Cost-Optimized Vendor Selection for Inventory Purchasing

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Abstract

Building material distributors operate in a difficult space; they are expected to have the right products available for time-sensitive jobs while managing bulky, high-value inventory and long, often uncertain lead times. In many organizations, inventory decisions are still driven by local judgment, static safety stocks, and manual purchasing, which leads to a familiar pattern: overstocked items consume working capital while critical SKUs still fall into stock-out. This paper proposes a practical inventory optimization framework tailored to building material distribution companies. It focuses on three areas: setting stock levels based on demand patterns and service targets, systematically reducing both overstock and stock-outs, and using IT-enabled controls to embed these decisions into day-to-day operations. The framework is designed to sit on top of existing ERP and warehouse systems rather than replace them, using data, simple analytical models, and guided workflows to influence how branches forecast, replenish, and buy. A key element is cost-optimized vendor selection for inventory purchasing, where branch buyers are nudged toward lower-cost vendors for the same items using transparent, system-driven vendor cost rankings. The paper outlines the core models, the supporting system design, and change management considerations, and illustrates how this approach can improve service levels, reduce avoidable inventory, and support healthier margins in a multi-branch distribution network.

Index Terms

Inventory optimization, building material distribution, stock level optimization, overstock reduction, stock-out reduction, vendor cost optimization, procurement, ERP integration, and IT-enabled inventory control.

I. INTRODUCTION

Building material distributors work under constant tension between availability and cost. Branches are expected to support time-sensitive construction projects, often with short notice and strict timelines, while holding products that are bulky, high-value, and sometimes slow-moving. Lead times can be long and variable, supplier capacity is not always predictable, and customer demand is strongly influenced by local project pipelines rather than by stable, repeatable patterns. In this environment, inventory decisions have a direct impact on both service performance and margin.

In many organizations, however, inventory is still managed through a mix of static rules and local experience. Safety stock levels are often set once and rarely revisited. Minimum and maximum stock parameters are adjusted reactively, typically after a service failure or an audit. Purchasing decisions at the branch level may prioritize convenience, relationships, or habit over cost and network-wide optimization. The result is a familiar pattern: some SKUs sit overstocked for months, tying up working capital and yard space, while other critical items regularly fall into stock-out and delay jobs.

These issues are not only a forecasting problem, but they are also a control problem. Even when central teams build models or recommendations, the decisions that create or prevent overstock and stock-outs are executed in day-to-day operations, such as which SKUs are stocked at which branches, how much is ordered, when orders are placed, and from which vendors. Without a clear and practical way to connect analytical inventory policies to the ERP and purchasing workflows that branch users rely on, optimization remains a one-time exercise rather than an operating discipline.

This paper focuses on inventory optimization for building material distribution companies from that practical perspective. Rather than proposing a single "perfect" algorithm, it outlines a framework that links three areas:

- **Stock level optimization**: using demand patterns, lead times, and service targets to set more intentional minimums, maximums, and safety stocks for key SKUs.

- **Reduction of overstock and stock-outs**: identifying where stock levels are structurally misaligned and introducing simple rules and thresholds to correct courses.
- **IT-enabled inventory control**: embedding these policies into existing ERP and purchasing processes so that branches are guided by system-driven logic, not just local intuition.

A particular emphasis is placed on the intersection of procurement and inventory decisions. In many distributors, the same SKUs can be sourced from multiple vendors at different price points. If the system does not make those differences visible at the moment of purchase, branches may unintentionally choose higher-cost options even when lower-cost alternatives exist. To address this, the paper includes a case example of **cost-optimized vendor selection for inventory purchasing**, where vendor cost rankings are calculated centrally and surfaced directly in operational tools to influence branch-level buying behavior without removing necessary flexibility.

The goal of this work is not to replace existing ERP or warehouse management systems, but to demonstrate how analytics, simple models, and targeted system enhancements can be integrated with them to enhance inventory outcomes. The contributions of the paper are threefold:

- It describes a lightweight inventory optimization framework adapted to the realities of building material distribution, where demand is lumpy, products are bulky, and project timing matters.
- It outlines how IT-enabled controls—such as parameter governance, guided replenishment, and cost-aware vendor selection—can be used to reduce both overstock and stock-outs in a multi-branch network.
- It presents a real-world example of cost-optimized vendor selection for inventory purchasing, illustrating how small changes in system design and data use can shift branch behavior and support margin improvement.

The remainder of the paper is organized as follows. Section II summarizes background concepts and common inventory models relevant to distribution environments. Section III introduces the proposed inventory optimization framework and its main components. Section IV discusses the design of IT-enabled inventory control mechanisms, including parameter management and guided purchasing. Section V presents the case example on cost-optimized vendor selection. Section VI offers a discussion of implementation considerations and limitations, and Section VII concludes the paper with suggested directions for further work.

II. LITERATURE REVIEW

Inventory management has been widely studied across manufacturing, retail, and distribution, with a strong foundation in classical models such as Economic Order Quantity (EOQ), reorder-point systems, and service-level driven safety stock formulas [1], [4], [9]. These models typically assume relatively stable demand, known lead times, and well-defined cost parameters for ordering, holding, and stock-out. They provide a useful starting point for setting stock levels, but their assumptions often need to be adapted for project-driven and multi-branch environments, such as building material distribution [2], [5].

In distribution networks, researchers have examined multi-echelon inventory models, where stock is held at central warehouses and downstream branches, and policies must coordinate replenishment across locations [5], [8], [9], [11]. Such models analyze how to allocate inventory across the network to minimize total cost or achieve target service levels while accounting for lead times, transportation constraints, and demand variability. In practice, many distributors implement simplified versions of these concepts through min–max policies, safety stock rules, and service targets by item and location [3], [5], [9].

Another important stream of work focuses on demand segmentation and SKU classification. Techniques such as ABC and XYZ analysis are commonly used to distinguish high-value from low-value items, and stable demand from intermittent or highly variable demand [3], [7], [9]. For building materials, this is particularly relevant because assortments often combine fast-moving standard SKUs with slow-moving, project-specific items. Segment-specific policies, for example tighter control and more frequent review for high-value or high-variability items, have been shown to improve both cost and service performance compared with uniform policies [3], [7].

More recent literature considers IT-enabled inventory management and the role of enterprise systems in enforcing or supporting inventory policies. Studies describe how ERP, warehouse management systems (WMS), and advanced planning tools can embed reorder logic, parameter governance, and exception handling into daily operations [5], [10], [11]. Rather than relying only on analytical optimization, these works emphasize integrating decision rules into the systems and user interfaces that planners and buyers use in practice.

Finally, there is growing attention on the interaction between inventory decisions and procurement behavior. In many sectors, the same SKU can be sourced from multiple vendors with different prices, lead times, and reliability. Research on vendor selection, supplier evaluation, and total cost of ownership highlights that inventory cost is driven not only by how much is ordered, but also by who supplies it and under what terms [5], [10], [12]. This is especially relevant in building material distribution, where branches may exercise local discretion while central procurement teams negotiate contracts. The idea of system-supported, cost-aware vendor choice, which this paper emphasizes in the context of inventory purchasing, aligns with this line of work and brings it closer to day-to-day decisions at the branch level.

Overall, the existing literature provides robust building blocks, classical inventory models, multi-echelon thinking, demand segmentation, and IT-supported planning, but there remains a gap in practical frameworks tailored to building material distributors, where bulky items, project-driven demand, and branch autonomy all play a major role. This paper positions itself in that space, focusing on how to combine simple models with IT-enabled controls for a realistic, implementable approach.

III. TECHNICAL ARCHITECTURE

The proposed inventory optimization approach assumes that most building material distributors already operate an ERP system and, in many cases, a warehouse management system. The goal is not to replace these platforms, but to add an analytics and control layer that can guide stock levels and purchasing decisions consistently across branches.

At a high level, the architecture comprises five key components:

1. Data Sources

- *Transactional data:* sales orders, shipments, returns, purchase orders, receipts, and on-hand balances by SKU and location.
- *Master data:* SKU attributes (dimensions, weight, product group), vendor records, lead times, cost information, and stocking indicators.
- *Reference data:* branch hierarchy, customer segments, and calendar data (holidays, seasonality markers).

2. Analytics and Modeling Layer

This layer calculates the parameters and indicators that drive inventory and purchasing decisions, such as:

- Demand profiles by SKU–location (average demand, variability, intermittency).
- Lead time statistics and service-level targets.
- Suggested safety stocks, reorder points, and min–max levels.
- Vendor cost rankings for inventory items (e.g., effective unit cost per SKU–vendor over a defined window).

The calculations can be implemented in a data warehouse, analytics platform, or dedicated planning system, depending on the organization’s landscape.

3. Inventory Policy and Parameter Store

The resulting parameters—such as target min–max values, safety stock, and vendor cost bands—need to be stored in a way that is both auditable and easy to integrate with the ERP. This can be a dedicated parameter table in the ERP, a planning module, or a linked data repository. The key requirement is that:

- Parameters are versioned and traceable.
- Effective dates and owners are clear.
- Updates can be pushed to operational systems in a controlled way.

4. Operational Integration Layer

This layer connects the analytics outputs to the daily tools used by planners and buyers. Typical integration points include:

- *Replenishment screens:* where suggested order quantities are driven by the calculated reorder points or min–max levels.

- *Purchase order creation screens:* where vendor options for a given SKU are displayed along with cost-related indicators.
- *Exception dashboards:* Highlighting deviations such as overstock, frequent stock-outs, or purchases from systematically higher-cost vendors.

The **cost-optimized vendor selection** capability fits here: vendor cost rankings generated in the analytics layer are surfaced in purchase order or item inquiry screens, making it clear which vendors are cost-optimal for inventory purchases.

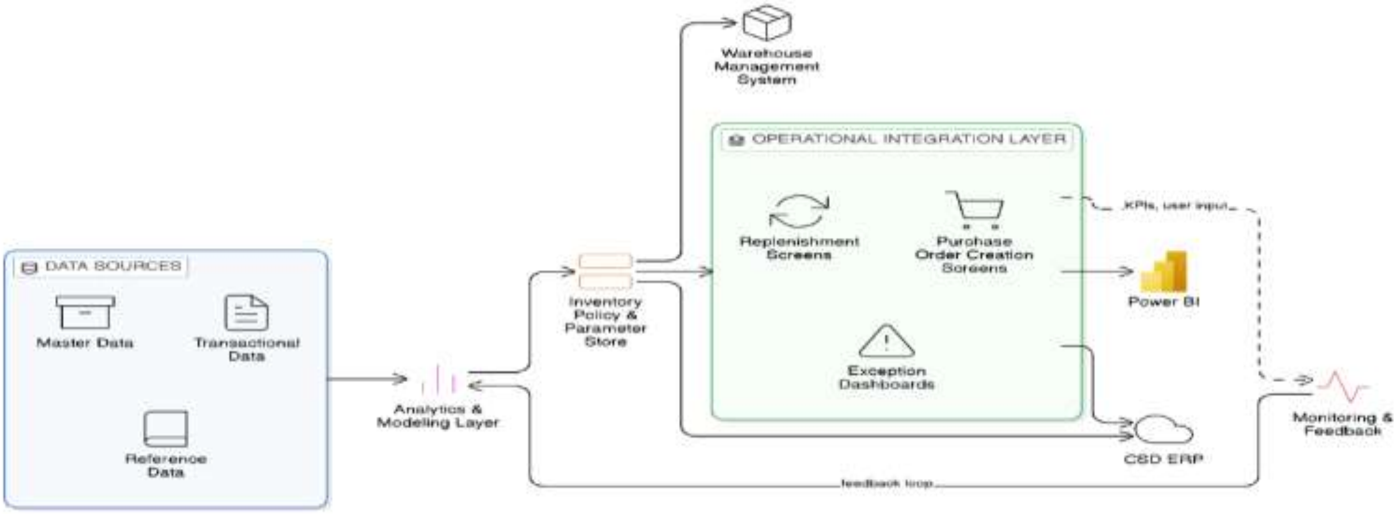
5. **Monitoring and Feedback**

Finally, the architecture includes monitoring of key performance indicators (KPIs), such as:

- Service levels by SKU and branch.
- Inventory turns and days on hand.
- Incidence and duration of stock-outs.
- Mix of spend by vendor for key inventory items.

Feedback from these KPIs, along with user input from branches and procurement, is fed back into the analytics layer to refine models, thresholds, and parameters over time.

This architecture is intentionally modular. Organizations with more advanced tools can layer optimization engines on top of the analytics layer; those with simpler environments can implement the logic via SQL, scheduled jobs, and reporting tools. The central idea is that inventory policies and vendor cost signals are calculated centrally but applied locally through the systems that users already rely on.



IV. METHODOLOGY

The methodology for implementing the inventory optimization framework is organized into several phases. It is designed to be iterative, so organizations can start with a subset of SKUs, branches, or product lines and expand as they gain confidence [5], [11], [13].

A. Diagnostic and Baseline Assessment

The first step is to understand the current state of inventory and purchasing:

- Quantify overstock and stock-out patterns by SKU and location.
- Analyze demand variability and identify items with intermittent or highly volatile demand.
- Review existing min–max or safety stock settings and how frequently they are updated.
- Examine vendor usage for inventory items, including price dispersion for the same SKU across vendors and branches.

This diagnostic establishes a baseline and highlights where optimization efforts are likely to have the most impact [2], [3], [5], [9].

B. Demand Segmentation and Policy Design

Next, SKUs are segmented based on criteria such as:

- Demand volume and variability (e.g., high/medium/low, stable vs. intermittent).
- Value and margin impact.
- Strategic importance (e.g., items critical to core product offerings or key customer segments).

Demand segmentation and classification are well-established practices in inventory management and have been shown to improve policy effectiveness when different item classes are treated with differentiated rules [3], [7], [9]. For each segment, an inventory policy is defined. Examples include:

- High-volume, stable SKUs: tighter safety stock, frequent review, high service targets.
- Low-volume, erratic SKUs: lower on-hand targets, more reliance on central stock, or make-to-order approaches.
- Bulky or slow-moving items: stricter review and clear exit criteria to prevent chronic overstock.

These policies guide how safety stock, reorder points, and min–max levels will be calculated [1], [4], [9].

C. Parameter Calculation and Governance

Using historical demand and lead time data, parameters are calculated according to the chosen policies. This may include:

- Safety stock based on target service levels and demand/lead time variability.
- Reorder points that combine expected demand during lead time with safety stock.
- Min–max bands that reflect practical order sizes, space constraints, and transportation frequencies.

These approaches are consistent with classical inventory theory and reorder-point systems that link service targets to stock levels [1], [4], [9].

In parallel, a governance model is defined:

- Who owns the parameters (e.g., central planning, regional teams)?
- How often are parameters recalculated (e.g., quarterly, semi-annually)?
- How are exceptions handled (e.g., local overrides, project-specific adjustments)?

Clear ownership and review cycles help prevent parameter “drift,” a common pitfall noted in supply chain and advanced planning literature [2], [5], [11].

D. Cost-Optimized Vendor Selection Logic

For SKUs with multiple approved vendors, vendor cost optimization is added as a complementary lever:

- Historical purchase data is used to compute the effective unit cost by SKU–vendor over a defined time window.
- Vendors are ranked or grouped based on cost differences for each SKU.
- Business rules are defined (e.g., primary vendors within a certain cost band, secondary options for flexibility, criteria for exceptions).

This reflects the broader view in sourcing research that vendor selection should consider price, performance, and total cost, and that structured models improve consistency of decisions [5], [10], [12]. These vendor cost signals are then prepared for integration into the ERP or purchasing tools, so that buyers see clear guidance when placing inventory-related orders.

E. System Integration and Pilot

The computed inventory parameters and vendor cost indicators are integrated into operational systems. A pilot is usually run with:

- A limited set of branches or regions.
- A selected subset of SKUs (e.g., top volume or top value).

During the pilot, the focus is on:

- Testing technical integration and ensuring data is accurate and timely.
- Observing how planners and buyers respond to the new guidance.
- Tracking early impacts on stock-outs, overstock, and purchasing patterns.

The importance of integrating policies into ERP and advanced planning tools, and validating their performance through controlled pilots, is widely recognized in supply chain planning research [10], [11]. Agile and iterative piloting also aligns with best practices in project and product delivery [13].

F. Rollout and Continuous Improvement

Based on the pilot results, the framework is refined and rolled out more broadly. Continuous improvement includes:

- Adjusting policy parameters and thresholds as more data becomes available.
- Incorporating feedback from branches on practicality and usability.
- Expanding the scope to cover more SKUs, vendors, and locations.

Over time, the framework can be extended with additional capabilities, such as automatic replenishment suggestions, exception-based workflows, or more sophisticated multi-echelon optimization [5], [8], [11]. Iterative refinement and stakeholder feedback are consistent with Agile and continuous improvement principles applied in other operational domains [13].

G. Case Example: Cost-Optimized Vendor Selection in Practice

To illustrate the methodology in a real distribution environment, the framework was applied to a regional network of branches operated by a building material distributor. The initial scope focused on inventory purchasing for approximately 250 stocked SKUs that could be sourced from multiple approved vendors across 38 branches.

A 12-month history of purchase orders and receipts was used to calculate an effective unit cost for each SKU–vendor combination. For each SKU, vendors were ranked by cost, and a simple rule set was defined: vendors within 0–2% of the lowest observed cost were treated as cost-optimal, vendors 2–5% above the minimum as acceptable alternatives, and vendors more than 5% above the minimum as materially higher-cost options. These rankings were refreshed monthly, consistent with the idea that vendor performance and prices must be reviewed periodically to maintain alignment with sourcing strategy [5], [10], [12].

The resulting vendor cost indicators were then integrated into the purchasing workflow. When branch users created a purchase order for an in-scope SKU, the system displayed vendor options along with their cost classification. Orders placed with vendors more than 5% above the lowest-cost option required a short justification, while orders with cost-optimal vendors flowed without additional steps.

After six months, several changes in purchasing behavior and cost outcomes were observed for the SKUs in scope:

- The share of inventory spend going to higher-cost vendors (more than 5% above the lowest-cost option) decreased significantly.
- The proportion of purchase order lines placed with cost-optimal vendors increased substantially.
- The weighted average unit cost for the in-scope SKUs declined noticeably based on internal calculations.
- Inventory turns for the same group of SKUs improved modestly, reflecting better alignment between purchasing decisions, demand, and stocking policies.

These results were achieved without removing local flexibility: branches retained the ability to choose higher-cost vendors when justified by urgency, local availability, or project-specific requirements. The case suggests that relatively simple, IT-enabled vendor guidance, when combined with structured inventory policies, can produce measurable improvements in inventory-related costs while maintaining service levels [2], [5], [10].

V. DISCUSSION

Implementing inventory optimization in building material distribution is as much an organizational change initiative as it is a technical project. Several themes emerged from applying the framework in practice and are consistent with findings in the broader supply chain and inventory management literature [2], [5], [9], [11].

First, **data quality and transparency** matter more than complex algorithms. Many of the gains come from making demand, lead times, and vendor cost differences visible and reliable, then using that information to set and maintain sensible parameters. If transactional data is incomplete or inconsistent, even the best models will produce fragile output. This emphasis on foundational data quality and basic parameter discipline echoes long-standing observations about supply chain inventory pitfalls and opportunities [2], [3], [9].

Second, there is a balance between **central control and local flexibility**. Branches often have valid reasons for deviating from centrally suggested stock levels or vendor choices, especially in project-driven environments. The framework works best when it is positioned as guidance and support, with clear escalation paths for exceptions, rather than a rigid set of rules. This is aligned with work on advanced planning and coordination, which highlights the need to provide structure without eliminating local responsiveness [5], [11].

Third, **system design strongly influences behavior**. When inventory policies and vendor cost information are embedded directly into the ERP and purchasing screens, users are far more likely to follow them. By contrast, if users must manually consult reports or external tools, adoption tends to drop over time. Research on inventory policies and information sharing similarly underscores that the way information is presented and integrated into operational systems has a direct impact on how effectively policies are implemented [10], [11].

Fourth, there are trade-offs between **service levels, cost, and operational complexity**. Improving service levels on key SKUs may require higher safety stock, while reducing overstock on slow-moving items may increase the risk of occasional backorders. Vendor cost optimization can lower material costs but may introduce slightly longer lead times or different minimum order quantities. These trade-offs are well recognized in classical inventory and supply chain texts, which stress that organizations must choose balanced policies rather than optimizing a single metric in isolation [3], [5], [9].

Finally, implementation is incremental. Starting with a small number of branches or a focused SKU set allows the organization to learn, adjust policies, and build confidence before scaling. Over time, the same structure can support more advanced capabilities, such as multi-echelon optimization or integrated sales and operations planning (S&OP) [5], [8], [11]. This phased, feedback-driven approach is consistent with Agile and iterative delivery principles, which have also been shown to be effective in other technology and process change initiatives [13].

Overall, the discussion suggests that success in inventory optimization for building material distributors depends on a combination of sound models, appropriate system support, and practical governance, rather than on technical sophistication alone.

VI. CONCLUSION

Building material distribution companies operate under unique constraints: bulky products, project-driven demand, long and variable lead times, and distributed decision-making across branches. In this context, inventory problems rarely come from a single cause. Overstock and stock-outs are the outcome of how stock levels are set, how often they are reviewed, how purchases are placed, and how well systems support these decisions.

This paper has outlined a practical framework for inventory optimization that focuses on three elements: stock level optimization based on demand and service targets, structured reduction of overstock and stock-outs, and IT-enabled inventory control systems that embed these decisions into daily operations. Rather than proposing a single advanced algorithm, the approach emphasizes combining basic models, clear policies, and system integration.

A particular feature of the framework is **cost-optimized vendor selection for inventory purchasing**, where vendor cost differences are made visible and actionable at the point of purchase. This aligns procurement strategy with branch behavior and can improve inventory costs without compromising service.

The framework is designed to be implemented on top of existing ERP and warehouse systems, using analytics and simple rules to improve decisions rather than requiring a wholesale technology replacement. Future work could extend this approach with more detailed multi-echelon optimization, integration with predictive project demand, or automated replenishment suggestions that incorporate both inventory and procurement dimensions.

For organizations willing to invest in data quality, parameter governance, and thoughtful system design, inventory optimization can move from a periodic project to a sustained operational capability, supporting better service levels, healthier margins, and more resilient supply chains in the building materials sector.

COMPETING INTEREST

The authors declare that they have no competing interests.

FUNDING

Not Applicable.

AUTHOR'S CONTRIBUTIONS

I independently analyzed and interpreted the data. I am solely responsible for writing and finalizing the manuscript. I confirm that I have read and approved the final version of the manuscript.

ACKNOWLEDGMENTS

Not Applicable.

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