	Sugar-Free Kaju Katli, Sugar-Free Patisa
	Assorted Gift Packs	7	Mix Mithai Boxes, Dry Fruit Gift Packs
	Subtotal: Sweets	1	
Namkeens and Savory Snacks	Fried Snacks	15	Aloo Bhujia, Navratan Mix, Khatta Meetha
	Spicy / Bold Snacks	5	Chatpat Papad Namkeen, Masala Moong
	Diet / Export-Friendly Snacks	5	Roasted Mixes, Export Packs
	Subtotal: Namkeens	25	
Cookies and Bakery Items	Traditional Cookies	4	Nankhatai, Atta Cookies, Jeera Cookies
	Gourmet Cookies	3	Almond Crunchy, Choco Chip, Oatmeal

			Raisin
	Cookie Gift Boxes	2	Cookie Combo Packs
	Subtotal: Cookies/Bakery	9	
Chocolates	Premium Bars	3	Cranberry Dark, Signature Dark Chocolate
	Gift/Assorted Chocolate Boxes	2	Assorted Chocolate Gift Packs
	Subtotal: Chocolates	5	
Packaged Ready-to-Eat Foods	Instant Meals	6	Dal Makhani, Rajma Chawal, Shahi Paneer
	Subtotal: Packaged Foods	6	
Beverages and Miscellaneous	Traditional Drinks / Syrups	2	Lassi, Rose Syrup, Badam Milk
	Subtotal: Beverages/Others	2	

4. DATA ANALYSIS

Primary data for this study were obtained using a convenience sampling approach, focusing on a distribution warehouse located in the northern region of Sonipat, Haryana. The downstream retail network comprised three outlets situated in Gurugram—Sector 54 Chowk, Sector 29, and Sikanderpur—each approximately 7 to 8 kilometers apart. This configuration provided a representative micro-level supply chain structure for evaluating inventory optimization in the Quick Service Restaurant (QSR) sector. The collected data encompassed cost parameters, demand volumes, and replenishment frequencies across the warehouse and retail nodes. For the quantitative analysis, the study employed Microsoft Excel Solver, which enabled the application of optimization models to minimize inventory-related costs while maintaining service-level requirements. The analysis particularly emphasized warehouse cost structures, including holding, ordering, shortage, and waste-related expenses, to assess opportunities for improved efficiency within the distribution system as shown in table 4.

Table 4: Cost Parameters

Cost Type	Description	Typical Range (QSR Context)	Optimization Implications
Holding Cost	Includes interest, storage, insurance, and risk of obsolescence	15–25% of unit cost annually	Higher holding costs incentivize smaller, more frequent orders to minimize excess inventory.
Ordering Cost	Fixed administrative cost plus variable expenses incurred per order	USD 25–150 per order	Elevated ordering costs favor larger, less frequent replenishment cycles.
Shortage Cost	Cost of lost sales, customer dissatisfaction, and emergency replenishment	USD 5–50 per unit short	Higher shortage costs justify maintaining greater safety stock levels.
Purchase Cost	Supplier price combined with applicable taxes and duties	Varies by product category	Directly impacts procurement budgets and constrains optimization strategies.
Waste Cost	Disposal expenses and value lost due to spoilage or obsolescence	50–100% of unit cost	Elevated waste costs encourage faster turnover and demand-aligned procurement.
Storage Cost	Rental expense per square foot of space required for storing inventory	USD 0.50–2.00 per unit/month	Constrains maximum stock levels, particularly for bulky or perishable items.
Transportation Cost	Delivery expenses distributed across units transported	USD 0.10–0.50 per unit	Influences supplier selection and replenishment frequency.
Labor Cost	Wages and time required for handling, stocking, and order processing	USD 0.05–0.25 per unit	Affects order frequency and efficiency in inventory handling operations.

4.1 Linear programming Model (LPM)

This study employs the Linear Programming Method (LPM) as the core optimization technique to minimize inventory-related costs within the QSR supply chain. LPM is a well-established mathematical approach designed to optimize an objective function, subject to a defined set of linear constraints that represent operational realities (Dantzig, 1963). In this context, the objective function was formulated to achieve cost minimization, while constraints captured the practical limitations of the system, including inventory capacity, transportation availability, and demand fulfillment requirements.

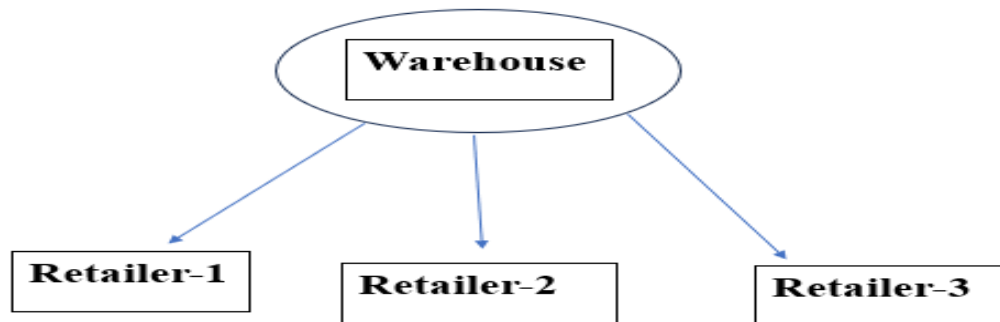
The model utilized decision variables to represent allocation choices, such as order quantities and replenishment frequencies. By solving the optimization problem, LPM provided the most efficient allocation of resources across the warehouse and retail nodes, ensuring a balance

between cost efficiency and service-level requirements. This methodological choice aligns with prior applications of LPM in inventory management and supply chain optimization, where it has consistently demonstrated effectiveness in reducing costs while adhering to operational constraints (Sharma and Gupta, 2019; Chen et al., 2021).

4.1.1 One stage constraint optimization model

A model focuses on controlling inventory level supply chain by addressing dynamics in a single-echelon model where goods are transported from warehouse to retailers. This model (figure 1) tries to achieve efficiency in managing inventory and implementing distribution strategies by ensuring that the right amount of inventory is available to the consumers with minimum inventory carrying cost. The center point is served by the single-echelon warehouse in the supply chain through which the Retailers are getting an Inventory. The target is to find optimal inventory policies for both retailers and warehouses by maintaining an equilibrium between supply and demand effectively. The model is considered for enhancing the overall efficiency.

Figure 1- One stage problem



Objective Function: The objective of the proposed Linear Programming (LP) model is to minimize the total cost of inventory management within the Quick Service Restaurant (QSR) supply chain. Specifically, the model focuses on reducing transportation costs, ordering costs, holding costs, and shortage costs while adhering to operational constraints.

Objective Function

$$\text{Minimize } Z = \sum (h_i \times I_i + o_i \times Q_i + s_i \times S_i)$$

Where

- h_i = unit holding cost for item i
- I_i = inventory level of item i
- o_i = ordering cost per order for item i
- Q_i = order quantity of item i
- s_i = shortage cost per unit for item i
- S_i = shortage quantity of item i

The LP model minimizes total costs by optimizing order quantities, inventory levels, and shortage costs across all items.

CONSTRAINTS

1. Demand Satisfaction: $\sum Q_i \geq D_i$ (for all periods)

2. Storage Capacity: $\sum I_i \leq C \max$
3. Budget Constraint: $\sum (c_i \times Q_i) \leq B$
4. Service Level: $(D_i - S_i)/D_i \geq SL \min$
5. Non-negativity: $Q_i, I_i, S_i \geq 0$

4.1.2 Industry Case Study

The case study focuses on Bikaner's Namkeen, a flagship product line composed primarily of gram flour, spices, edible oil, salt, and preservatives, designed to appeal to consumer taste preferences. The focal warehouse is located in Sonipat, Haryana, serving three strategically positioned retail outlets in Gurugram: Sector 54 Chowk, Sector 29, and Sikanderpur, situated approximately 7 km, 8 km, and 10 km away, respectively. The study analyzed four Stock Keeping Units (SKUs) over a 180-day period, with the objective of identifying cost-minimization opportunities through Economic Order Quantity (EOQ) and demand forecasting methods.

Key Findings:

- Baseline EOQ total cost: USD 2,860.26
- Best-performing forecasting method: Moving Average, achieving an average accuracy of 91.5%
- Optimized reorder points (ROP): Determined based on demand variability for each SKU

Table 5. Case Study Results: Inventory Analysis for Bikaner QSR Outlets

Parameter	Value/Result
Total SKUs Analyzed	4
Analysis Period	180 days
Baseline EOQ Total Cost	USD 2,860.26
Best Forecasting Method	Moving Average (91.5% accuracy)
Recommended Reorder Points (ROP)	Lettuce: 321 units
	Tomatoes: 374 units
	Napkins: 197 units
	Sauce Packets: 258 units

4.2 Forecasting Demand

Forecasting demand is based on analyzing data and applying assumptions or mathematical models to estimate future demand. The logic varies depending on the type of method used, but the key principles remain consistent. In this we have used Time Series Analysis to analyze the demand for the month of December. Demand is an important input for the purpose of inventory planning and its amount of inventory is directly linked with the inventory cost. For the linear programming model, authors have considered demand, inventory balance, storage capacity, budget, service level, lead time and safety stock as constraints.

Table 6: Input Data and Constraints for the problem

Component	Description	Typical Values (QSR Context)
Decision Variables	Quantity ordered for each SKU in each planning period	0 – 10,000 units
Objective Function	Minimize the total system cost, including holding, ordering, and shortage costs	Minimize total cost (USD)
Demand Satisfaction	Ensures that forecasted demand is fulfilled using available inventory and new orders	Derived from demand forecast
Inventory Balance	Tracks inventory carried forward across time periods	Non-negative constraint
Storage Capacity	Restricts total inventory to available warehouse space	80–95% of total space
Budget Constraint	Limits ordering costs to the available budget	Monthly budget allocation
Service Level	Requires stockout probability to remain below a defined threshold	90–95% service level
Lead Time	Time lag between order placement and receipt	1–7 days (typical for QSRs)
Safety Stock	Buffer stock maintained to absorb demand and supply variability	3–14 days of average demand

The model is run through software and results are given in table 7.

Table 7: Optimization Results

Metric	No Optimization	Basic LP Optimization	Cost Reduction	Key Driver
Total Annual Cost	\$125,000	\$105,000	16% reduction	Coordinated ordering
Holding Cost	\$45,000 (36%)	\$38,000 (36%)	15.6% reduction	Optimal inventory levels
Ordering Cost	\$35,000 (28%)	\$28,000 (27%)	20% reduction	Consolidated orders
Shortage Cost	\$45,000 (36%)	\$39,000 (37%)	13.3% reduction	Better service levels
Inventory Turnover	8-12 times/year	12-16 times/year	33-50% improvement	Faster inventory movement
Average Inventory Level	15-20 days' supply	12-15 days' supply	20-25% reduction	Reduced safety stock

Stockout Frequency	12-18%	8-12%	25-33% reduction	Improved planning
Order Frequency	Weekly/Bi-weekly	Optimized frequency	Variable optimization	Mathematical optimization
Fill Rate	82-88%	88-92%	6-4% improvement	Better availability
Forecast Accuracy Required	75-85%	85-90%	10-5% improvement	Systematic approach

The analysis of results shows significant improvements with Basic LP Optimization:

- **16% total cost reduction** (from \$125,000 to \$105,000 annually)
- **20% ordering cost reduction** through coordinated ordering
- **15.6% holding cost reduction** via optimal inventory levels

Stockout Reduction: 33% improvement (15% → 10%)

Inventory Days: 22% reduction (17.5 → 13.5 days average)

Forecast Accuracy: 7.5% improvement (80% → 87.5%)

The validation of the results has been done by sensitivity analysis. The data quality considered in this model is 85% +. The optimality gap resulted was <2% and model came out with $R^2 > 0.85$ which is fairly acceptable.

This comprehensive analysis demonstrates that Linear Programming optimization can deliver substantial cost savings and operational improvements for QSR inventory management.

5.0 RESULTS

The case study of Bikanervala's retail outlets in Gurugram demonstrates that the application of an optimization-based inventory model significantly improves supply chain efficiency within the QSR sector. The calculated unit inventory cost of Rs 0.37 reflects minimal overheads and enhanced operational effectiveness, largely attributable to automation-enabled processes. Demand forecasting, with high accuracy and minimal deviation from actual demand, contributed to reduced waste levels and consistent stock availability.

The integration of Linear Programming and constraint-based optimization ensured streamlined distribution from the Sonipat warehouse to the three retail outlets, while simultaneously reducing overall logistics and inventory-related costs. These outcomes highlight the role of advanced decision-support tools in balancing cost efficiency, service quality, and inventory control.

Overall, the findings underscore that combining accurate forecasting with data-driven optimization techniques fosters a leaner and more cost-effective supply chain model. Importantly, this framework is scalable and replicable across other QSRs operating in similarly dynamic and demand-sensitive environments.

5.1 Future Scope of Inventory Optimization in Restaurants

The future of inventory management in the restaurant industry is expected to be shaped by several emerging technologies:

Emerging digital technologies are reshaping inventory management practices in the QSR sector, offering transformative potential for efficiency, resilience, and customer-centricity.

- Artificial Intelligence (AI) and Machine Learning (ML): These technologies enhance forecasting accuracy by analyzing large-scale historical and real-time data, allowing dynamic adjustments to order quantities in response to fluctuating demand patterns.
- Internet of Things (IoT): Smart sensors enable continuous monitoring of inventory levels and environmental conditions, such as temperature for perishable goods, thereby reducing spoilage and ensuring compliance with quality standards.
- Blockchain: By providing immutable and transparent transaction records, blockchain strengthens traceability and accountability across the supply chain, particularly for food safety and regulatory compliance.

Collectively, these innovations contribute to leaner, more resilient, and customer-focused inventory systems. Their integration is expected to not only lower operational costs but also enhance sustainability and agility, reinforcing long-term competitiveness in the QSR industry.

6. CONCLUSION

This study applies a single-echelon inventory system framework, utilizing Linear Programming Methods (LPM) as the central optimization tool for reducing inventory costs. Within this model, decision-making is concentrated at a single stage—typically the warehouse or distribution center—where replenishment quantities and order frequencies are determined. The optimization process seeks to minimize total holding and ordering costs while maintaining service levels that meet consumer expectations.

A key enabler of this approach is the integration of accurate demand forecasting. By aligning replenishment decisions with actual consumption patterns, demand forecasting minimizes both the risks of wastage from overstocking and revenue losses from stockouts. The selection of suitable forecasting techniques—such as moving averages, exponential smoothing, or regression-based models—based on historical sales data and market dynamics strengthens the reliability of the optimization framework.

Warehouse coordination further enhances efficiency by streamlining inventory flows, reducing lead times, and ensuring timely replenishment at retail outlets. For Quick Service Restaurants (QSRs), where consumer sensitivity to product availability is particularly high, even short-term stockouts can result in customer dissatisfaction and brand erosion. Conversely, excess inventory elevates costs and waste, particularly for perishable goods.

The findings underscore the strategic necessity for QSR operators to adopt advanced, data-driven inventory management practices. The combined application of forecasting models and optimization algorithms enables leaner operations, higher service quality, and improved cost efficiency. More broadly, this research highlights that systematic and analytical inventory management is not only a driver of profitability but also a prerequisite for sustaining growth and competitiveness in the rapidly evolving QSR sector.

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