Model to Optimize ROA in Pharmaceutical SMEs Using DMAIC, ABC Method, Dynamic Pricing, and Digital Transformation)

Wagner Romañol-Tuanama[1], Yamile Araujo-Romero[1], Carlos Céspedes-Blanco[1], Carlos Raymundo[1]
[1]Ingeniería de Gestión Empresarial, Universidad Perúana de Ciencias Aplicadas, Perú U201924904@upc.edu.pe, U201811233@upc.edu.pe, pcincces@upc.edu.pe, carlos.raymundo@upc.edu.pe

Abstract*– In a dynamic market environment, pharmaceutical product distributors face significant challenges in managing their costs and asset turnover, resulting in low return on assets (ROA). Cost optimization and inventory management are crucial for improving profitability and competitiveness in the market. Recent research has shown that large companies implementing digital transformation, DMAIC, and dynamic pricing have successfully reduced costs and improved inventory turnover. However, Peruvian SMEs have not widely adopted these tools. This research proposes applying the DMAIC methodology, ABC method, dynamic pricing, and digital transformation in pharmaceutical distribution SMEs, adapting these strategies to their specific needs. The five phases of DMAIC, the ABC method for categorization, a dynamic pricing system, and digital transformation were implemented in a pharmaceutical distribution SME. Data was collected before and after implementation to measure the impact on costs, inventory turnover, and return on assets (ROA). The results showed a significant 12% reduction in operating costs, an 80% increase in ROA, a 120% improvement in inventory turnover, and optimization in sales pricing. The application of this methodology in pharmaceutical distribution SMEs can significantly enhance return on assets, confirming the feasibility and benefits of these tools in the context of small and medium-sized enterprises.

***Keywords*-- Costs, Assets, Inventory, Turnover, Return on Assets**

I. INTRODUCTION

The problem addressed in this research focuses on the low profitability of a pharmaceutical distribution company, which has maintained an average monthly ROA (Return on Assets) of 2.9% and 3.5% in the years 2021 and 2022, respectively. This is significantly below the industry average of 6% in the Vietnamese market. This issue is caused by poor product classification management, low inventory turnover, highly competitive prices, and a lack of adaptation to the digital era. Therefore, methods are proposed to counteract the main problem and achieve positive results, particularly in increasing profitability.

Globally, research and development spending in the pharmaceutical sector increased significantly by 4.7% between 2012 and 2020 and is projected to grow by 4.2% between 2020 and 2026 [1]. Additionally, the global pharmaceutical sector experienced revenue growth, reaching a value of $1.48 trillion USD in 2022 [2]. This indicates that the competitiveness of pharmaceutical companies will be strengthened through the development of new drugs. On the other hand, in Peru, medical expenses as a percentage of the income of the poorest quintile of the population increased from 14% in 2019 to 20% in 2020 due to the health crisis [3], highlighting the increased demand for pharmaceuticals. Furthermore, the country faces a major issue affecting thousands of patients who are waiting for treatment in hospitals with a supply of some medication. However, hospitals are unable to provide medicines due to shortages in the sector [4].

In this context, it is crucial to address the issues faced by the company under study, as it can improve its competitiveness in the market and ensure long-term sustainability through better asset and cost management. It is worth emphasizing that improvements will not only be observed at the business level but will also have a positive social impact. By improving internal efficiency, the availability of medications for those who need them most can be ensured. In this way, the company contributes to public health by ensuring that more people have access to more medications.

To address the issue, research has been conducted in different areas, where the DMAIC methodology, the ABC method, dynamic pricing, and digital transformation have proven to be good alternatives for solving the problem. For instance, in a pharmaceutical company in Rwanda, the ABC method was applied, allowing the identification and classification of products based on their impact on total cost. This approach optimized costs and operational efficiency [5]. Another example is the application of the DMAIC methodology to reduce logistics costs in a Turkish company, where the author developed a plan to mitigate the problem of low profitability and market competitiveness, ultimately increasing the amount exported and boosting the company's revenues [6]. Lastly, a small Italian company conducted research on barriers to digitalization, identifying issues such as resistance to change, fear of dependency on suppliers, lack of integration with activities, and investment levels [7].

However, these methodologies are mostly applied in large companies outside of Peru. Peruvian SMEs generally lack strong business skills, sector-specific experience, adequate resources, and exhibit a notable resistance to change [8]. Therefore, it is evident that local companies are at a competitive disadvantage compared to foreign markets. Similarly, Peruvian companies might be missing opportunities for optimization and growth, as their capacity to adapt and innovate in processes and technologies is limited. This results in lower operational efficiency and reduced quality of service

and products, which negatively impacts not only the country's economic development but also its ability to compete with international companies.

Motivated by the lack of application of improvement models in pharmaceutical distribution SMEs in Peru, this proposal seeks to increase ROA by reducing sales costs and inventory levels through the application of various improvement models. To this end, a comprehensive analysis of the current global and sectoral situation will be conducted, evaluating the best practices and previous experiences in the field to enhance profitability and operational optimization. Similarly, the current situation of the company under study will be examined, where the following improvements will be implemented.

The tools selected to achieve the objective include the DMAIC methodology, which focuses on defining, measuring, analyzing, improving, and controlling processes; the ABC method, which enables better product classification based on their significance in total costs; the application of dynamic pricing to adjust prices according to market conditions; and digital transformation, which will reduce human errors and optimize operational processes. These strategies are designed to increase profitability and improve operational efficiency, positioning Peruvian SMEs in the competitive global market.

The article will be structured into six parts, starting with the introduction, where the purpose and objectives of the research will be presented. Next, the state of the art will be detailed, classifying relevant articles into three categories. The contribution section will describe the research's contributions to the field of study. In the validation section, the application of the tools in the case study will be developed. The discussion section will interpret the findings relating to previous studies. Finally, the conclusions will summarize the main results and propose potential directions for future research.

II. STATE OF THE ART

A. Approaches and Technologies in Inventory Management

Mfizi et al. applied the ABC method in a distribution company to efficiently classify medications and ensure their availability, avoiding shortages. They classified 76 products in group A (75% of total cost), 116 in group B (20%), and 191 in group C (5%) [12]. Nathan used the same method in a Brazilian pharmaceutical network, relocating high-turnover products to strategic areas, which led to a 25% savings in labor [13]. Meanwhile, Pei et al. employed machine learning and web tracking to improve product traceability in a complex pharmaceutical supply chain, achieving tracking rates between 94% and 97% [14]. However, this approach does not prioritize products. In contrast, the ABC method is more suitable as it focuses on prioritization based on market demand.

B. Approaches and Trends in Price Setting

Kogut et al. evaluated the impact of dynamic pricing on different types of medications and demonstrated that it significantly affects cost-effectiveness analysis. They analyzed 2% increases during the exclusivity period and 25% to 40% reductions after its expiration, which influences profitability and competitiveness in the North American market [15]. In the prescription drug market, the impact of both price related and non-price related advertising on the demand for specific categories and brands has also been studied [16]. Additionally, the rising cost of these medications in the United States has driven the use of international reference pricing, although these policies were associated with a 73% reduction in the probability of launching new drugs within the first nine months [17]. Therefore, dynamic pricing represents a key strategy, especially due to its importance in volume-based pricing.

III. CONTRIBUTION

A. Foundation

To increase profitability in the pharmaceutical industry, the DMAIC methodology is considered the primary proposed solution, surpassing the PDCA and Kaizen-Kata methodologies. According to Pakdil et al., "DMAIC is generally the most suitable due to its structured approach, which allows for identifying and eliminating operational inefficiencies, improving process quality, and, above all, reducing costs while increasing profitability" [18].

To improve the classification of medications, the ABC method was chosen over machine learning and web tracking. This is because these tools require prolonged implementation time, highly experienced and specialized personnel in these technologies, and a high budget. Meanwhile, "the ABC method allows companies to prioritize inventory management through its simplicity and affordable cost" [19].

Finally, to apply optimal pricing in the pharmaceutical market, the Dynamic Pricing strategy was selected over artificial intelligence and ERP systems. Dynamic Pricing adjusts prices in response to supply and demand, competitor pricing, and other market factors, ensuring that prices reflect current conditions, which helps maximize revenue and maintain competitiveness" [20]. Additionally, digital transformation is employed to counteract manual errors and facilitate invoicing processes in an optimized manner [21].

B. General

To achieve a positive impact on the company under study, the DMAIC methodology, ABC method, dynamic pricing, and digital transformation were implemented, as shown in "Fig. 1."

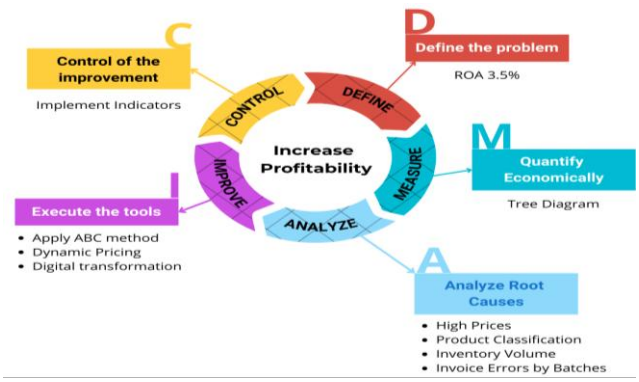

Fig. 1 Schematic Representation of the Proposed Mode

C. *Detail*

The implementation of the DMAIC model and dynamic pricing will allow the reduction of operating costs in the pharmaceutical distribution company. Initially, the DMAIC approach aims to provide a comprehensive view of the root causes affecting the company's profitability and then analyze them. To detail the relationship between the root cause and the selected technique, we can analyze how each proposed technique addresses one or more of the identified causes of high sales costs and declining sales [22].

The ABC method enabled the classification of products into three categories (A, B, and C) based on profitability, which helped focus management efforts on the most critical products (category A), optimizing inventory and improving inventory turnover by category. This classification guides the use of dynamic pricing, which adjusts in real time according to demand and competition by modifying prices, product turnover and inventory levels are regulated, creating a feedback loop for inventory management.

As part of the digital transformation, a system was implemented to automate this logic: it organizes products by category and dynamically updates prices. This improves accuracy in inventory control, especially for sensitive batches like ampoules and pills, reduces human error, and optimizes costs, all within the continuous improvement framework of DMAIC.

The implementation proceeds by developing the phases of the DMAIC methodology:

- Define: General processes are identified using process analysis tools.
- Measure: Information is collected from the company's income statements and balance sheets, as well as from the pharmaceutical sector. Profitability ratios, focusing on supply and sales, are calculated, along with horizontal and vertical analysis of income statements and balance sheets.
- Analyze: Root causes are identified and analyzed using a prioritization matrix to determine critical factors affecting the company's performance.
- Improve: Solutions are developed to address the problem. This includes optimizing inventory turnover, adjusting competitive pricing, and implementing digital transformation through the application of the DMAIC approach.
- Control: Indicators are established to ensure that the improvements are sustained over time. Additionally, feedback systems are implemented to identify deviations and take corrective actions.

D. Tentative Process

- The sales process where the tools will be implemented to improve this process is shown, as illustrated in "Fig. 2."

E. *Indicators*

Indicators will be used after implementation, as they are crucial for measuring the effectiveness of the changes implemented and ensuring that strategic objectives are

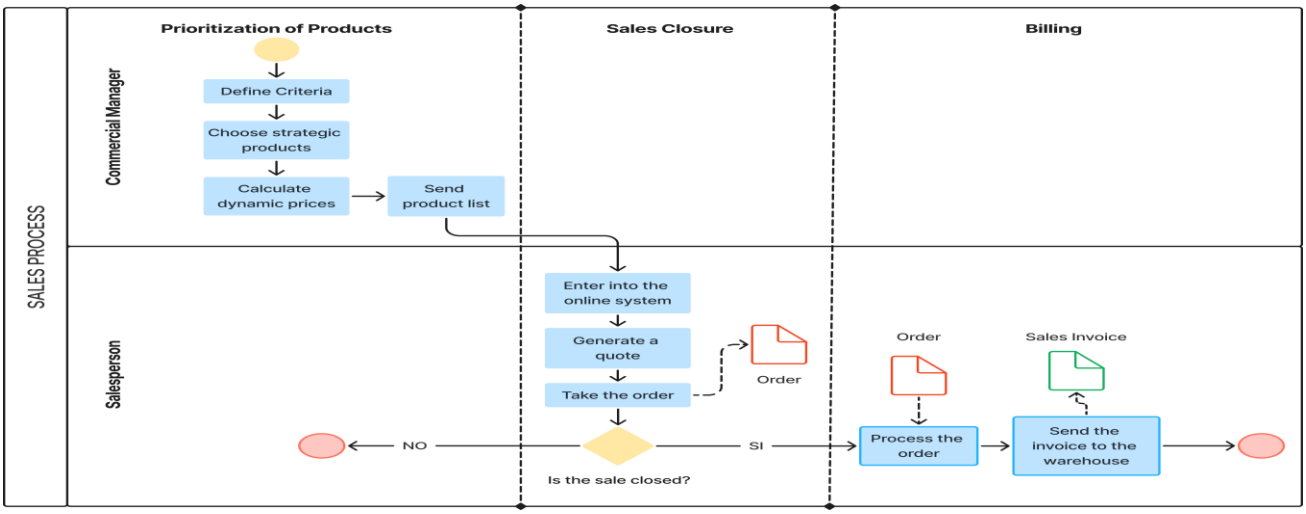

Fig. 2 Sales Process of the Case Study

achieved [23].

To determine if the company is profitable, a ROA (Return on Assets) of 6% or higher must be obtained [24]. The percentage of sales should exceed a 29% decrease from the periods under study. The inventory turnover ratio must be higher than that of the case study period, specifically 2.1 times.

TABLE I
MANAGEMENT INDICATORS OF THE PROPOSAL

Indicator	Calculation	Danger	Acceptable	Excellent
Return on Assets	Net Profit / Total Assets	2%	$3\% \leq x \leq 5\%$	$\geq 6\%$
Percentage of Operating Costs	(Cost of Sales + Expenses) / Total Sales	$\geq 90\%$	$89\% \leq x \leq 87\%$	$\leq 86\%$
Inventory Turnover	Cost of Sales / Total Inventory	≤ 0.9 times	$1 \leq x \leq 2$ times	≥ 2.1 times

IV. VALIDATION

A. *Scenario*

The scenario or case study involves a pharmaceutical product distributor located in Lima, Peru. In this case, causal variables that lead to a decrease in return on assets will be identified.

B. *Initial Diagnosis*

The return on assets for the case study will be measured as a monthly average for the years 2021 and 2022, as shown in "Fig. 3."

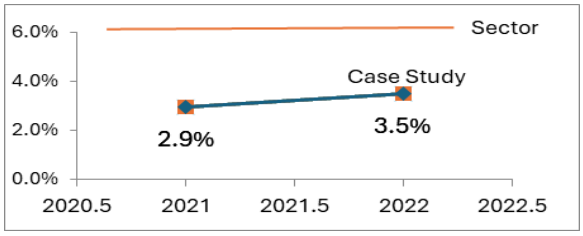

Fig. 3 Average Monthly Return on Assets (ROA) of the Case Study between 2021 and 2022.

In the "Fig. 5.", the average monthly ROA of Vietnam's pharmaceutical sector is used as a reference, which is 6%. Vietnam, like Peru, is an emerging market. The case study shows an average monthly ROA of 2.9% and 3.5% in 2021 and 2022, respectively. Therefore, it is below the sector's average ROA, highlighting an issue with return on assets profitability.

C. *Design*

The DMAIC model, ABC method, Dynamic Pricing, and digital transformation are implemented to increase profitability. The phases of the DMAIC methodology, which allows for a structured visualization of the problem to be addressed, will be developed as follows [25].

D. *Define*

The primary objective of this research is to increase the return on assets (ROA) of a small pharmaceutical distribution company. For this purpose, the process map shown in "Fig. 4" is analyzed to detail the company's existing processes and identify areas needing improvement.

E. *Measure*

In this stage, information from the company's income statements and balance sheets, as well as those of the pharmaceutical sector, is collected. This is evidenced in the initial diagnosis in "Fig. 3."

F. *Analyze*

In this phase, the data is analyzed to identify the causes of the problem, as shown in the tree diagram. This diagram provides a clear and structured visualization of the factors affecting profitability.

This approach allows complex problems to be broken down into detailed levels, facilitating the identification of specific root causes [26].

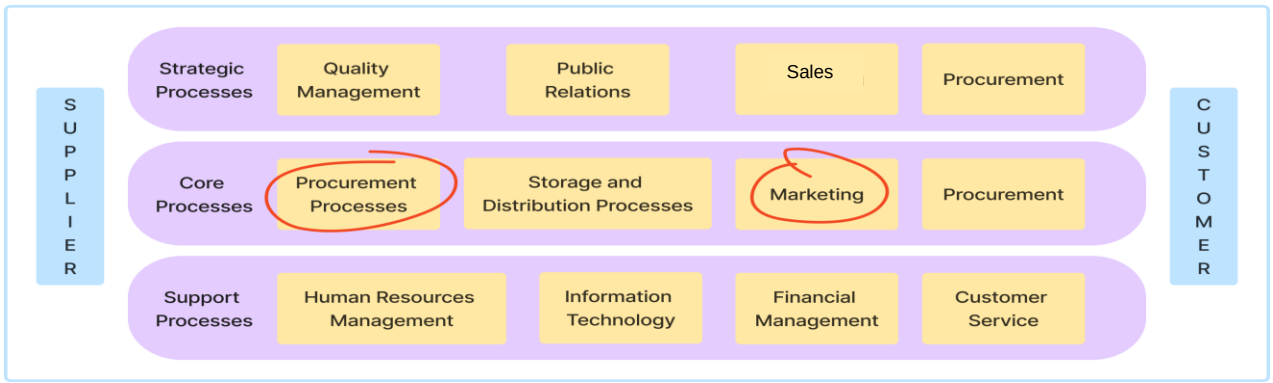

Fig. 4 Process Map of the Case Study

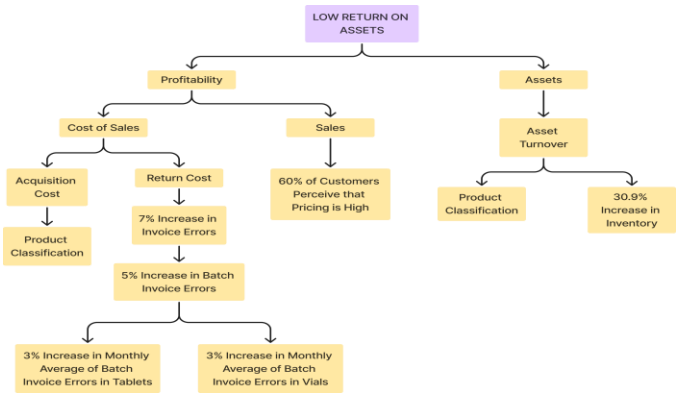

Fig. 5 Tree Diagram of the Company in the Case Study

Then, the problem is broken down, considering the causes that generate it.

1) Causes of Net Profit: As a primary cause, it is important to highlight that net profit is crucial for measuring the benefits generated by companies, as well as their ability to sustain and grow in the long term [28]. In this case, the profit margin is used to support the company's net profit relative to the sector and validate the cause.

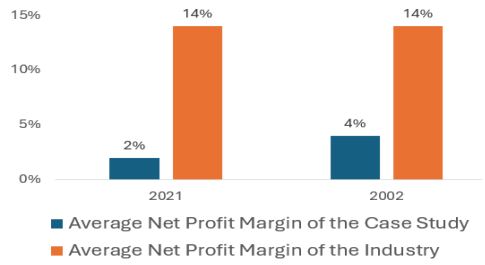

Fig. 6 Average Net Profit Margin of the Case Study Compared to the Sector in 2021 and 2022

In "Fig. 6", the average monthly net profit margin of 14% for the pharmaceutical industry is taken as a reference [27]. It is observed that the case study falls more than 10% below the sector's average.

2) Operating Costs: To validate costs, the profit-loss income statement is used.

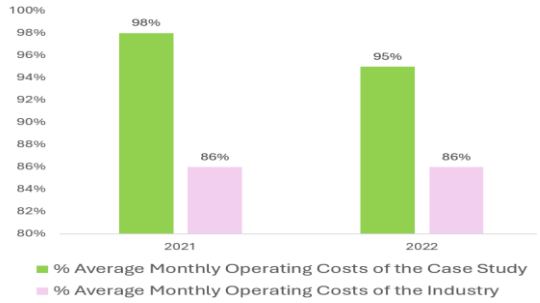

Fig. 7 Average Net Profit Margin of the Case Study Compared to the Sector in 2021 and 2022

In "Fig. 7", the company's operating costs have shown a slight decrease of approximately 3%; however, it is not sufficient to validate efficient improvement. As inferred from the figure, the average monthly operating cost margin is 86% for the sector in developing countries (Ledley et al., 2020, p. 837).

3) Cost of Salest:

According to "Table II", the cost of sales represents the largest percentage of operating costs, making it the focus of this research. The average monthly cost of sales margin in the sector for developing countries is 86% (Ledley et al., 2020, p. 837). Therefore, the cost of sales in the case study is 18% higher than the sector average.

In "Fig. 8," it is evident that acquisition costs and return costs represent 80% of the problem related to the increase in cost of sales.

TABLE II
PERCENTAGE OF OPERATING COSTS IN THE CASE STUDY FOR 2021 AND 2022 (EXPRESSED IN THOUSANDS OF SOLES)

Item	2021	2022	Percentage in 2021	Percentage in 2022
Cost of sales	s/1,955	s/1,404	93%	90%
Administrative expenses	s/135	s/100	6%	6%
Selling expenses	s/21	s/52	1%	3%
Total operating cost	s/2,112	s/1,555	100%	100%

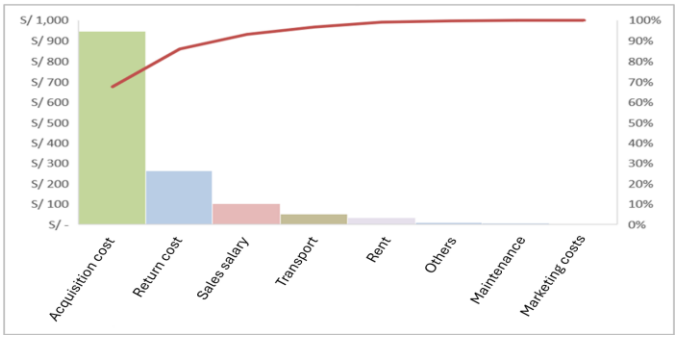

Fig. 8 Cost of sales distribution for the case study in 2022 (Expressed in thousands of soles)

4) Return Costs:

In "Fig. 9", return costs were caused by the number of invoices with errors: 353 and 330 out of a total of 4,138 and 2,180 invoices issued, with the percentage of invoices with errors being 9% and 15% in 2021 and 2022, respectively. Additionally, the percentage of invoices with errors increased by 7%.

Errors in product batches were the most significant type of invoice error, with a growth in errors of 5.3%.

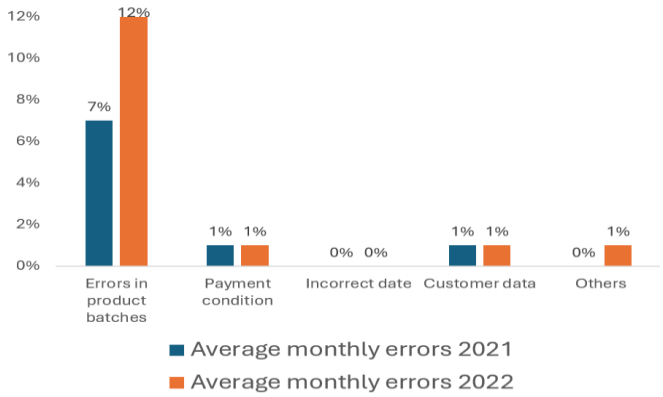

Fig. 9 Monthly average percentage by type of invoice error in relation to the total number of invoices issued for the case study in 2021 and 2022

In "Fig. 10.", the monthly average percentage of presentation errors shows that invoice errors in pill batches accounted for 3% and 6%, in ampoules 2% and 4%, and in syrups 2% and 1%. Furthermore, invoice errors in pill and syrup batches increased in 2022 compared to 2021, by 3% and 2%, respectively.

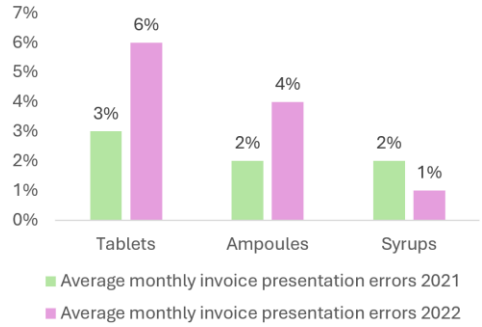

Fig. 10 Monthly average percentage of invoice errors by presentation in relation to the total invoices issued in the case study for 2021 and 2022

5) Causes of Sales:

To assess the cause of sales performance, the variation in the company's sales is compared with the sector.

Sales in the pharmaceutical industry increased by 4% in 2022, as shown in "Fig. 11" (Statista, 2022). However, in the case study, sales during the same year decreased by 25%. The monthly average sales were 179 million soles.

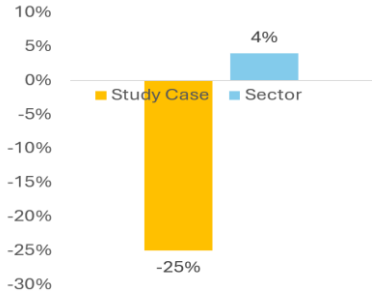

Fig. 11 Percentage of sales variation for the case study compared to the sector in 2022

Additionally, according to Marsha, consumer perception of pharmaceutical prices is that medication prices are excessively high, with 60% to 70% holding this view. As a result, distributors and pharmacies aim to purchase medications at the lowest possible price [29].

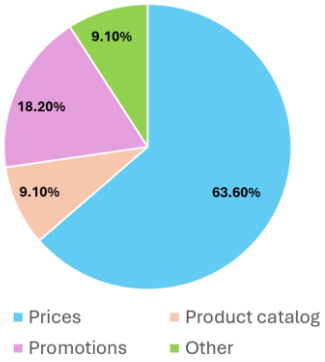

Fig. 12 Decision-making factors for pharmacy purchases in the case study

The "Fig. 12." shows that, according to the survey conducted among the clients of the case study, 64% of them consider price as an important factor in purchasing decisions.

6) Causes of Assets in the Case Study:

A comparison of total assets for 2021 and 2022 is conducted to validate the annual increase.

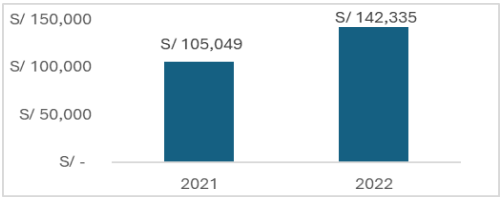

Fig. 13 Assets in the case study for 2021 and 2022 (Expressed in thousands of soles)

In "Fig. 13," a significant increase of more than 30% in the company's assets is observed when comparing 2021 to 2022.

7) Inventory Turnover:

An inventory turnover analysis is performed to validate whether the company is managing its inventory efficiently.

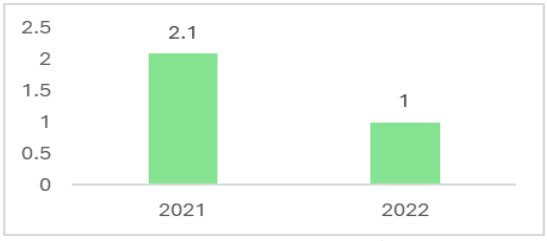

Fig. 14 Monthly average inventory turnover ratio for the case study in 2021 and 2022 (Expressed in turnover rate)

In “Fig. 14,” a decrease from 2.1 to 1 time is observed between 2021 and 2022, indicating low efficiency in inventory management.

8) Stock:

An analysis of the inventory volume in the company’s warehouse has been conducted to verify the presence of surplus or shortages of products.

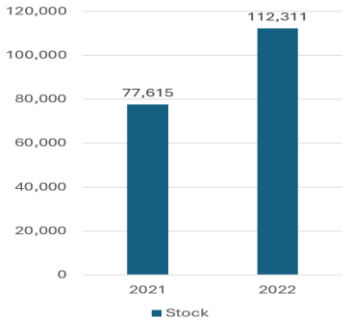

Fig. 15 Inventory levels in the case study for 2021 and 2022 (Expressed in thousands of soles)

In “Fig. 15,” inventory increased by 30.9% in 2022 compared to 2021, indicating excessive purchasing by the company in the study.

A. Improvement

In this stage, solutions are identified and implemented. The ABC method will be applied to classify the most profitable products, with category A being the focus of the investigation. Additionally, these processes will be optimized and digitized using ERP Systematic to enable digital transformation.

9) Classification of Products Using the ABC Method:

The ABC method will be used to classify products based on profitability, as shown in “Fig. 16.” A total of 137 products falls under category A, 178 under category B, and 281 under category C. However, working with such many products can be cumbersome and impractical.

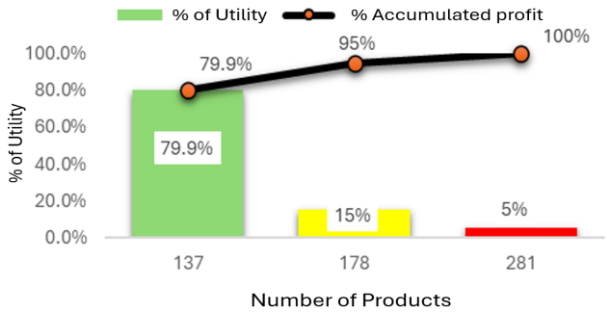

Fig. 16 Product classification by category in the case study

To improve the efficiency of the method, a new classification was performed. As shown in “Fig. 17,” the reclassification resulted in 75 products belonging to category A, 60 to category B, and 30 to category C.

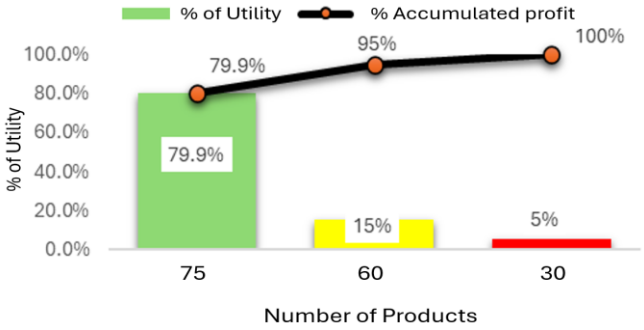

Fig. 17 Classification of category A in the case study

10) Pricing of Category A Products

As previously mentioned, pricing is determined by using software. However, the company does not have the necessary resources to acquire software on this scale. Instead, Excel was used to define the prices for category A products, as shown in “Table III”. First, variables were selected: a value of 1 was assigned for high demand, and 0 for low demand. Additionally, the expiration date of the product was chosen. The pricing formula used was:

$$Price = Base\ Price + Adjustments \quad (1)$$

Where:
Price is the final price established.
Base Price is the initial price before any adjustments.
Adjustments are changes in price based on dynamic factors.

The demand-based adjustment formula was then applied:

$$Demand\ Adjustment = Base\ Price \times Demand\ Elasticity \times (Current\ Demand - Average\ Demand) \quad (2)$$

Where:
Demand Elasticity is a factor indicating how demand responds to price changes.
Current Demand is the product's demand at the current time.
Average Demand is the historical average demand.

TABLE III
DEMAND LEVEL OF CATEGORY A BETWEEN JANUARY AND JUNE

N	SKU	January	February	March	April	May	June
1	614	0	0	0	1	0	0
2	186	0	1	0	0	0	0
3	591	1	0	0	0	0	0
9	407	0	0	0	1	1	0
10	287	1	0	0	0	0	0
11	505	0	0	0	1	0	0
12	607	0	0	0	1	0	0
13	174	0	0	1	0	0	0
61	706	0	0	0	0	1	0
62	571	1	0	0	0	0	0

63	689	0	0	1	0	0	1
75	875	0	0	0	0	0	1

Based on "Table III," the prices of category A products were determined using the product's expiration date and demand, as shown in "Table IV."

TABLE IV
PRICES BASED ON EXPIRATION DATE AND DEMAND FOR CATEGORY A PRODUCTS

N	SKU	Expire Date	High Demand	Low Demand
1	614	More than 1 year	145.00	130.00
		Less than 1 year	125.00	114.00
2	186	More than 1 year	15.69	14.91
		Less than 1 year	14.12	13.34
3	591	More than 1 year	25.00	23.75
		Less than 1 year	22.50	21.25
18	919	More than 1 year	1.93	1.84
		Less than 1 year	1.74	1.64
19	105	More than 1 year	43.28	41.12
		Less than 1 year	38.95	36.79
55	428	More than 1 year	29.73	28.25
		Less than 1 year	26.76	25.27
75	875	More than 1 year	27.12	25.76
		Less than 1 year	24.41	23.05

Subsequently, an interactive price search tool was programmed in Excel, allowing the purchasing analyst to read the price from "Table V" and input it into the sales system.

TABLE V
PRICE SEARCH TOOL FOR CATEGORY A PRODUCTS IN THE CASE STUDY

SKU	614
Expiration	Less than 1 year
Demand	High
Price	s/ 125.00

11) Digital Transformation

The Forrester method will be used to assess the digital maturity of the case study, as it enables the evaluation of its capacity to adopt digital transformation initiatives. As shown in “Fig 18”, the company scored 37, classifying it as an adopter that is already investing in digital infrastructure and knowledge. However, since its culture is not fully digital, resistance to change may arise. This risk can be mitigated through effective communication, identifying the most critical system, and implementing an intuitive solution.

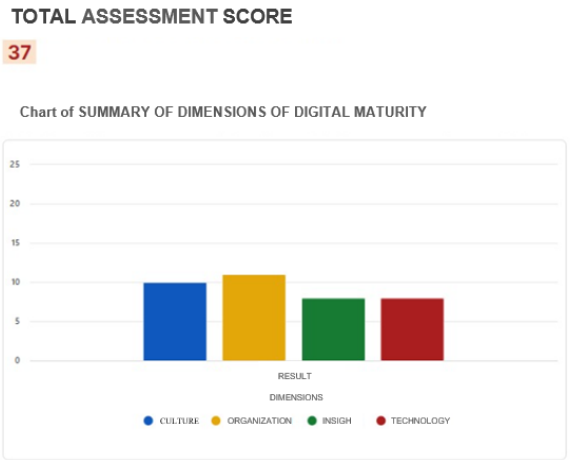

Fig. 18 Summary of Digital Maturity Matrix Dimensions of the Case Study

The existing systems in the company were identified, and a traffic-light system was used to prioritize critical systems, with the billing system identified as critical. Based on this, the software to be implemented was selected using criteria such as online and physical versions, required investment, inventory control, and adaptability of the ERP system to the business model, as shown in "Table VI".

TABLE VI
SOFTWARE SELECTION MATRIX

Criteria	**Systematic**	**Ant ERP**	**Oxserva**
Online and physical version	Yes	No	No
Required investment	$700	$2,000	$16,000
Inventory control	Yes	Yes	Yes
Adaptability	Yes	Yes	Yes
Final selection	**Systematic**		

Systematic was chosen as it is the most economically accessible and allows for a more comprehensive digital transformation of the company's processes.

B. Control Phase

After identifying and implementing the improvements in the previous stage, “Table VII” shows that the Net Present Value (NPV) of the improvement project is positive, resulting in an NPV of 8 thousand soles over the 10-month project implementation period. Additionally, the payback period is reached in month 6, with an Internal Rate of Return (IRR) of 26%.

TABLE VII
RESULTS OF THE PROPOSAL IN THE CASE STUDY (EXPRESSED IN THOUSANDS OF SOLES)

Item	Monthly Average
Sales	s/327
Cost of Sales	s/231
Sales Expenses	s/20
Expenses	s/26
Operating Cost	s/277
% Operating Cost	84%
Operating Income	s/51

Tax	s/15
Net Income	s/36
Assets	s/646
ROA (Return on Assets)	6%
Inventory	s/107
Inventory Turnover Ratio	2.2
NPV	s/8
IRR	26%

From "Table VII," the improvements in the case study are identified, showing that all indicators performed excellently after the implementation of the improvement.

TABLE VIII
COMPARISON OF INITIAL INDICATORS WITH IMPROVED INDICATORS

INDICATOR	BEFORE THE IMPROVEMENT	AFTER THE IMPROVEMENT	% IMPROVEMENT	STATUS
RETURN ON ASSETS	4%	6%	80%	
OPERATING COSTS PERCENTAGE	95%	84%	-12%	
INVENTORY TURNOVER	1.0	2.2	120%	

The medications are also segmented according to the product lines managed in the case study:

- **Brand name drugs:** These medications, marketed under a patented brand name, are more expensive than generics due to research, development, and marketing costs.
- **Generic drugs:** These are equivalent to brand-name drugs in terms of dosage, safety, efficacy, quality, performance characteristics, and intended use. They are generally priced lower than brand-name medications.
- **Over the counter (OTC) drugs:** These medications can be purchased without a prescription and are used to treat common, minor conditions.

The brand name and generic drug lines met their ROA targets, but the over the counter (OTC) line fell short. It should be noted that the standard deviation of the ROA increase post-improvement from its mean was 0.58%

All product lines (brand name, generic, and OTC drugs) achieved their operating cost targets. The standard deviation of the cost reduction post-improvement from its mean was 1.73%.

The generic and OTC drug lines met their inventory turnover targets, while the brand-name drug line did not. The standard deviation of the inventory turnover increase, post-improvement from its mean was 0.41%.

TABLA XII.
INDICATORS OF THE SCENARIOS AFTER IMPROVEMENT

INDICATOR	RETURN ON ASSETS	OPERATING COSTS PERCENTAGE	INVENTORY TURNOVER
BRAND NAME DRUGS	6%	85%	2.0
GENERIC DRUGS	6%	82%	2.8
OVER THE COUNTER	5%	85%	2.5
AVERAGE	6%	84%	2.4
VARIANCE	0.33	3	0.2
STANDARD DEVIATION	0.58	1.7	0.41

VI. CONCLUSIONS

This research demonstrated an increase in return on assets (ROA) using the DMAIC methodology, dynamic pricing, the ABC method, and digital transformation. The average monthly ROA was successfully increased from 3.5% to 6%.

The company improved operational efficiency and increased inventory turnover from 1 time in 2022 to 2.1 times in 2024. The low inventory turnover rate was one of the causes of the problems affecting the company, as excessive purchasing of pharmaceutical products was common. To address this, the ABC method was applied. Products were categorized into A, B, and C categories, where category A represents 80% of profits, category B represents 15%, and category C represents 5%. This classification improved inventory organization and control, ensuring that high-priority products (category A) were always available. As a result, operational efficiency improved, and inventory turnover increased from 1 time in 2022 to 2.1 times in 2024.

Additionally, operating costs were reduced by 9% through a decrease in billing errors, thanks to the implementation of digital transformation in the company. This also reduced the number of returned orders. Manual errors, which previously increased sales costs due to data entry mistakes, were eliminated. Furthermore, the optimization of these processes freed up valuable time for employees, allowing them to focus on more important tasks, thereby improving customer satisfaction by ensuring more accurate and faster deliveries.

Sales increased by 29% due to improved product pricing strategies. A dynamic pricing strategy was implemented to estimate pharmaceutical product prices according to market conditions. This strategy not only improved the company's competitiveness but also optimized profit margins.

Considering the results obtained and the implications of the proposed strategies, several opportunities arise for future research and development in optimizing return on assets for an SME distributing pharmaceutical products. Given the complexity of the pharmaceutical market and the sensitivity of prices in this sector, it is crucial to further investigate the impact of implementing dynamic pricing strategies. This includes exploring how factors such as competition, market demand, government regulations, and production costs can influence the effectiveness of dynamic pricing strategies, as well as identifying the optimal conditions for their implementation.

REFERENCES

[1] La industria farmaceútica lidera la inversión mundial I+D: ya supera los 200.000 millones anuales. (2022). FarmaIndustria. https://www.farmaindustria.es/web/otra-noticia/la-industria-farmaceutica-lidera-la-inversion-mundial-en-id-ya-superan-los-200-000-millones-anuales/

[2] Statista (2021). Industria farmacéutica: ingresos mundiales 2001-2021. Statista; https://es.statista.com/estadisticas/635153/ingresos-mundiales-del-sector-farmaceutico/
[3] INEI. (2022). La pobreza monetaria afectó al 27,5% de la población del país en el año 2022. https://m.inei.gob.pe/prensa/noticias/pobreza-monetaria-afecto-al-275-de-la-poblacion-del-pais-en-el-ano-2022-14391/
[4] IPE. (2022). Uno de cada 5 centros de salud públicos está desabastecido. Instituto Peruano de Economía. https://www.ipe.org.pe/portal/uno-de-cada-5-centros-de-salud-publicos-esta-desabastecido/
[5] Kogut, S., Campbell, J. D., & Pearson, S. D. (2023). The Influence of US Drug Price Dynamics on Cost-Effectiveness Analyses of Biologics. Value in Health, 26(3), 378–383. https://doi.org/10.1016/j.jval.2022.12.010
[6] Guerrero, M., & Liguori, E. (2021). Repensar la investigación para las PYMES. Aacsb.edu; AACSB. https://www.aacsb.edu/insights/articles/2021/11/rethinking-research-for-smes
[7] San, Chun, Raaj, Prem, Hao, Tzer, Sock, , Hooi, Meixuan, Huang, Siok, Sau y Poh. (2021). Augmenting Product Defect Surveillance Through Web Crawling and Machine Learning in Singapore. Drug Safety, 44(9), 939–948. https://doi.org/10.1007/s40264-021-01084-w
[8] Şişman, G. (2022). Implementing lean six sigma methodology to reduce the logistics cost: a case study in Turkey. International Journal of Lean Six Sigma. https://doi.org/10.1108/IJLSS-02-2022-0054
[9] Arredondo, Miranda, Solís, Vásquez y García (2021). A Plan-Do-Check-Act Based Process Improvement Intervention for Quality Improvement. IEEE Access, 9, 132779–132790. https://doi.org/10.1109/access.2021.3112948
[10] Suárez, Miguel y Morales, (2020). Application of Kaizen-Kata methodology to improve operational problem processes. A case study in a service organization (2020). International Journal of Quality and Service Sciences, 13(1), 29–44. https://doi.org/10.1108//IJQSS
[11] Ephrem Mfizi, François Niragire, Bizimana, T., & Marie Françoise Mukanyangezi. (2023). Analysis of pharmaceutical inventory management based on ABC-VEN analysis in Rwanda: a case study of Nyamagabe district. Journal of Pharmaceutical Policy and Practice, 16(1). https://doi.org/10.1186/s40545-023-00540-5
[12] Voehler, D., Koethe, B., Synnott, P. G., & Ollendorf, D. A. (2023). The impact of external reference pricing on pharmaceutical costs and market dynamics. Health Policy OPEN, 4, 100093–100093. https://doi.org/10.1016/j.hpopen.2023.100093
[13] Ang, PS, Teo, DCH, Dorajoo, SR, Prem Kumar, M., Chan, YH, Choong, CT, Phuah, DST, Tan, DHM, Tan, FM, Huang, H., Tan, MSH, Ng, MSY, y Poh, JWW (2021). Aumento de la vigilancia de defectos de productos mediante rastreo web y aprendizaje automático en Singapur. Seguridad de los medicamentos: una revista internacional de toxicología médica y experiencia en medicamentos, 44 (9), 939–948. https://doi.org/10.1007/s40264-021-01084-w
[14] Zhang, X., Tran Phuong Duc, Eugene Burgos Mutuc, & Tsai, F.-S. (2021). Intellectual Capital and Financial Performance: Comparison With Financial and Pharmaceutical Industries in Vietnam. Frontiers in Psychology, 12. https://doi.org/10.3389/fpsyg.2021.595615
[15] Nathan, Peixoto Oliveira, Gonçalves, D., & Jesus. (2020). Use of the ABC Curve in Medicine Line Balancing: A Case Study at a Brazilian Pharmaceutical Distribution Center. International Journal of Production Management and Engineering, 8(1), 13–13. https://doi.org/10.4995/ijpme.2020.11619
[16] Han, X., Zhang, M., Hu, Y., & Huang, Y. (2022). Study on the Digital Transformation Capability of Cost Consultation Enterprises Based on Maturity Model. Sustainability (Switzerland), 14(16). https://doi.org/10.3390/su141610038
[17] Ledley, F. D., Sarah Shonka McCoy, Vaughan, G., & Ekaterina Galkina Cleary. (2020). Profitability of Large Pharmaceutical Companies Compared With Other Large Public Companies. JAMA, 323(9), 834–834. https://doi.org/10.1001/jama.2020.0442
[18] Pakdil, F., Can, GFF y Toktaş, P. (2023). Editorial invitada: Desarrollos de Lean Six Sigma en Türkiye. Revista internacional de Lean Six Sigma , 14 (3), 517–519. https://doi.org/10.1108/ijlss-05-2023-231
[19] Forkiotis, KP y Tsadiras, A. (2024). Aplicar métodos de pronóstico estadístico y aprendizaje automático para mejorar las predicciones de ventas farmacéuticas. Previsión, 6 (1), 170–186. https://doi.org/10.3390/forecast6010010
[20] Precios dinámicos: qué es y por qué es importante. (2024). Blog de información empresarial. https://online.hbs.edu/blog/post/what-is-dynamic-pricing
[21] Cardinali, S., Pagano, A., Carloni, E., Giovannetti, M., & Governatori, L. (2023). Digitalization processes in small professional service firms: drivers, barriers and emerging organisational tensions. Journal of Service Theory and Practice, 33(2), 237–256. https://doi.org/10.1108/JSTP-06-2022-0132
[22] Ali, S. F., Md. Anwar Hossen, Zeynalzadeh Mahtab, Kabir, G., Sanjoy Kumar Paul, & Ziaul Haq Adnan. (2020). Barriers to lean six sigma implementation in the supply chain: An ISM model. 149, 106843–106843. https://doi.org/10.1016/j.cie.2020.106843
[23] Mejora continua. (2023, 22 de junio). Arena; Arena, una empresa de PTC. https://www.arenasolutions.com/what-is-qms/continuous-improvement/
[24] Asq.org. Recuperado el 12 de junio de 2024, de https://asq.org/quality-resources/tree-diagram
[25] Why Net Income is Important to Investors. (2022, agosto 8). MarketBeat. https://www.marketbeat.com/financial-terms/why-net-income-important-investors/
[26] Shan Chen, Fuli Zhou, Jiafu Su, Longxiao Li, Biyu Yang, Yandong He.(2020)Pricing policies of a dynamic green supply chain with strategies of retail service . Asia Pacific Journal of Marketing and Logistics, 33(1), 296–329. https://doi.org/10.1108//APJML
[27] Clancy, R., Brunton, K. y Sullivan, D. (2021). The HyDAPI framework: a versatile tool integrating Lean Six Sigma and digitalisation for improved quality management in Industry 4.0. Internacional Journal of Lean Six Sigma. https://doi.org/10.1108/IJLSS-12-2021-0214
[28] Kihel, Y. E. (2022). Digital Transition Methodology of a Warehouse in the Concept of Sustainable Development with an Industrial Case Study. Sustainability (Switzerland), 14(22). https://doi.org/10.3390/su142215282
[29] Makinde, O., Selepe, R., Munyai, T., Ramdass, K., & Nesamvuni, A. (2022). Improving the Supply Chain Performance of an Electronic Product-Manufacturing Organisation Using DMAIC ApproacH. Cogent Engineering, 9(1). https://doi.org/10.1080/23311916.2021.2025196
[30] Yadav, N., Shankar, R., & Singh, S. P. (2020). Impact of Industry4.0/ICTs, Lean Six Sigma and quality management systems on organizational performance. The TQM Journal, 32(4), 815–835. https://doi.org/10.1108/tqm-10-2019-0251