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Improvement Model for Inventory Management with the use of the ABC Classification, Economic Lot (EOQ) and Reorder Point (ROP) in a tire retailing company

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Abstract*–The global tire marketing sector faced disruptions due to the pandemic, affecting production and demand. The recovery, driven by economic revival and increased vehicle demand, especially in strategic countries like China, the US, and the EU, is evident. In Peru, the tire trade sector mirrors global trends, with sustained growth linked to increased car sales. The investigated company, operating for over two decades, engages in stores, distribution, fleet, and web businesses. 85% of purchases come from foreign suppliers, mainly Brazil and Germany. Despite pandemic challenges, the company maintained and exceeded pre-pandemic sales since August 2021. However, inventory management remains a challenge, impacting customer satisfaction and sales. This research project aims to demonstrate that implementing an inventory management improvement model enhances company productivity and efficiency. Specific objectives include reviewing supply management in Peru's tire sector, analyzing inventory management issues, proposing engineering-based solutions, and validating the proposed solution's economic feasibility. Some of the most significant results obtained include a 30.6% improvement in total logistic costs, a 15% enhancement in average customer response time, and a current net benefit of approximately $200,000. Focusing on light vehicle tire sales, the project employs a correlational-descriptive approach with experimental design to manipulate independent variables. Limitations include data collection challenges from the company and infrequent analysis of inventory-related procedures. Key performance indicators (KPIs) like high inventory turnover, idle inventory, and total logistic cost are identified as challenges. The project addresses these challenges to enhance operational efficiency and company profitability.

Keywords: Reorder Point, Economic Lot, ABC Classification, SCM, inventory management, tire company.

I. Introduction

The global tire market faced disruptions due to the pandemic, impacting production and demand. As restrictions eased, tire demand gradually recovered, driven by economic revival and increased vehicle demand in key countries. In Peru, the tire trade sector follows global trends, experiencing sustained growth tied to increased car sales.

The investigated company, operating for over two decades, engages in stores, distribution, fleet, and web businesses. 85% of purchases come from foreign suppliers, mainly Brazil and Germany. Despite pandemic challenges, the company maintained and exceeded pre-pandemic sales since August 2021. However, inventory management remains a challenge, impacting customer satisfaction and sales.

This research project aims to demonstrate that implementing an inventory management improvement model enhances company productivity and efficiency. Specific objectives include reviewing supply management in Peru's tire sector, analyzing inventory management issues, proposing engineering-based solutions, and validating the proposed solution's economic feasibility.

Focusing on light vehicle tire sales, the project employs a correlational-descriptive approach with experimental design to manipulate independent variables. Limitations include data collection challenges from the company and infrequent analysis of inventory-related procedures.

Key performance indicators (KPIs) like high inventory turnover, idle inventory, and total logistic cost are identified as challenges. The project addresses these challenges to enhance operational efficiency and company profitability.

A. Literature Review

A systematic literature review (SLR) emerges as an essential tool, providing clarity on key concepts and comprehensive access to previous research. This approach, consisting of three fundamental stages, spans initial exploration to result disclosure, playing a crucial role in formulating solution proposals.

The research focuses on optimizing inventory management to reduce the total logistic cost (TLC), aiming to improve business profitability and efficiency. The methodology involves careful selection of scientific articles, limiting age to five years, prioritizing Q1 and Q2 journals based on SJR classification, and focusing on Scopus or Web of Science databases. Specific filters related to ABC classification, economic order quantity (EOQ), and reorder point (ROP) were incorporated.

The filtering phase used key questions, emphasizing the importance of supply management, ABC methodology, advantages of ABC classification in inventory, and the relationship between inventory management and business profitability. These criteria allowed the selection of 40 articles using the PRISMA Diagram, ensuring transparency in the search and selection process.

Classification of articles by journal quartiles and research type adds layers of analysis. Most selected articles are in Q1 and Q2 quartiles, indicating high-quality sources. The research type analysis reveals a predominance of case studies, offering a detailed view of practical applications.

Keyword-based analysis highlights influential terms such as "ABC CLASSIFICATION," "EOQ," "ROP," "TIRE INDUSTRY," "SCM," and "INVENTORY MANAGEMENT." These keywords evidence key thematic areas explored in the SLR. Typologies like Supply Chain Management, ABC Classification, SCM and ABC, and Economic Order Quantity and Reorder Point offer a framework for understanding and categorizing articles.

The referenced articles applied techniques proposed in this research, demonstrating successful outcomes. As highlighted by Asad & Siddiqui (2019) [1], the implementation of Supply Chain Management (SCM) tools within a company aims at enhancing various aspects, including quantity, time, quality, and costs.

In a 2019 study focused on a motorcycle parts trading company (Hanafi, Mardin, Asmal, Setiawan, and Wijaya, 2019) [2], the reorganization of the warehouse based on ABC classification proved effective. Placing high-consumption materials closer to the entrance significantly reduced workers' annual walking distance and the time required to pick specific customer-requested parts.

According to Eksler, Aviram, Elalouf, and Kamble (2019) [3], the implementation of a standard Economic Order Quantity (EOQ) model is deemed straightforward, even when dealing with products exhibiting purely constant demand.

Contrastingly, a 2020 study addressing policies in companies trading perishable products (Emre, Ulku, and Saeed, 2020) [4] suggests that while implementing Reorder Point (ROP) is common, it may not always be the optimal policy. The authors advocate for considering policies related to delivery time, as they could exert a more significant influence on cost reduction within a business.

Numerous authors underscore the significance of optimizing inventory control through diverse tools or policies. As noted by Benssoussan, Skaaning, and Turi (2018) [5], the continuous exploration of different inventory control and optimization strategies is evident in numerous articles and research. In recent years, companies are increasingly focused on maximizing inventory management to substantially reduce costs and achieve heightened productivity and profitability.

In summary, the SLR in this research represents a rigorous and structured approach to gather essential information on inventory management. Emphasizing source quality, specific filters, and detailed quartile and research type analysis contribute to the review's robustness and relevance. This methodical approach lays the groundwork for a well-founded and applicable improvement proposal in the realm of business logistics and inventory management

II. PROBLEM

Detailed analysis of the Total Logistic Cost (TLC) as a percentage of sales reveals a significant technical gap in the company compared to the sector. While the sector's TLC indicator represents 3% of sales, the company shows a current value of 5%, revealing a 2% discrepancy. This difference, translating to a 40% improvement opportunity, is accentuated considering the economic impact of the vehicle and auto parts sales sector on the country's GDP and is presented in figure 1.

Quantitatively, operational surcharges due to inefficient inventory management practices are evident. Dead stock storage costs represent 12% of the company's total inventory, approximately $ 27,000. Comparatively, the tire marketing sector maintains this indicator around 10%, indicating room for improvement for the company. Additionally, the lack of synchronization between orders and sales results in extra costs for closing sales without stock, representing 13% of annual purchases, approximately $ 13,500. While common in the sector, there is room for optimization.

This qualitative analysis is complemented by identifying various missed opportunity costs, mainly associated with stockouts. Estimated losses from these missed operations

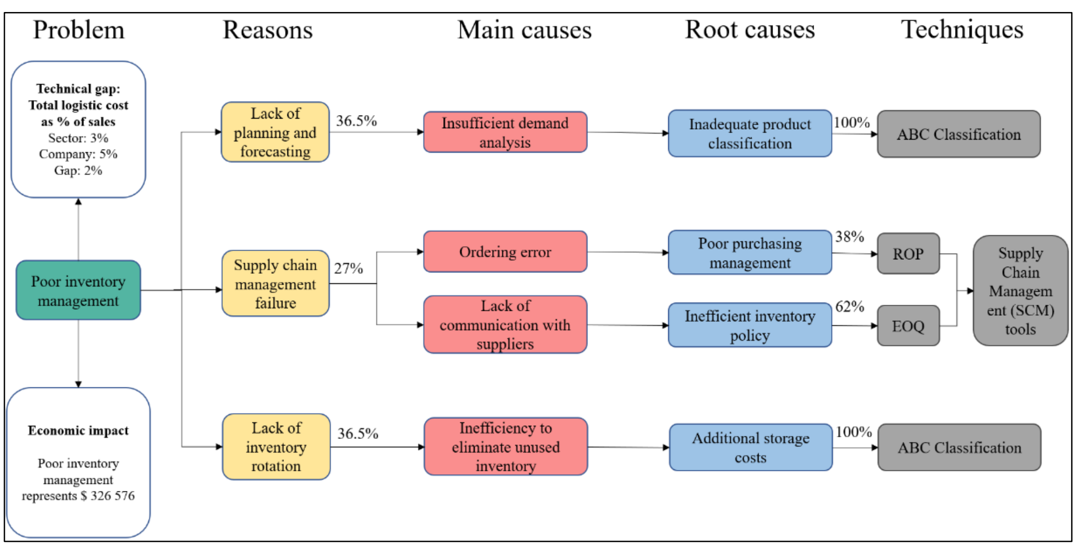

Fig 1. Diagram of the linkage of causes, problems, and techniques.

represent a 10% loss in annual sales, equivalent to $ 28,052 in margin. While the company does not keep an exact record of these losses, the comparison with the sector highlights a significant margin for improvement.

Root cause determination is conducted through a problem tree, identifying issues related to inventory management and their main drivers. These root causes, linked to the project's independent variables, set the foundation for the objective tree. The latter guides research objectives toward implementing economic order quantity (EOQ) analysis, reorder point (ROP), and ABC classification as key tools to optimize inventory management and reduce total storage costs.

The company ultimately aims to increase the efficiency of its inventory management to reduce costs and boost profitability. The selected tools, along with root cause identification and research objectives, constitute a comprehensive approach to address current challenges and significantly improve logistical and economic processes

III. Methodology

Efficiency in logistics management and supply chain optimization is critical for any company seeking to enhance performance and reduce costs. In this context, this chapter focuses on proposing specific strategies for improving logistical processes in a company dedicated to tire distribution. Figure 2 shows the principal inputs, outputs, and the components of the improvement model.

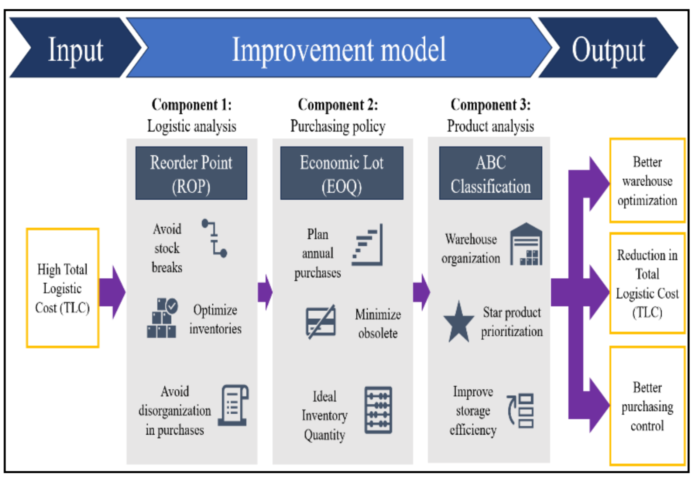

Fig 2. Implementation method of the proposed general model.

A. *Logistics Warehouse Analysis*

The company currently manages its tire inventories in a rather unsystematic manner, resulting in inefficient purchasing processes. The lack of a thorough analysis of annual and daily demand has led to purchase orders based on historical experiences, generating obsolescence problems and possible stockouts.

The implementation of the Reorder Point (ROP) technique is proposed using a mathematical formula (1) considering daily demand, delivery time, and safety stock.

$$d. L + SS = ROP \quad (1)$$

Where:

- d: Daily demand
- L: Lead time
- SS: Security stock

Applying this technique to a sample of the top 15 selling tire types allowed the determination of ideal inventory quantities, facilitating purchase planning, reducing storage costs, and avoiding stockout losses. The sample was chosen considering that those Stock Keeping Unit (SKU) were the only ones that did not generate a selling bottleneck. Regarding this technique, a macro designed in Excel was implemented in the company to calculate the Reorder Point (ROP) based on the type of tire.

TABLE I
TOP 15 SELLING TIRE TYPES

Description	**Annual Demand**
Tire 6.50-13-06 G8 Goodyear	15,880
Tire 185/70R14 Eagle Ventura 88H Goodyear	4,869
Tire 185/70R13 Eagle Ventura 86H Goodyear	3,374
Tire 185/70R14 Assurance MaxLife 88H Goodyear	3,302
Tire 185/70R13 Edge Touring 86T Kelly	2,389
Tire 185/70R14 Edge Touring 88T Kelly	2,292
Tire 185/65R15 Assurance 88T Goodyear	2,291
Tire 185/70R13 Assurance MaxLife 86T Goodyear	2,162
Tire 185/65R14 Assurance MaxLife 86H Goodyear	1,191
Tire 175/65R14 Assurance MaxLife 86H Goodyear	903
Tire 205/55R16 Edge Sport 91V Kelly	789
Tire 11R22.5 AMS Steelmark	773
Tire 265/70R16 Wrangler Armortrac 112T Goodyear	744
Tire 7.00-15-10 Caminera Goodyear	714
Tire 5.50R13LT 10PR 94/93P V888 Vitour	704

The results demonstrated substantial improvements in the efficiency of purchasing and storage processes. The widespread implementation of this tool is expected to provide the company with a robust indicator for order planning and effective warehouse management.

B. *Purchasing Policy*

The company lacks an annual purchasing schedule, resulting in poorly planned orders based on historical data or specific customer requests. This lack of planning leads to the potential for exceeding actual demand, generating increased storage costs.

The implementation of the Economic Order Quantity (EOQ) tool is proposed to establish the optimal quantity per order. Applying this technique to the top 15 demanded tire models, ideal quantities were calculated to minimize inventory-associated costs using a formula. (2)

$$\sqrt{\frac{2DS}{CI}} = EOQ \quad (2)$$

Where:

- D: Annual demand
- S: Average cost per order
- C: Unit cost
- I: Inventory holding cost

The implementation of the EOQ-based purchasing policy is expected to reduce storage costs and optimize the quantity of annual orders, avoiding excess inventory and stockout losses. Just like with the ROP technique, a macro was implemented for the Economic Order Quantity (EOQ) calculation to perform various calculations.

C. Product Analysis

Disorganization in tire distribution in the warehouse leads to location problems and lost sales. The implementation of ABC classification is proposed to organize products based on their importance in sales.

ABC classification involves analyzing sales to categorize products into three groups based on importance (A, B and C). This classification is expected to allow warehouse rearrangement, prioritizing the most relevant products.

The implementation of ABC classification translates into an estimated 15% improvement in the average time an operator takes to pick an order from the warehouse. The reorganization of storage space should streamline processes and reduce costs and increase sells.

The adoption of these logistical optimization strategies promises to significantly improve tire supply chain efficiency. The combination of mathematical formulas, purchasing policies, and product analysis provides the company with a comprehensive approach to maximize operational efficiency and reduce logistical costs. The successful implementation of these proposals can make a difference in a competitive market, ensuring agile and efficient logistics management.

In contrast to the other techniques, a simulation was conducted using the Arena program to compare the current situation with the proposed improvement, aiming to showcase the enhancement in lead times.

IV. INNOVATIVE PROPOSAL

As previously mentioned, the company is lagging behind its competitors in terms of Total Logistics Cost (TLC) as a percentage of sales. In order to propose a new model demonstrating significant improvements with the application of the tools explained earlier, it was necessary to conduct simulations or implementations, depending on the component. The following details each component's proposal to showcase the effectiveness of the tools.

Component 1: Logistics Warehouse Analysis

The first component aims to demonstrate that the use of the Reorder Point (ROP) tool can reduce storage costs. By applying the mathematical formula in the Excel-developed macro, presented in figure 3, the optimal inventory quantity per tire type for placing an order can be calculated.

ROP CALCUALTION

ROP = d·L+SS

Where:
d: Daily demand by tire type
L: Delivery time in days by type of tire
SS: Safety stock by tire type
***All this data was provides by the company**

Records	
Model	Tire 6.50-13-06 G8 Goodyear
Annual demand (unit)	15,880
Delivery time (days)	130.58
Safety stock	130.58

CALCULATE ROP

SKU	Annual demand (unit)	Daily demand	Delivery time (days)	Safety stock	ROP (unit)
Tire 6.50-13-06 G8 Goodyear	15,880	45	130.58	0	1530
Tire 185/70R14 Eagle Ventura 88H Goodyear	4,869	14	167.52	0	476
Tire 185/70R13 Eagle Ventura 86H Goodyear	3,374	10	156.52	0	340
Tire 185/70R14 Assurance MaxLife 88H Goodyear	3,302	10	148.58	0	340
Tire 185/70R13 Edge Touring 86T Kelly	2,389	7	118.19	0	259
Tire 185/70R14 Edge Touring 88T Kelly	2,292	7	127.3	0	259
Tire 185/65R15 Assurance 88T Goodyear	2,291	7	181.39	0	238
Tire 185/70R13 Assurance MaxLife 86T Goodyear	2,162	7	140.23	0	238

Fig 3. ROP Calculation Excel-developed macro

With this value, the new Storage Cost can be determined using the following formula (3):

$$SC = \left(\frac{Q}{2} + SS\right) x\, C\, x\, I \quad (3)$$

Where:

- SC: Storage Cost
- Q: Minimum stock to place an order
- SS: Security Stock
- C: Unit Cost
- I: Storage cost (%)

***Company says that manages a 2% storage cost**

Component 2: Purchasing Policy

Similar to Component 1, an Excel macro will be utilized to apply the Economic Order Quantity (EOQ) tool with its corresponding mathematical formula. The macro can be visualized in figure 4.

EOQ CALCULATION

EOQ = √(2xDxS/CxI)

Where:
D: Annual demand by tire type
S: Costo to place an average order
***The cost to place an order is $887**
C: Cost per unit
I: Cost of holding inventories
***The cost of holding inventories is 2%**

Records	
Model	Tire 6.50-13-06 G8 Goodyear
Annual demand (unit)	15,880
Unit cost ($)	131

CALCULAR EOQ

SKU	Annual demand (unit)	Unit cost ($)	EOQ (unit)
Tire 6.50-13-06 G8 Goodyear	15,880	130.58	6367
Tire 185/70R14 Eagle Ventura 88H Goodyear	4,869	167.52	3112
Tire 185/70R13 Eagle Ventura 86H Goodyear	3,374	156.52	2680
Tire 185/70R14 Assurance MaxLife 88H Goodyear	3,302	148.58	2722
Tire 185/70R13 Edge Touring 86T Kelly	2,389	118.19	2596
Tire 185/70R14 Edge Touring 88T Kelly	2,292	127.3	2450
Tire 185/65R15 Assurance 88T Goodyear	2,291	181.39	2052
Tire 185/70R13 Assurance MaxLife 86T Goodyear	2,162	140.23	2267

Fig 4. EOQ Calculation Excel-developed macro

In this case, the key performance indicator to improve is the Total Logistics Cost, following the formula (4):

$$TLC = \frac{D}{Q} x\, S + \left(\frac{Q}{2} + SS\right) x\, C\, x\, I \quad (4)$$

Where:

- TLC: Total Logistic Cost
- D: Annual demand
- Q: Economic Order Quantity
- S: Costo of placing an order
- SS: Security Stock
- C: Unit Cost
- I: Storage cost (%)

Upon determining the Economic Order Quantity (EOQ), a new order frequency for the company can be calculated to meet the annual tire demand. Consequently, this approach enables a reduction in the cost per order, leading to a decrease in the overall logistics cost.

Component 3: Product Analysis

The third component involves implementing the ABC Classification tool. The proposed model, represented in figures 5 and 6, includes a warehouse reorganization to reduce service times. Initially, an exhaustive analysis of the warehouse and tire locations was conducted. The proposed layout prioritizes Type A tires, placing them closer to the warehouse door, while other tire types are positioned farther away to achieve shorter service times.

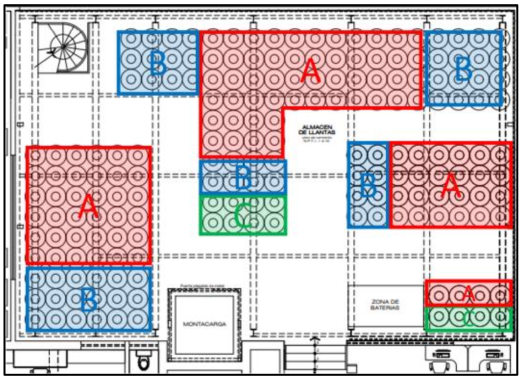

Fig 5. Actual warehouse distribution

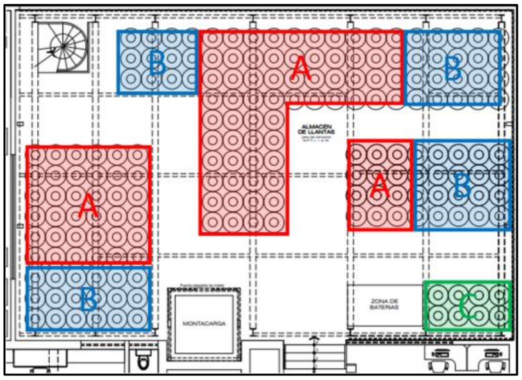

Fig 6. New warehouse distribution

Additionally, a simulation of times was carried out using Arena software. This model aided in gaining a better understanding of all processes within the company and, most importantly, allowed for a realistic time measurement in the event of a complete warehouse reorganization. The whole simulation is presented in figure 7. To prove that there was going to be an improvement in service time, a total of 40-time measurements were made on a Saturday within the company's warehouse and compared with the results of the 40 repetitions of the simulation in the Arena program.

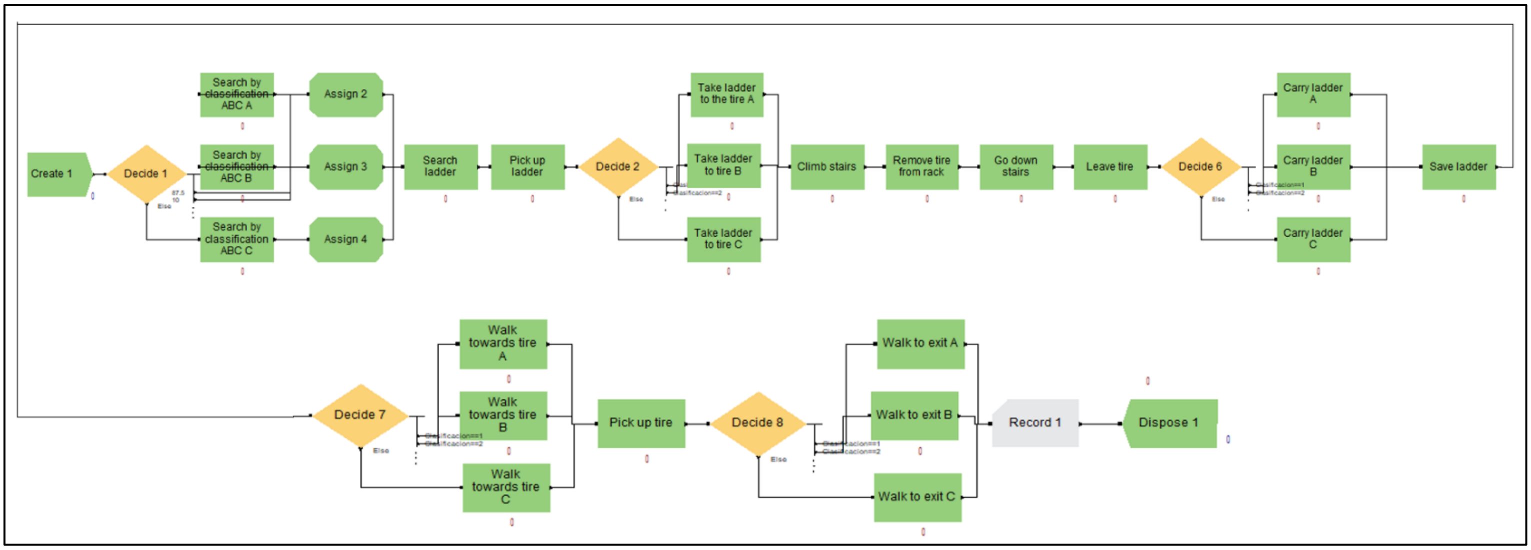

Fig 7. Arena simulation model with ABC Classification

IV. RESULTS

In the economic evaluation of the project, a detailed comparison was made between two financial scenarios: one without improvements and another incorporating the necessary $ 20,446 investment for the proposed solutions. It is crucial to mention that the investment would be fully financed with internal funds, avoiding external financing.

The Shareholder Opportunity Cost (COK) was calculated to determine financial indicators related to the improvement. With an annual COK of 20.40% and a monthly COK of 1.54%, it was incorporated into the analysis of the company's economic flow with the proposed improvements.

Financial indicators of the economic flow with improvements:

- Economic Net Present Value (NPV): $ 416,736
- Internal Rate of Return (IRR): 378%
- Benefit-Cost Ratio (B/C R): 21.38
- Payback Period (PP): 0.27 months or 7.98 days

These indicators reflect the project's financial robustness. The positive NPV, exceeding half millions of dollars ($), and the IRR of 378% indicate high profitability. The B/C R shows that the investment is highly profitable, and the PP reveals that the investment recovers in approximately 8 days, a manageable duration given the company's current billing.

Considering both economic scenarios, the specific benefits of implementing tools like ABC Classification, ROP Macro, and EOQ Macro are highlighted:

A. ABC Classification

- 16.67% increase in tire sales to individuals, representing 30% of total sales.

B. ROP (Reorder Point)

- 47% reduction in storage costs, constituting 40% of the total logistic cost.

C. EOQ (Economic Lot)

- 30.60% reduction in total logistic cost.

Once the net benefit attributable to the improvement (increases in sales and savings in costs) is calculated, a new economic flow with encouraging financial indicators is generated: Indicators of the economic flow of the net benefit of the proposal:

- NPV: $ 289,442
- IRR: 262%
- B/C R: 15.16
- PP: 0.38 months or 11.27 days

This new analysis confirms the financial viability of the proposed improvement.

Additionally, a sensitivity analysis of the NPV considering scenarios where the improvement does not reach 100% implementation was conducted. After 1000 iterations, the probability of a favorable NPV between $ 12,530 and $ 286,410, with a 90% probability of occurrence, was evaluated. The results support the project's strength.

A detailed analysis of the results after implementing improvements in the company has revealed substantial positive impacts on its productivity and efficiency. Each addressed component in the optimization process has significantly contributed to overall improvement in logistical processes and, consequently, the company's economic outcomes.

A. Component 1: Logistics Warehouse Analysis

The application of the ROP tool has generated notable improvements, notably a 47.4% reduction in storage costs. This tool has not only optimized the essential tire quantities in inventory, avoiding stockouts and minimizing costs, but has also highlighted the need for a more in-depth logistics analysis in the warehouse. By correcting overstock and loss issues, the implementation of the ROP tool has led to more efficient inventory management and increased agility in purchasing and storage processes.

TABLE II
EVOLUTION OF THE STORAGE COSTS DURING THE IMPLEMENTATION OF ROP

Month	Phase	Storage costs
1	As Is	27,794
2	Transition	22,743
3	Transition	17,888
4	To Be	14,626

TABLE III
STORAGE COSTS COMPARATIVE

Description	As Is	To Be	Real
Storage Cost	27,794	14,626	14,626

B. Component 2: Purchasing Policy

The implementation of EOQ has had a significant impact, with a 30.6% reduction in Total Logistic Cost. The previous lack of an established purchasing policy led the company to place excessive orders, relying solely on historical data and sales forecasts. The introduction of EOQ has allowed the determination of ideal quantities per tire type in each order, optimizing costs associated with inventory. This implementation has contributed not only to more effective purchasing management but also to the reduction of unnecessary expenses in logistics and storage.

TABLE IV
TOTAL COST LOGISTIC COMPARATIVE

Description	As Is	To Be	Real
Total Logistic Cost (TLC)	173,134	120,135	120,135

C. Component 3: Product Analysis

ABC Classification, considering the Pareto principle and classifying tire types based on their sales volume, has improved the average order picking time by 36.5%. The initial disorganization in the location of tire models has been corrected, optimizing staff efficiency and significantly reducing waiting times for customers. The implementation of ABC Classification has provided a more organized structure in the warehouse, improving the overall purchasing experience for customers and contributing to operational efficiency.

TABLE V
AVERAGE TIME PER SERVICE COMPARATIVE

Description	Indicator	As Is	To Be	Real	Improvement
ABC Classification	Average time per service	13.5	8.7	8.57	36.50%

V. DISCUSSION AND CONCLUSIONS

The literature review cites articles supporting the positive impact of implementing Supply Chain Management (SCM) tools in inventory management. Asad & Siddiqui (2019) [1] emphasize SCM's goal of improving quantity, time, quality, and costs, aligning with the proposed EOQ, ROP, and ABC Classification tools.

A 2019 study on ABC Classification in a motorcycle parts company (Hanafi et al.) [2] demonstrates worker time reduction and potential sales increase through warehouse reorganization. Both studies highlight EOQ and ROP for minimizing inventory costs.

Implementing a standard EOQ model, as suggested by Eksler et al. (2019) [3], is straightforward, as applied in this research using a known mathematical formula. Contrarily, a 2020 study (Emre et al.) [4] questions the always-optimal nature of ROP policies, but the current research shows reduced storage costs through ROP implementation. Authors like Benssoussan et al. (2018) [5] stress inventory control optimization for cost reduction, productivity, and profitability. The research aligns with this, emphasizing the benefits of inventory optimization.

In essence, the research aligns with existing literature on the positive outcomes of SCM tools in inventory management.

General Considerations and Conclusions

In the overall evaluation, it is concluded that the investment required for these improvements does not represent a prohibitive cost, especially when weighing the benefits obtained. The true added value to the company lies not only in the adoption of specific software or assets but in the acquisition of accurate, detailed, and precise knowledge in the field of supply chain management.

The improvement proposal addresses the fundamental needs of any company, especially in a business environment in a developing country, such as Peru. Proper supply chain management is a crucial element for achieving sustainable growth and continuity in the market. While Peruvian companies may prioritize increasing sales, reducing logistical costs emerges as a key differentiator when seeking sustainable growth and a lasting presence in the market.

In recent years, companies from various sectors have recognized the strategic importance of improving inventory management. The inclusion of Supply Chain Management (SCM) tools, such as those investigated in this study (EOQ, ROP, and ABC Classification), has become a common practice to optimize operations and enhance logistics efficiency.

In summary, the successful implementation of these logistical optimization strategies has proven to significantly improve the efficiency of the company's supply chain. The combination of mathematical tools, purchasing policies, and product analysis has not only contributed to reducing operational costs but has also improved the overall customer experience and strengthened the company's competitive position in the market.

Finally, based on the scenarios observed during the financial evaluation, the improvement proposal would be highly profitable for the company, as it has a positive economic Net Present Value (VAN) and an Internal Rate of Return (TIR) higher than the Cost of Capital (COK) in 75% of the scenarios, even surpassing many existing investment markets.

REFERENCES

[1] Asana, I. M., Radhitya, M. L., Widiartha, K. K., Santika, P. P., & Wiguna, I. K. (2020). Inventory control using ABC and Min-max analysis on Retail Management Information System. Journal of Physics: Conference Series, 1469(1), 012097. https://doi.org/10.1088/1742-6596/1469/1/012097 M. King, B. Zhu, and S. Tang, "Optimal path planning," *Mobile Robots*, vol. 8, no. 2, pp. 520-531, March 2001.

[2] Hanafi, R., Mardin, F., Asmal, S., Setiawan, I., & Wijaya, S. (2019). Toward a green inventory controlling using the ABC Classification Analysis: A case of motorcycle spares parts shop. IOP Conference Series: Earth and Environmental Science, 343(1), 012012. https://doi.org/10.1088/1755-1315/343/1/012012.

[3] Eksler, L., Aviram, R., Elalouf, A., & Kamble, A. (2019). An EOQ model for multiple products with varying degrees of substitutability. Economics, 13(1). https://doi.org/10.5018/economics-ejournal.ja.2019-30.

[4] Berk, E., Gürler, Ü., & Poormoaied, S. (2018). On the (Q, r) policy for perishables with positive lead times and multiple outstanding orders. Annals of Operations Research, 284(1), 81–98. https://doi.org/10.1007/s10479-018-3044-3

[5] Alain Bensoussan, Sonny Skaaning, & Janos Turi. (2018). Inventory control with fixed cost and price optimization in continuous time. Journal of Applied Analysis & Computation, 8(3), 805–835. https://doi.org/10.11948/2018.805 J.-G. Lu, "Title of paper with only the first word capitalized," *J. Name Stand. Abbrev.*, in press.

[6] AAP. (2022). Asociación Automotriz del Perú. Obtenido de https://aap.org.pe/estadisticas/informe-estadistico-automotor/iea-2022/

[7] Blume Dibos. C. E.. Cruzado Huerta. S.. & Zegarra Cavero. C. M. (2018). Análisis de las estrategias de comercialización de vehículos livianos de marcas chinas. ESAN Graduate School of Business. 167.

[8] Flores Tananta. C. A.. Arévalo Arévalo. J. G.. Pérez Hidalgo. J.. & Escalante Torres. J. A. (2020). Gestión del inventario y el rendimiento financiero en las empresas automotrices. Tarapoto. 2020. Ciencia Latina Revista Científica Multidisciplinar. 21.

[9] Galarza. C. R. (2020). LOS ALCANCES DE UNA INVESTIGACIÓN. CienciAmerica.

[10] Misra. V. (2020). Supply Chain Management Systems: Architecture. Design and Vision. JOURNAL OF STRATEGIC INNOVATION AND SUSTAINABILITY.

[11] Peña. A. (2019). Analisis del sector automotriz Ecuador. Infoeconomia. 63.

[12] Rendon Cox. R. A. (2019). PROPUESTA DE UN SISTEMA DE GESTIÓN DE INVENTARIOS PARA LA BODEGA DEL TALLER AUTOMOTRIZ "EL PIBE 2". Universidad de Guayaquil. 86.

[13] SÁNCHEZ BAQUERO. J. P.. BENITEZ ALVAREZ. W. O.. MÁSMELA USECHE. D. M.. ORTEGA GARCÍA. C.. & MEZA REYES. D. C. (2018). Beneficios al implementar estrategias de Supply Chain Management y Logística. Universidad Nacional Abierta y a DIstancia. 32.