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Original Article

Lean Warehousing and Supplier Management to Improve Service Level in a Peruvian Apparel SME: A Case-Based Approach

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Abstract *- The Peruvian garment industry has struggled with ongoing inefficiencies in the warehouse operations, which have resulted in an inability to deliver adequate service and remain competitive. Previous literature has examined the use of Lean Warehousing tools, but few have explored the integration of these tools and their impact on service quality. This study focuses on small textile firms and strategically analyzes the issue of service performance using a systematically structured method. It applies 5S, ABC classification, and better supplier collaboration to improve accuracy in orders and inventory movement. Key steps included streamlined workspace setup, prioritized materials for order assembly, and supplier communication enforcement. As a result, the model reduced cycle time by 36% and increased service level by 12%. From an academic standpoint, this study offers a diverse approach to service improvement based on Lean principles. Socioeconomically, the results point to possible decreased costs and increased customer satisfaction. The model's application across various industries and scales is recommended for future research.*

Keywords *- Lean Warehousing, Supplier Management, Service Level Improvement, Apparel Industry, Operational Efficiency.*

1. Introduction

The textile and garment industry is very important to the world economy. It employs millions of people and brings in a lot of money for exports and national GDPs, especially in Small and Medium-sized Businesses (SMEs). This industry helps the economy grow in Latin America by creating jobs, encouraging new ideas in industry, and improving manufacturing skills. Brazil, Colombia, and Peru are just a few countries that have seen a rise in Small and Medium-sized businesses (SMEs) making and selling clothing. These businesses are a vital link between local Production and global fashion supply chains. For example, small and medium-sized textile and garment businesses (SMEs) in Peru create jobs in cities and keep traditional crafts alive, which helps growth that includes everyone [1]. Even though these SMEs are very important, they often work in very competitive markets where cost efficiency, delivery performance, and product quality are what keep the business going and help it grow [2].

However, garment SMEs, especially in developing areas, often have trouble managing their inventory and working with their suppliers efficiently. These companies often have problems with their stock, like having too much or too little, which causes production delays and lost sales. One major reason is that their storage facilities do not have systematic control mechanisms in place, and they do not follow the delivery schedules set by their suppliers. Also, using old or manual inventory tracking systems makes stock levels even more inaccurate, making it hard to always meet customer needs. Poor warehouse layout and lack of standard procedures make it even easier for materials to get lost and take longer to get to their destination [3]. In these situations, production planning becomes reactive instead of proactive, which leads to inefficient batch production, high defect rates, and higher operational costs [4].

Fixing these issues is important for boosting productivity, making the business more competitive, and keeping customers happy. Small and medium-sized businesses (SMEs) can reduce waste, make the best use of storage space, and ensure products are on time with good inventory management. This is very important in the fashion industry, where being able to respond quickly to market trends is a strategic advantage. Using structured warehouse methods like FIFO (First In, First Out), ABC analysis, and 5S has worked well in similar situations by keeping things organized, reducing inventory errors, and making workflows more efficient [5]. Also, making sure that warehouse processes are in line with supplier management can make

deliveries much more reliable and cut down on procurement bottlenecks. Studies have shown that using lean practices in the warehouse helps lower the number of mistakes and raise the level of service [6].

Even though these strategies could be helpful, there is not a lot of research on how to use Lean Warehousing strategies in small and medium-sized businesses that make clothes. There have been a lot of studies on Lean Manufacturing in the textile industry, but not as many on storage operations, supplier integration, and cyclical inventory controls in this area. It is very important to figure out how to use lean tools like Supplier Management, Cycle Counting, FIFO, ABC Analysis, and 5S in a planned way to make garment SMEs' inventory more accurate and lower the number of defects. This study aims to fill this gap by suggesting and testing a production and warehouse management model that fits the needs of small and medium-sized clothing businesses in Peru. The proposed model combines Lean Warehousing tools and looks at how they affect the accuracy of inventory, the speed of order fulfilment, and the number of defects [7].

This study is different because it takes a broad view and looks at both inbound logistics and internal warehouse processes using a practical implementation framework based on lean principles. This study goes beyond previous ones that only looked at ways to improve production lines. It applies lean thinking to inventory and warehouse management in small clothing businesses. Previous research has shown that lean approaches work in distribution SMEs [8] and service-oriented storage systems [9], but they have not fully looked at the special problems that come up when managing raw materials and finished goods in fast-paced garment production settings. This study also adds to the small number of empirical studies done in Latin America by providing evidence in context on how Lean Warehousing can help Peruvian SMEs be more competitive and ready to export [10], [11].

2. Literature Review

2.1. Lean Warehousing in Apparel and Retail SMEs

Lean Warehousing- the application of Lean principles within warehousing activities- has produced clear gains for small apparel and retail firms. Research on a mid-sized Peruvian retailer that adopted Lean tools such as ABC classification, FIFO/FEFO control, and step-by-step work guides showed return rates dropping from 7.14 percent to 4 percent, alongside tighter inventory and stronger OTIF [12], [13]. Likewise, Hietasari, Subianto, and Adi (2024 [14] tested Lean storage planning and zone-based stowage in several Peruvian shops, recording higher inventory accuracy and faster operator moves. Briones-Chavez, Sandoval-Soldevilla, and Quiroz-Flores [15] tracked a distribution house and noted the time needed to find an item fell by 66 percent, while picking speed rose by 12 percent after Lean was adopted. Neyra, Muñoz, Eyzaguirre, and Raymundo [16] partnered with a textile-support warehouse and saw productivity jump 3.95 times and inventory record accuracy reach 98.2 percent through 5S audits and standardized tasks. These cases suggest that Lean Warehousing helps garment-oriented SMEs fill orders quickly, shrink return volumes, and cut mismatches between physical and recorded stock.

2.2. Supplier Management for Reliable Inventory

Effective supplier management is central to keeping stock levels accurate and agile in small-to-medium apparel companies. A study of U.S. clothing producers found that product quality and dependable delivery are the two leading criteria when choosing suppliers, and these factors shape the final quality of garments made [17]. Work by Castorena, Jiménez, and Marín Aguilar [18] showed that routinely assessing supplier performance cuts the frequency of stockouts and trims overall operating costs for Latin American manufacturers.

Quiroz-Flores, Dubois Torres, and Inga de la Cruz [19] noted that forward-looking Buyer-Supplier practices—like Strategic Relationship Management and Demand-Driven Material Requirements Planning—better match supply with volatile sales and dramatically lessen excess stock in smaller firms. Complementary evidence from Bonilla Ramírez and associates found that pairing Lean Warehousing methods with clear, written supplier agreements in Peruvian textile plants lowered return rates and boosted on-time shipments [20]. Systematic supplier selection, ongoing partnership work, and transparent review processes strengthen inventory reliability across the apparel value chain, keeping materials flowing smoothly into Production and retail channels.

2.3. Inventory Accuracy through Cycle Counting Techniques

Scheduled cycle counting is crucial for maintaining high inventory accuracy within garment warehouses, especially those operating on a small scale. Fathoni et al. paired the ABC-VED framework with daily counts and lifted recorded stock accuracy above 90 percent, a gain that also spared the facility lengthy full-audit closures [21]. Likewise, Destro and colleagues employed computer simulation to demonstrate that assigning a dedicated team to count every day steadily reduced Inventory Record Inaccuracy (IRI) in several warehouse layouts [22].

In yet another historical review, Brooks and Wilson found that classifying items into A, B, and C groups and counting the A-skewed high-value stock repeatedly curbed shrinkage and kept balanced books [23]. In a retail setting in Indonesia, combining the same stratification with cycle counts pushed stock-verification accuracy to 99 percent and improved order-fulfilment speed [24]. These studies together show that apparel SMEs who embed ABC-driven counting into standard practice can achieve reliable, low-cost

inventory control and lower the risk of unanticipated order shortages.

2.4. ABC and FIFO: Frameworks to Optimize Stock Flow

ABC classification combined with the FIFO rotation has long served as a dependable blueprint for controlling stock in the apparel industry. By sorting items according to value and moving the oldest stock first, firms can focus resources on high-impact lines while protecting revenue from unsold merchandise. Evidence from Vasquez-Quispe et al. [13] at a small Peruvian retailer showed that aligning their shelves with an 80-20 ABC rule and FIFO cut picking time and quickened turnover. Building on that, Hietasari et al. [14] folded the same ABC-FIFO pairing into a Lean Warehousing plan, adding standardized storage layouts, and saw picking errors drop while order accuracy climbed. Further tests in pharmacies that blended ABC-VED tags with regular cycle counts pushed scan precision over 95% for lifesaving drugs and similar SKUs [21], [23]. Although the fashion and apparel sector has published a few dedicated studies, these adjacent findings suggest that ABC-FIFO remains a compelling guard against short-runway flash sales and costly obsolescence.

2.5. 5S Methodology: The Foundation of Warehouse Orderliness

The 5S framework-Sort, Set in Order, Shine, Standardize, Sustain-forms the bedrock of any well-organized warehouse. Romero Parra and colleagues [25] integrated 5S with standard work in a small Peruvian textile firm, lifting labor productivity by 5 percent and time efficiency by 96 percent. A similar hybrid model applied in a Lima facility yielded nearly four times greater output, 98.2 percent inventory accuracy, and a two-thirds drop in search time [16]. Latin American SMEs often report parallel gains, with 5S cutting non-value-added moves by 62.9 percent and sharpening order accuracy [15, 26]. In addition to these metrics, 5S enhances safety, maximizes space, and instils the discipline that underpins lasting Lean systems in garment supply chains [25]. By addressing clutter on both floors and minds, 5S becomes a cultural anchor for sustainable warehouse performance.

3. Contribution

3.1. Proposed Model

Figure 1 shows an inventory management model based on Lean Warehousing tools designed for a small-to-medium fashion distributor. Intended chiefly to raise service quality, the system organizes stock so that counts are quicker and errors easier to spot. Its framework rests on four linked practices: regular cycle counts, ABC classification tied to a 5S workplace, close supplier oversight, and First-In-First-Out (FIFO) flow. These tools directly target frequent pain points-quick stockouts, leftover off-season items, misplaced merchandise, and pending orders. Rolled out in a steady loop, the practices bolster count accuracy, trigger timely reorders, and force older items out of storage, breathing new life into the warehouse layout. Space is kept clear, products are easy to find, and peak demand can be met with far fewer stops. In short, the model gives the retailer a nimbler, customer-focused, and more economical stock operation built for the fast turns and shifting trends of seasonal fashion selling.

Fig. 1 Proposed model

3.2. Model Components

Figure 1 illustrates a framework intended to refine inventory practices in a Small-and-Medium Enterprise (SME) that distributes fashion apparel. This framework emerged from recurrent operational shortfalls common in retail, notably disruptions in product availability, storage errors, and delayed order shipments. Lean Warehousing techniques were harnessed to connect logistical activities, so they function continuously, raising overall service levels. At its core, the framework seeks to eliminate non-value-adding activities, optimise storage space, and enhance inventory accuracy, issues acknowledged in lean theory as vital for performance.

From this foundation, three structural pillars emerge: strengthening identification, tightening flow, and simplifying controls, each of which results in a distinct operational gain. Within this hierarchy, a single high-level target-increased service level-guides every tactical initiative. Achieving that target depends on the systematic roll-out of four interrelated tools: periodic cycle counting, ABC grouping and 5S sorting, supplier partnership, and FIFO-driven inventory rotation. Because each tool addresses a particular source of error-stockouts, end-of-season overhang, misplaced items, or incomplete shipments-they must operate in concert to realise the model's full benefit. The next section elaborates on each element's purpose, procedure, and performance metric.

3.2.1. Cycle Counting: Enhancing Inventory Accuracy

The first component of the inventory-management plan is cycle counting, an ongoing procedure that cross-checks the physical stock against electronic records. Instead of waiting for a once-a-year audit, personnel assess a set, smaller portion of the inventory on a predictable timetable. This regular review reveals mismatches sooner, so mistakes can be fixed before they cause stockouts or excessive surplus. With repeated counts, employees grow more trusting of the data, and faster judgment follows on when to restock shelves or shift items within the warehouse. Since the activity draws in workers from different sections, it nurtures a culture of continuous improvement, given that staff themselves highlight recurring issues that lower service quality. In a fashion retail SME that is hyper-responsive to trends and customer demands, precise records are vital for filling orders quickly and completely. Because of this, cycle counting directly supports the broader objective of elevating overall service levels.

3.2.2. ABC Analysis and 5S: Structuring the Storage Space Strategically

The second element combines ABC analysis with the 5S system to organize warehouse storage in a purposeful way. ABC analysis sorts products by value and turnover speed, spotlighting high-volume items that staff need to reach quickly. This clear ranking allows warehouse layout to place fast movers near packing stations, shrinking the distance workers travel and cutting the number of times an item is handled. 5S then reinforces this arrangement by standardizing locations, keeping walkways clear, and making dirt or damage easy to spot immediately. When these approaches are used together, every square meter of space serves a clear role, surplus boxes disappear, and seasonal shifts in fashion stock can be accommodated without chaos. By improving visibility and reducing search time, the combined strategy also reveals slow-moving lines sooner, allowing managers to decide whether to mark them for promotion or clearance. In short, pairing ABC with 5S boosts speed in receiving, sorting, and shipping orders, and in doing so, it helps the full operation deliver to customers on schedule.

3.2.3. FIFO Inventory Control: Ensuring Proper Product Rotation

The third component stresses using the FIFO, or First-In-First-Out, system to manage stock. By sending out the oldest items before the newer ones, FIFO promotes a steady flow and minimizes the risk of products sitting idle for too long. Because fashion lines often refresh every season or even sooner, the approach protects profit margins by curbing overages of dated merchandise. Making FIFO work in practice calls for accurate entry date labels, a storage plan that naturally channels stock forward, and regular teamwork between receiving, picking, and shipping crews. Beyond preventing obsolescence, the method keeps available goods in step with current trends and seasonal demands. When adopted rigorously, FIFO boosts turnover rates, preserves product freshness, and drives sales, all of which are crucial in a crowded and rapidly evolving retail landscape. As a result, this inventory-control pillar plays a key role in sustaining service consistency and meeting shoppers ' expectations for timely access to the latest styles.

3.2.4. Supplier Management: Securing Timely Product Replenishment

The fourth element considers supplier management a core routine that keeps inventory coming in steadily and on time. For small and medium fashion retailers, solid, predictable ties to suppliers guard against empty racks and let the business seize seasonal sales spikes. To build that reliability, the retailer writes contracts spelling out lead times, quality standards, and shipping calendars, and pairs them with open, regular talks with every vendor.

Regular scorecard reviews and joint forecasting sessions allow both parties to spot possible shortages early and adjust before a hitch becomes a crisis. By nurturing these give-and-take partnerships, the retailer tightens outbound logistics, lowers the risk of stockouts, and protects revenue from surprise voids. A smooth, constant flow of goods then links purchasing to sales, unclogs the warehouse, and keeps shelves ready when shoppers arrive. When the system runs smoothly, the agile supply chain fills orders quickly, builds customer trust, and fuels stronger top-line growth.

3.2.5. Expected Results of the Proposed Model: A Holistic Approach to Improvement

The model's four interlinked elements work together in a continuous cycle: all focused on lifting service standards across the business. Figure 1 shows how each part tackles a separate bottleneck in warehouse flow, and when combined, they produce a system-wide gain in inventory control. By grounding these actions in Lean Warehousing ideas—such as cutting waste, using space smartly, and measuring value- the approach builds a logistics operation that is both quicker and more dependable.

For a small-to-medium fashion retailer, putting the model into everyday use means stock is available more often, items are found in minutes, records are almost error-free, and old seasonal goods sit on shelves for shorter spells. Such gains drive better speed, save costs, please customers, and sharpen the Company's edge in a crowded market. Because the framework can be sized up or down and tweaked to fit a firm's assets and culture, it blends the rigour of scholarly theory with the realism needed on the warehouse floor. The proposal adds fresh, hands-on insight to inventory research while addressing the daily struggles that fast-moving SMEs face worldwide.

3.3. Model Indicators

The performance evaluation criteria developed for a particular small and medium-sized enterprise (SME) clothing retail business case study enabled the assessment of inventory management models powered with Lean Warehousing tools. These criteria enabled coherent inventory and service responsiveness evaluation across the case study.

The employed methodology made it possible to track fundamental operational processes in the SME such that strategic goal alignment and multi-dimensional performance evaluation coherence were maintained. Such tailored assessment processes were integral in pinpointing inefficient operations, justifying the reliance on objective metrics for refining business operations, and strengthening the ongoing enhancement of inventory processes servicing a highly competitive retail environment.

3.3.1. Fill Rate

This metric checks how often customer demand was satisfied straight from available stock, giving a fast pulse on product availability and service-level reliability.

$$\text{Fill Rate} = \frac{\text{Units Shipped on First Attempt}}{\text{Units Ordered}} \times 100\%$$

3.3.2. Rate of Compliant Services

It records the share of service orders delivered exactly as specified—right quantity, quality, paperwork, and lead-time—signalling operational discipline and a uniform customer experience across the network.

$$\text{Compliant Service Rate} \frac{\text{Compliant Service Events}}{\text{Total Service Events}} \times 100\%$$

3.3.3. Equipment Reliability Index (ERI)

The index reveals how reliably machinery runs during scheduled hours by contrasting productive time with planned availability, spotlighting maintenance issues before they sap throughput.

$$\text{ERI} = \frac{\text{Scheduled Operating Time} - \text{Unplanned Downtime}}{\text{Scheduled Operating Time}} \times 100\%$$

3.3.4. Out-of-Season Rate

This indicator gauges the proportion of inventory tied to products no longer in their selling window, highlighting dormant stock that ties up space and capital without serving current demand.

$$\text{Out-of-Season Rate} = \frac{\text{Units Out of Season}}{\text{Total Inventory Units}} \times 100\%$$

3.3.5. Picking Delay

It captures the percentage of order lines not retrieved within the allotted picking slot, translating minor scheduling slips into a clear signal of labor balance and layout efficiency.

$$\text{Picking Delay} = \frac{\text{Late Picked Lines}}{\text{Total Order Lines}} \times 100\%$$

4. Validation

4.1. Validation Scenario

The validation scenario was conducted for an SME in the apparel sector located in Lima, Peru. The Company operated in the market, designing and selling cotton garments, which included t-shirts, sweatshirts, and hoodies, catering to multiple customer segments. The Company's business model for this Company hinged on outsourcing the entire manufacturing process while retaining the functions of production planning, supply management, and distribution. The Company also had four proprietary retail stores funnelling to the end-customers, which required regular deliveries of finished products. This structure required seamless coordination across procurement, outsourced production, and distribution logistics. From the analysis carried out during the period in question, customer service levels were deficient as there were stockouts, delays in product replenishment, and lost sales opportunities, which diminished the Company's competitiveness.

4.2. Initial Diagnosis

The case study diagnosis indicated that the service level achieved was only 73.04 percent, significantly lower than the global benchmark of 95 percent. This service level shortfall

also had an economic effect of PEN 198,714.00. Nearly half of the performance losses were due to stockouts (49 percent); within this dimension, bad supplier control was responsible for 26 percent, and inventory inaccuracies for 23 percent. Inefficient Warehousing was also a factor and accounted for a further 40 percent of the shortfall, where out-of-season products contributed 16 percent and delay in item location contributed 24 percent.

The remaining 11 percent stemmed from various small factors that, while individually negligible, cumulatively undermined dependability in the provided services. By quantifying how heavily each contributed, it was possible to prioritize interventions and allocate assistive resources to those that stood the most to restore performance.

4.3. Validation Design

The newly developed inventory management system based on Lean Warehousing principles was validated in an SME retailer of garments over a four-month period. This validation aimed to improve service level performance by correcting service problems related to internal inventory and stock supply systems.

The solution adopted supplemented the implementation of several lean techniques to enhance the efficiency of storage, material flow, and restock intervals. There was a stepwise execution plan to ensure adherence to the work processes and operational objectives planned for the business. Their impact was calculated using operational data, which ensured an unbiased assessment within the set parameters and the targets achieved.

A Peruvian garment firm confronting chronic service failures agreed to pilot the continuous improvements proposed by this study. Shortages, poor inventory records, cluttered storage, and weak supplier relations together drained 7.95 percent of revenue each year. To reverse those losses, the team deployed a Lean Warehouse framework that combined ABC analysis, 5S, cycle counting, FIFO controls, and a formal supplier scorecard. The project aimed to streamline internal flows, guarantee on-time shipments, and boost customers' operational confidence. Because the design emphasizes low cost and clear metrics, the model can be scaled to other sector SMEs eager for fast, proven gains.

4.3.1. Product Prioritization with the ABC Method

Using ABC analysis, the firm now sorts its entire range of garments by each item’s revenue impact and annual turnover. Historical sales data and unit costs were examined to cluster products into seven process-based families with similar manufacturing flows. The families were then ranked in three tiers-A, B, and C-for targeting resources and attention. Group A, which covers everyday items like T-shirts and sweatshirts, alone yields 73.4% of sales and therefore receives focused improvement efforts. This ranking drives decisions about storage locations, restock levels, and counting schedules, ensuring that profitable items are managed first. It also sets the cadence for cycle counts and clarifies how much shelf space each tier deserves.

4.3.2. Workspace Reorganization through the 5S Method

The first step in 5S was training for managers and section leaders, so everyone grasped how order, cleanliness, and standard work strengthen the warehouse. A cross-functional 5S committee, including team leaders, facilitators, and front-line communicators, then guided and recorded each stage. During this step, items judged unnecessary were moved to a holding area awaiting disposal or recycling.

In shine, shelves were reconfigured, cages labelled, and high-turnover garments- Group AS- AS-facilitated first-pick access. A weekly cleaning rota was established and backed by simple check-sheet audits. Each zone was visually marked with floor tape and boards during standardise, speeding item retrieval and reducing search time. In sustain, senior management conducted monthly walk-through audits that verified compliance and reinforced accountability. Collectively, these measures sliced average picking delay from 59.44 percent to 13.61 percent, yielding a 45.83 percent gain in overall efficiency.

Figure 2 illustrates the organization of garments based on product type, rotation, and demand. Items were relocated from the red zone, and storage locations were defined. Shelves were arranged by category, separating items by size, design, and colour to improve accessibility and space efficiency.

Fig. 2 Implementation of the “Set in Order” Phase in the Storage Area

Figure 3 illustrates a radar chart evaluating the implementation level of the 5S methodology (Seiri, Seiton, Seiso, Seiketsu, Shitsuke). It compares the initial condition (As Is), the target condition (To Be), and the results achieved. The chart highlights performance improvements and identifies gaps to guide continuous improvement efforts.

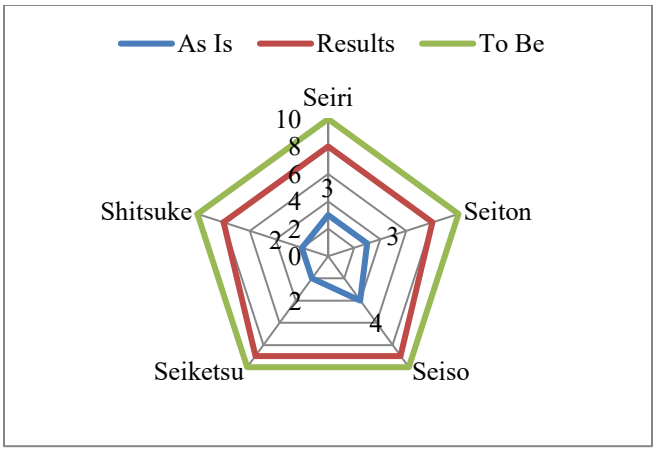


Fig. 3 5S Assessment Radar Chart: Initial, Target, and Result States

4.3.3. Inventory Turnover with FIFO System

In response to the build-up of out-of-season merchandise, management adopted a First-In, First-Out (FIFO) procedure planned for clarity and effectiveness. Employees learned to use colour-coded tags-red, yellow, and green-in line with the traffic-light scheme to show how long each item had been on the shelf: green meant less than two months, yellow signalled two to three months, and red warned of three months or older. This simple, visible check made sure older stock was moved out first. A daily electronic record now flags products nearing the red zone, prompting sales and promotions sooner rather than later. Because of these steps, the share of spoiling goods fell from 11.6 percent to 5.35 percent, greatly boosting turnover and freeing valuable storage space.

Figure 4 displays a standardized inventory label designed to monitor product shelf-life using a color-coded system. It includes fields for entry date, item details, and observations. Each sticker colour (green, yellow, red) represents a one-month period, triggering action when red labels are identified to prevent obsolescence.

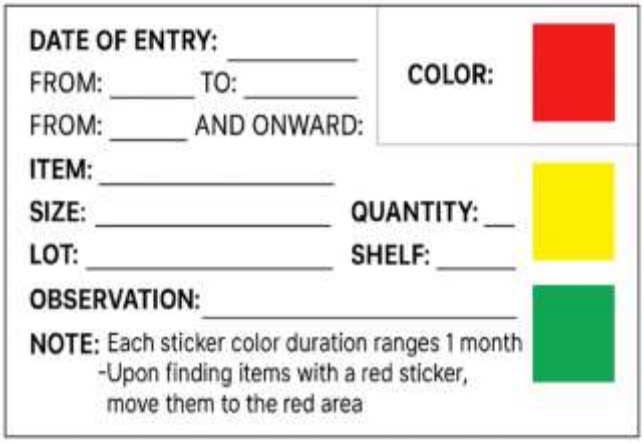


Fig. 4 Inventory Label for Shelf-Life Control

4.3.4. Inventory Accuracy through Cycle Counting

The firm's initial inventory accuracy of only 93.59% was substantially improved by dedicating specific cycle-counting procedures to each ABC category. Following targeted staff training, a formal schedule was set. Group A items are counted once a month, Group B items every two months, and Group C items four times a year, yielding a total of 218 separate procedures annually. Counts are performed on Mondays and weekdays with historically light sales activity. As a result of this rhythmic counting and immediate problem resolution, accuracy jumped to 99.96%, strengthening order forecasting and stock visibility, which is critical for steady operations and customer trust.

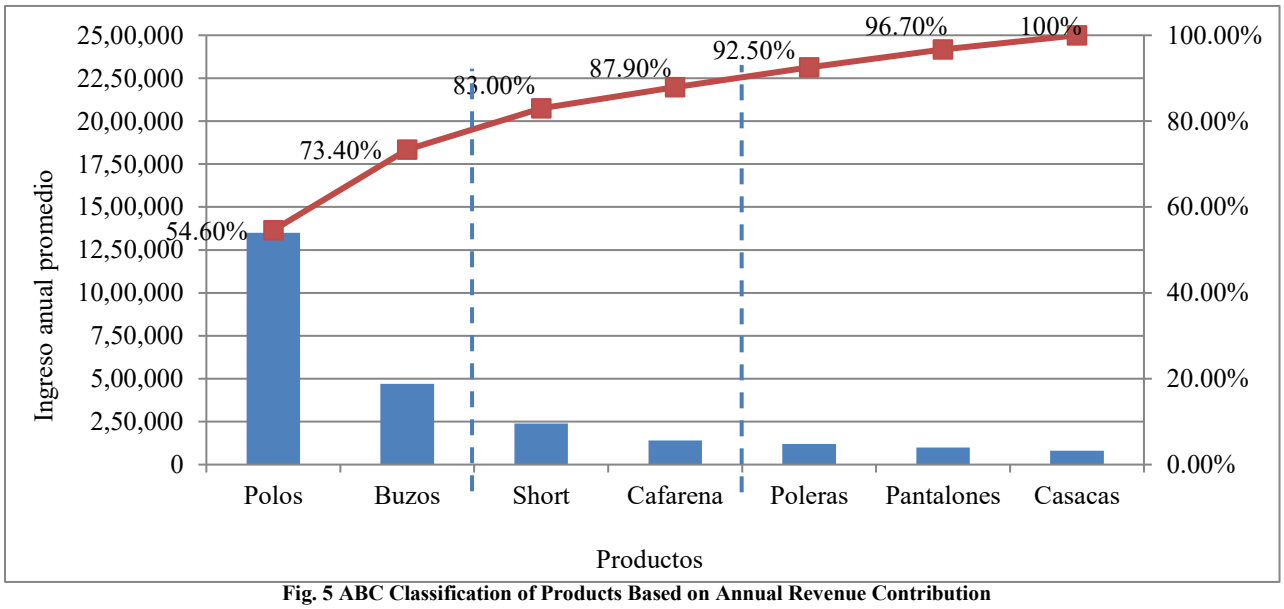
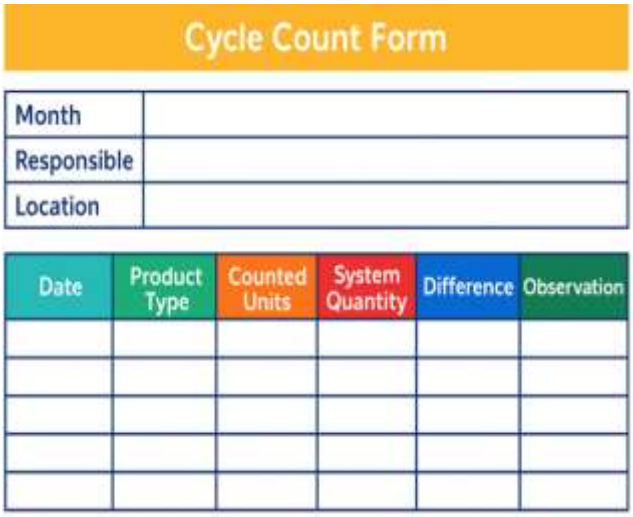


Fig. 5 ABC Classification of Products Based on Annual Revenue Contribution

Figure 5 presents an ABC classification based on average annual revenue. Category A (Polos and Buzos) generates 73.4% of income, category B (Shorts and Cafarenas) contributes 19.3%, and category C (Poleras, Pantalones, Casacas) represents only 7.3%. This analysis supports prioritizing high-impact items for inventory and sales strategy decisions.

Figure 6 presents a standardized format for conducting cycle counts in inventory management. It includes fields for recording date, product type, counted units, system quantity, differences, observations, and general data such as month, responsible person, and location. The color-coded layout enhances data visibility and operational clarity.



Cycle Count Form

Month	
Responsible	
Location	

Date	Product Type	Counted Units	System Quantity	Difference	Observation

Fig. 6 Cycle count form for inventory reconciliation

4.3.5. Supplier Evaluation and Monitoring

Persistent stockouts linked to erratic suppliers were reduced after the logistics department launched a structured evaluation and monitoring system. Nine weighted criteria- including on-time delivery, production capacity, and defect rate- now produce a quantified score for every vendor. High-performing suppliers are flagged and prioritized.

A digital tracker logs every shipment date, quantity received, and service lapse, feeding procurement decisions and minimizing surprise delays. In practice, the proportion of deliveries meeting all expectations climbed from 73% to 91%, fortifying the supply chain and ensuring that finished goods are restocked without interruption.

Figure 7 presents a standardized matrix for evaluating and comparing suppliers based on weighted criteria such as delivery time, service quality, and flexibility. It allows assigning scores and calculating total performance, facilitating objective selection. The structured layout supports informed decision-making in procurement and supply chain management processes.

SUPPLIER EVALUATION

DATE:
Reviewed:

PRODUCT
QUANTITY
EVALUATOR | EXPECTED DELIVERY DATE

SUPPLER EVALUATION CRITERIA

Enter the following score in the biank spaces, depending on the evaluator's criteri
Poor=1, Fair=2, Good=3, Very Good=4
Then, multiply by the weight for each criterion

Supplier evaluation Criteria	Weight	Supplier 1	Supplier 2	Total
Delivery time	18%	Score	Score	Total
Price	12%	18%		Total
Service quality	15%			Total
Meets specifications	10%			Total
Corrected deficiencies	15%			Total
Flexibility	10%			Total
Communication with provider	8%			Total
After-sales service	5%			Total
Form of payment	7%			Total
Result	100%			
Selected provider				

Fig. 7 Supplier Evaluation Matrix for Decision-Making

4.3.6. Model Consolidation and Quantitative Impact

When the five proposed management tools were rolled out at the same time, they worked together much better than expected and helped the firm hit its goals ahead of schedule. The fill-rate metric, which tracks service levels, climbed from 73.04 percent to 96 percent, comfortably above the target mark of 95 percent. That jump showed real progress in product availability, faster logistics, and a keener ability to respond to shopper spikes. Inventory counts became nearly spot-on, picking hold-ups were almost erased, and shelves clogged with expired stock dropped sharply. Keeping an eye on supplier performance also smoothed coordination with outside partners.

4.3.7. Economic Feasibility and Scalability

Bringing the system to life cost S/. 27,787.50 in total, funds for training sessions, half-day audits, printed guides and front-line labor. A careful economic check afterwards produced a Net Present Value of S/. 36,765.84 and an Internal Rate of Return of 58.27 percent, strong signs that the project pays back. Solid numbers now point to sign-on potential for other small and medium enterprises in the space. Because the framework is modular and does not demand heavy up-front spending, it bends to different settings while still pushing waste-cutting, reliable stock, and smooth supplier teamwork.

4.4. Results

Following the validation of the inventory management model using Lean Warehousing tools in a clothing retail SME, key indicator results are captured in Table 1. Analysis of the data revealed improvements in service level performance; fill rate increased from 73.04% to 96%, and the

compliant services rate increased from 70% to 91%, well above target metrics. In addition, inventory record accuracy (ERI) reached a stunning 99.96%, which was a 7% improvement from the baseline. The out-of-season product rate also experienced a significant reduction from 11.60% to 5.35%, while picking delays experienced a significant reduction from 59.44% to 13.61%. These results demonstrated the effectiveness of the proposed model for inventory management in improving service levels in the highly competitive retail market.

Table 1. Results of Key Performance Indicators After Model Implementation

Indicator	Unit	Frequency	As-Is	To-Be	Results	Variation (%)
Fill rate	%	Monthly	73.04%	95%	96.00%	31%
Rate of compliant services	%	Monthly	70.00%	90%	91.00%	30%
ERI	%	Weekly	93.59%	98%	99.96%	7%
Out-of-season rate	%	Quarterly	11.60%	5%	5.35%	-54%
Picking delay	%	Monthly	59.44%	14%	13.61%	-77%

5. Discussion

The results of this study confirm and add to what previous research has found about the benefits of using Lean Warehousing tools in small and medium-sized textile businesses. The fill rate went up from 73.04% to 96%, and the inventory accuracy reached 99.96%. These results are in line with what Vasquez-Quispe et al. [13] found when they used a Lean Warehousing model to improve OTIF and inventory control. In the same way, the big drop in picking delay fits with what Briones-Chávez et al. [15] said: after using Lean tools, they cut item search time by 66% and made their operations more efficient. The successful use of ABC analysis and the 5S method shows that Neyra et al. [16] increased productivity by 3.95 times and got 98.2% accuracy in their textile-support warehouse. Also, the use of cycle counting based on product classification is similar to what Fathoni et al. [21] found when they used ABC-VED with daily counts to improve record accuracy to over 90%. Lastly, the supplier management part that raised the percentage of compliant deliveries from 73% to 91% backs up the findings of Quiroz-Flores et al. [19], who said that having good relationships with suppliers lowers the risk of stockouts and makes inventory more reliable. Overall, this study adds to the body of knowledge by providing a full implementation of Lean Warehousing practices that have been tested in real-world settings and produced results that are in line with the latest research.

5.1. Study Limitations

This study has some limitations, even though it made a lot of progress. First, the validation was done in just one small business in the Peruvian garment sector, which means that the results may not apply to other industries or areas. Second, the validation period was only four months, which might not be long enough to see how the model's effects will last over time. Third, some indicators, like supplier compliance or picking delays, are measured using internal records that may not be accurate or may not follow the same procedures every time. Also, staff and management had to be actively involved in the implementation, which could make it harder to do again in organizations with less engagement or fewer resources.

5.2. Practical Implications

This study gives some great pointers for people in the clothing game and other small businesses out there. Trying out a Lean Warehousing strategy—mixing in stuff like ABC classification, cycle counts, FIFO, 5S, and checking out suppliers—can really step up service and sort out those pesky inventory issues. The numbers speak for themselves: better fill rates, dead-on order accuracy, and a tighter grip on stock show that even cash-strapped small outfits can score big with a little investment. The economic rundown says it is not only doable but also a money-maker. This model hands logistics and operations folks a down-to-earth, repeatable plan, built on lean basics, that is perfect for tweaking processes and plotting a smart course in the crazy-fast retail scene.

5.3. Future Works

Looking ahead, I think it would be a brilliant move for future research to take this Lean Warehousing trick and try it out with more small and medium businesses across various industries and towns, really seeing if it stretches and fits their needs. I'd love to see long-term studies dig into how well the results hold up over time and what little changes teams might need to keep the good vibes going. Messing around with cool tools like RFID, warehouse management apps, or live data dashboards could really fine-tune how sharp and quick the model feels. Moreover, how about adding a sustainability angle—cutting down on waste or making energy work harder—to tie it into green supply chains and the company heart? Plus, I'd be curious to watch how businesses that go all in stack up against those just dipping their toes in with a few pieces, giving us a clear peek at what makes Lean Warehousing really sing.

6. Conclusion

This research really opened my eyes—mixing an integrated model with Lean Warehousing tricks and supplier

know-how can seriously boost a clothing company's service game. The big wins? Order fulfilment shot up by 16.28%, and picking times dropped by 27.42%, which tells me operations are running smoother than ever. Plus, bringing in 5S and a digital supplier tracker made keeping tabs on warehouse orders and product stock a breeze. This approach clearly works in the real world, and the data backs it up.

What caught my attention is how it tackles a headache lots of small and medium-sized textile businesses deal with—chaotic warehouse management and no clear way to judge suppliers. It shows how smart, tailored fixes can smooth out logistical bumps that bug customers, fitting the Company's own style.

And get this—it throws in a fresh model that blends Lean ideas with steady improvement for warehousing and supply chains, something you could use in a classroom or out in the field. Tossing in personal observations with hard numbers, all jazzed up with digital tools, makes it a solid match for companies with tight budgets but tons to handle.

Lastly, I would love to see more folks explore models that use AI to guess what suppliers might do or how demand might shift. Trying this out in other industries could reveal how flexible it is and how it settles into new scenes.

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