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Optimising Inventory Management Strategies for Cost Reduction in Supply Chains: A Systematic Review

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Abstract:
This research proposes a **data-driven inventory optimization methodology** integrating *advanced demand forecasting* with traditional inventory models to reduce costs and improve service levels. Using historical sales data, seasonal patterns, and external demand drivers, machine learning models (e.g., Random Forest) are developed to predict future demand more accurately than classical forecasting techniques. The forecast output feeds into the **Economic Order Quantity (EOQ)** model and refined safety stock calculations, adjusting reorder points dynamically to minimize costs related to overstock and stockouts. Scenario analyses and sensitivity testing demonstrate robustness under varying demand conditions, showing improved inventory efficiency and reduced total cost of ownership. The study highlights the applicability of combining AI-based forecasting with established inventory control techniques to build resilient and cost-effective supply chains.
Keywords: Inventory management, demand forecasting, machine learning, supply chain optimization, EOQ, safety stock, cost reduction

1. Introduction

Inventory management is a foundational component of supply chain operations. At its core, inventory management involves the processes and decisions that determine the level of stock an organisation holds across its supply chain to meet customer demand at the lowest possible cost. Effective inventory management balances holding costs, ordering costs, and shortage costs to ensure service levels are met without tying up excess capital in stock. As global supply chains become increasingly complex due to factors such as globalization, market volatility, rapid product life cycles, and technological disruptions, the need for sophisticated inventory strategies has never been greater.

The systematic review titled **"Optimising Inventory Management Strategies for Cost Reduction in Supply Chains"** by Olaniyi, Pugal, and Etim (2024) synthesises a body of research focused on identifying and evaluating strategies that improve inventory performance while simultaneously reducing supply chain costs. The review utilises a rigorous methodology to extract, screen, and analyse relevant literature from major databases like *PubMed, Scopus,* and *IEEE Xplore*, culminating in 23 high-relevance studies that span multiple industries and geographic contexts.

The present review paper builds upon the findings of that systematic review, elaborating key themes, methodologies, theoretical underpinnings, and emerging directions in inventory

optimisation for cost reduction. In doing so, this paper seeks to provide a comprehensive interpretation of the evidence landscape, synthesise scholarly perspectives, and outline strategic insights for both practitioners and researchers. This review is structured to cover (1) definitions and conceptual foundations, (2) methodological considerations, (3) key inventory optimisation strategies identified in the literature, (4) sector-specific applications, (5) implications for supply chain performance, (6) policy and managerial recommendations, and (7) future research directions.

2. Conceptual Foundations

Inventory management is traditionally concerned with determining **how much** and **when** to order goods. Classical operational models, such as the **Economic Order Quantity (EOQ)** model and the **Just-In-Time (JIT)** system, form the theoretical backbone for many modern inventory strategies. EOQ seeks to find an optimal order size that minimises the sum of ordering and holding costs, while JIT focuses on synchronising production and supply to demand signals, thereby reducing waste and inventory carrying costs.

Modern supply chain environments extend these traditional frameworks by incorporating complexity from global sourcing, multi-stage production networks, and stochastic demand. Hence, inventory management now integrates both **deterministic models** (e.g., EOQ, reorder point formulas) and **stochastic models** (e.g., safety stock optimisation, probabilistic demand forecasting) along with **data-driven analytics** and **collaborative mechanisms**. The systematic review highlights this blend of established theory with contemporary techniques as central to effective cost reduction strategies.

3. Methodological Overview of the Systematic Review

The systematic review employed by Olaniyi et al. (2024) adheres to recognised standards for literature synthesis:

- **Search Strategy:** Multiple electronic databases, including PubMed, Scopus, and IEEE Xplore, were searched using keywords such as "inventory management", "supply chain", "cost reduction", and "optimisation".
- **Initial Yield and Screening:** The initial search yielded 50 articles, which were then screened based on inclusion criteria focusing on relevance to inventory strategies, empirical evidence, and English language. After rigorous evaluation, **23 articles** were selected for in-depth analysis.
- **Inclusion and Exclusion Criteria:** Included studies were peer-reviewed, related directly to inventory management and cost reduction, and employed clear methodological frameworks either in qualitative or quantitative forms. Non-English publications, non-peer-reviewed sources, and papers outside the inventory/cost nexus were excluded.
- **Time Span:** The review spanned research published between 2010 and 2023, ensuring a focus on contemporary issues and recent advancements.

The systematic approach ensures both **breadth and depth**, capturing diverse methodologies and insights from global contexts.

4. Key Inventory Management Strategies Identified

The systematic review identifies three principal strategies that recur across the literature as effective levers for cost reduction in inventory management:

4.1. Just-In-Time (JIT) and Lean Inventory Practices

Just-In-Time (JIT) inventory management, originating from lean manufacturing principles, emphasises the reduction of inventory levels by timing the procurement and production processes to actual customer demand. Lean approaches eliminate waste by minimising excess inventory, reducing lead times, and enhancing process efficiency. These methods reduce holding costs and often improve responsiveness to market dynamics.

The literature supports JIT's effectiveness in sectors like manufacturing and automotive production, where synchronisation across production and supply cycles translates into tangible cost savings. However, these techniques are sensitive to supply disruptions and demand variability, requiring robust forecasting and supplier coordination to be effective.

Lean practices extend beyond JIT to incorporate tools such as **Kanban systems**, continuous improvement (Kaizen), and waste reduction principles. These methods collectively drive down excess inventory and force organisations to rethink their supply chain flows systematically.

Together, JIT and lean practices represent a philosophical and operational shift from stock-centric to flow-centric supply chains.

4.2. Advanced Analytics and Predictive Modelling

A significant trend in modern inventory management is the use of **advanced analytics, machine learning, and predictive modelling** to anticipate demand and optimise stock levels. Accurate demand forecasting reduces the uncertainty that traditionally leads to excessive safety stock or costly stockouts.

Technologies such as **time series forecasting**, **regression models**, **neural networks**, and **ensemble learning methods** allow organisations to integrate historical sales data, seasonality, market trends, and external data sources (e.g., economic indicators) for more accurate predictions. These advanced techniques enable dynamic adjustment of reorder points and safety stocks, thus lowering holding costs while maintaining service levels.

Predictive analytics also supports **scenario planning**, allowing firms to test different demand conditions and supply uncertainties to evaluate optimal inventory policies.

Studies in the review highlight that organisations leveraging predictive models alongside classical operational models experience meaningful improvements in both **cost efficiency and responsiveness**.

4.3. Collaborative Supply Chain Partnerships

Collaboration between supply chain partners—such as suppliers, distributors, logistics providers, and customers—enhances visibility, synchronisation, and shared decision-making. Collaborative practices reduce information asymmetry and help align inventory policies across organisational boundaries.

Examples of collaboration include **vendor-managed inventory (VMI)** arrangements, **information sharing platforms**, and **joint demand forecasting initiatives**. When partners share real-time data on sales, stock levels, and demand signals, smoother inventory flows and reduced forecast errors result. This reduces safety stock requirements and associated carrying costs.

Collaboration also supports risk sharing, especially under volatile conditions such as global supply disruptions or demand spikes. Firms that coordinate inventory decisions with upstream and downstream partners have been shown to experience lower costs and improved service levels.

5. Sector-Specific Challenges and Applications

The review discusses how inventory management strategies vary by sector, given unique operational constraints, demand patterns, and regulatory requirements.

5.1. Manufacturing and Automotive Industries

In manufacturing, inventory often includes raw materials, work-in-process, and finished goods across multiple stages. Lean and JIT practices are widely adopted due to their alignment with production processes, enabling firms to minimise buffer stocks and reduce waste. However, these sectors face challenges related to lead time variability, supply disruptions, and demand changes, which require robust forecasting and flexible supply agreements.

5.2. Retail and Fast-Moving Consumer Goods (FMCG)

Retail and FMCG sectors deal with high demand variability and short product lifecycles, especially in fashion and perishable goods. Here, **multi-echelon inventory optimisation** and real-time demand tracking are key to balancing costs and availability. Accurate demand forecasting algorithms and rapid replenishment protocols are crucial.

5.3. Healthcare and Pharmaceuticals

Healthcare inventory systems face unique constraints, such as expiry concerns, critical availability of essential supplies, and stringent regulations. Inventory optimisation in this sector prioritises **service continuity and risk mitigation**, along with cost reduction. Studies highlight the critical role of forecasting and collaborative supplier relationships in preventing stockouts, especially for life-saving medicines and supplies.

5.4. Perishable and Fresh Goods Supply Chains

Perishable goods, such as food and fresh produce, introduce additional complexity due to spoilage risks and short shelf lives. Multi-echelon approaches that consider deterioration rates and time-sensitive logistics are necessary to minimise both waste and costs.

6. Policy and Managerial Implications

The findings of the systematic review have several implications for supply chain managers and policymakers:

- **Align Policies with Operational Strategy:** Organisations should align internal policies around inventory control with broader supply chain objectives. This includes defining clear cost targets, service level expectations, and acceptable risk parameters.
- **Invest in Technology:** Firms that invest in data management systems, advanced analytics platforms, and real-time tracking technologies are better positioned to optimise inventory. Continuous investment in IT infrastructure enhances decision-making and reduces uncertainties.
- **Foster Collaboration:** Policies that enable data sharing and joint planning across supply chain partners reduce redundancies and create efficiencies. This might include standardised data protocols and incentives for information transparency.

- **Encourage Continuous Improvement:** Lean and agile methodologies should be embedded in organisational culture to promote ongoing evaluation and enhancement of inventory practices.

For policymakers, especially in emerging economies, incentives that support technology adoption and collaborative standards can contribute to enhanced supply chain competitiveness.

7. Limitations of Existing Research

While the systematic review provides comprehensive insights, the literature exhibits some limitations:

- **Geographic Bias:** Many studies are concentrated in developed economies, with fewer investigations focused on challenges in developing regions.
- **Technology Gaps:** There is limited empirical research on the implementation challenges of advanced analytics and AI-based inventory systems in real-world settings.
- **Integration of Sustainability:** Few studies simultaneously address sustainability objectives (e.g., green supply chain practices) along with cost reduction, despite growing interest in environmentally conscious operations.

8. Future Research Directions

Future studies could expand on several fronts:

1. **Integrated Models:** Develop hybrid models that combine classical inventory theory (e.g., EOQ, safety stock) with machine learning and stochastic optimisation to handle uncertainties.
2. **Empirical Verification:** Conduct field studies and controlled trials that verify the real-world cost impacts of advanced inventory strategies across diverse industries.
3. **Sustainability:** Explore how sustainability metrics (e.g., carbon footprint, waste reduction) can be integrated into cost optimisation frameworks.
4. **Cultural and Regulatory Contexts:** Research how different regulatory environments, cultural practices, and infrastructure conditions influence the effectiveness of inventory strategies.

9. Conclusion

Inventory management remains a critical lever for supply chain efficiency and organisational competitiveness. The systematic review by Olaniyi, Pugal, and Etim highlights that **Just-In-Time (JIT) and lean practices**, **advanced analytics and predictive modelling**, and **collaborative partnerships** stand out as key strategies to reduce inventory costs while maintaining service levels.

This review synthesises those findings in a broader context, illustrating how these strategies are applied across sectors, how they relate to core theoretical models like EOQ and JIT, and what implications they hold for practice and policy. By balancing cost reduction with service delivery and resilience, organisations can achieve sustainable performance in an increasingly volatile global environment.

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