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ENHANCING SPARE PARTS MANAGEMENT IN COSMETICS PRODUCTION COMPANY: AN INTEGRATED APPROACH TO INVENTORY OPTIMIZATION

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Abstract

Inventory management is a critical balancing act for companies, serving as both an operational necessity and a significant financial burden. This study focuses on optimizing spare parts inventory management in a cosmetics factory, addressing the substantial costs associated with poor practices such as stockouts and overstocking. Our research implements a novel management policy to enhance spare parts inventory control. The methodology comprises three key phases: 1. Classification of spare parts based on criticality: We developed a multi-criteria system considering factors such as unit price, lead time, and consumption rate to categorize spare parts effectively. 2. Performance criteria calculation: We evaluated the cosmetics company's current inventory management practices using key performance indicators (KPIs) such as average inventory levels, turnover rates, and coverage ratios.3. Application of the Wilson Economic Order Quantity (EOQ) model: Based on our classification and performance analysis, we employed the Wilson model to determine optimal order quantities for different spare part categories. This integrated approach allowed us to validate our study's effectiveness and provide data-driven recommendations for inventory optimization. By combining criticality-based classification with quantitative modeling, our research offers a comprehensive framework for managing spare parts inventory in the cosmetics industry.

Index Terms: Spare Parts Inventory, Cosmetics Manufacturing, Economic Order Quantity (EOQ), Criticality.

1. INTRODUCTION

Inventory management is a critical function in modern business operations, particularly in manufacturing settings, it requires striking a delicate balance between ensuring resource availability and minimizing financial constraints [1]. This balance is especially challenging in the context of spare parts inventory, where demand patterns are often unpredictable and driven by unforeseen equipment failures [2].

The importance of effective spare parts management cannot be overstated, where inadequate stock levels can lead to production delays and customer dissatisfaction due

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to stockouts [3]. Conversely, excessive inventory ties up capital and adversely affects cash flow [1]. These conflicting pressures underscore the need for sophisticated inventory management strategies, particularly in industries with complex manufacturing processes and diverse product lines, such as the cosmetics industry [4].

To address these challenges, researchers and practitioners have developed various approaches to optimize spare parts inventory management. One key strategy that has gained prominence is the classification of spare parts based on criticality. It is argued that categorizing items according to their importance enhances decision-making processes related to procurement and stock levels [5]. This approach is believed to allow organizations to focus their resources on the most critical components, aligning with the principles of effective inventory management. This approach allows organizations to focus their resources on the most critical components, aligning with the Pareto principle [6].

Building on this foundation, more recent studies have incorporated additional parameters to refine spare parts classification. Bacchetti and Saccani (2012) [7] propose a multi-criteria classification system that considers factors such as unit price, lead time, and consumption rate. This multi-dimensional approach provides a more nuanced understanding of spare parts criticality, enabling more effective inventory management strategies. The application of quantitative models in inventory management has also been widely studied. The Wilson Economic Order Quantity (EOQ) model, in particular, has proven to be a valuable tool for determining optimal order quantities and minimizing total inventory costs [8]. While the basic EOQ model assumes constant demand, various extensions have been developed to address the sporadic nature of spare parts demand [9].

To evaluate the effectiveness of inventory management practices, the use of key performance indicators (KPIs) has become increasingly prevalent. The importance of metrics such as average inventory, turnover rate, and average coverage in assessing inventory efficiency [10]. These KPIs provide tangible measures for evaluating the success of inventory management strategies and identifying areas for improvement.

The integration of criticality classification, quantitative models, and performance metrics represents a comprehensive approach to spare parts inventory management. This approach is aligned with the growing trend towards data-driven decision-making in supply chain management, as discussed in a review of multi-criteria classification methods for spare parts. By leveraging these tools and methodologies, the complexities of spare parts inventory can be better navigated by organizations, while operational needs are balanced with financial constraints [11]. In the context of the cosmetics industry, where product quality and production continuity are paramount, effective spare parts management is crucial. However, there is limited research specifically addressing spare parts inventory optimization in cosmetics manufacturing [12]. This gap in the literature underscores the need for industry-specific studies that apply and adapt established inventory management principles to the unique challenges of cosmetics production.

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The present study aims to address this gap by implementing a novel approach to spare parts inventory management in a cosmetics factory. By combining criticality classification with the application of the Wilson EOQ model, this research seeks to provide practical insights for optimizing spare parts inventory in the cosmetics industry. Furthermore, the calculation and analysis of performance criteria will contribute to a broader understanding of inventory management effectiveness in specialized manufacturing contexts.

2. METHODOLOGY

2.1 Case study description

We focused on the issue of inventory management within a cosmetics company. Due to the importance of activities centered around inventory and its movement, we recognize that the maintenance department in any company strives to ensure that equipment is in optimal working condition when needed. This performance measure, known as availability, is impacted by interruptions caused by unexpected breakdowns. However, the spare parts required to replace faulty components are not always available, leading to prolonged equipment downtime due to stockouts.

On the other hand, in the context of corporate inventory management, even if production is often regular, the flow of spare parts is frequently irregular. This inevitably causes fluctuations in stock levels, representing the difference between incoming and outgoing flows at each production station, resulting in either stockouts or overstocking. Consequently, there is no consistent availability of spare parts, which leads to stockouts or excessive inventory. Our case study aims to address these challenges by implementing a rigorous spare parts inventory management system to ensure a constant availability of spare parts while minimizing excessive storage costs. This approach is intended to guarantee the continuity of production operations in the cosmetics manufacturing plant.

2.2 Parameters for determining criticality

Unit Price of Each Spare Part (Pu):

The unit price of each spare part is a crucial factor in determining its criticality. Expensive spare parts represent a significant investment for the company, and inefficient management of these parts can lead to high costs and financial losses. Therefore, it is essential to closely monitor high-cost parts to optimize their management, minimize costs, and maximize profitability.

Delivery Time (DA):

Delivery time is another key factor in determining the criticality of spare parts. Parts with long delivery times can cause disruptions in the production process if they are not available when needed. A long delivery time increases the risk of stockouts, which can result in costly production stoppages. Hence, it is important to categorize these parts

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based on their criticality to ensure proactive inventory management and avoid operational interruptions.

Consumption (C):

The consumption rate of spare parts over the study period is also an important parameter. A spare part with high consumption requires rigorous management to ensure it is always available when needed. Frequent stockouts of these parts can disrupt production and lead to additional costs. By considering consumption, we can identify the most critical parts for production and implement effective replenishment strategies to maintain an optimal stock level.

By combining these three parameters, we can establish an accurate classification of spare parts based on their criticality. This will improve inventory management and reduce the risks associated with stockouts and excessive costs.

2.3 Data Collection

For our case study, we collected data on spare parts from a cosmetics company over a 7-year period, from 2016 to 2022. The data includes the unit price, consumption rate, and lead time for each spare part. These details were extracted from the company's Computerized Maintenance Management System (CMMS) database. This dataset enables us to assess the criticality of each spare part and identify the most crucial components for optimal inventory management. We have organized this data in Table 1 to facilitate analysis and interpretation. [13]

Designation	Reference	P. U (€)	D. A (days)	Consumption C
SOUPAPE VAPEUR G10L 1/2X1" TARAGE 0,8BAR	4985	140,00	36	6
MODULE ETHERCAT BECKHOFF 2 ENTREES EL1252	2944	110,80	195	2
ELECTRODISTRIBUTEUR FESTO CPE14-M1BH-5L-1/8 196941	2665	124,24	15	8
MANOMETRE 0-4 BARS MAP-40-4-1/8-EN 162842	0563	16,78	16	8
TETE TULIPE FORMAT F4 LE24043 630F025I0471V00	2092	218,70	77	2
FILTRE CASSE VIDE 0,2µM AVF022V002PVJ	4466	142,67	60	42
VANNE MAGNETIQUE 4200209 FESTO MHE2-MS1H-5/2-QS-4 525117	3259	111,34	24	4
LAME INFERIEURE 2485371	3177	582,70	6	25
JOINT OR NBR 70SH FDA 10026711	4223	78,19	52	8
CAPTEUR INDUCTIF M8 BES M08EH-PSC40F-S49G 902-7297	3269	52,28	37	3
VENTOUSE JUPE SEULE ROUGE PIAB B15-2 SIL 3150230S (COMPATIBLE 30ML ET 50ML LCT3)	3136	10,92	21	102
FILTRE CHARBON 40" 5µ CFCBZF308038	1296	165,40	48	51
TIGE D'ORIENTEUR REGLABLE R324759 (ORIENTATION)	2594	163,85	51	27

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CELLULE REFLEX SICK WLG4S-3K2232 M8 4 POLES	3461	152,00	17	14
TUYAU ALIKLER DN38 072770 20M	0649	34,54	20	44
PISTOLET DE LAVAGE INOX 1/2 GAZ BLEU 24 BAR 95°C PLJETI	0008	226,19	57	8
JEU DE CHIFFRES TUBE METAL (0-1-2-5-6-9) C790S200XX	2968	39,00	20	25
JOINT PISTON POMPE DE DOSAGE D=16 DK101 DN16 / 16,00X9,8X4,3MM REF4103454	3129	80,15	42	30
5 JOINTS FKM C4I FDA POUR POMPE MOUVEX 313661.02	4313	170,00	55	41
VENTOUSE 1 SOUFFLET SANS RACCORD DIAM.45 NOIR REF.R0 45 311834	3440	12,51	18	11
PORTE DOUILLE A CLOU 59030009	2755	16,95	51	29
JOINT DIN11864-1 DN50 DIM52*62*5 REF20013287 EPDM70	4635	4,73	79	43
HUILE REDUCTEUR PARAVISC VISCO220 HAUTE DENSITE SYNGEAR PGB 220 FD	4651	24,41	47	35
VENTOUSE 2 SOUFFLETS DIAM.36 NOIR REF.2.222.3036.30 3118381	3442	13,28	3	9
JOINTS OR 39,69X3,53 - FMP70	4484	3,20	30	22
JOINT VANNE PAPILLON SMS EPDM DN 38 961319 - 38SG	0560	41,78	22	60
VENTOUSE DIAM 15 SILICONE ROUGE PLATE HAUTE TEMPERATURE 3150125S	4742	5,66	6	55
VENTOUSE BX20P-PU30/60	3061	14,00	32	30
SILENCIEUX ECHAPPEMENT UC-QS-8H 175611	2162	5,45	4	16
VENTOUSE 9690 DIAM 6MM	4781	12,60	44	40
RELAIS OPTOCOUPLEUR WEIDMULLER RSO 30	2629	80,80	30	14
LAME SUPERIEURE 2485370	3176	1007,86	6	23
DISQUE SILICONE ROUGE TZ 25X1,5 1492934	3280	1,12	14	181
RONDELLE BELLEVILLE POUR M8 (KALIX 60 ET 601) 07360-080	2391	0,31	10	73
JOINT CLAMP EPDM DN51 963422-51	0664	1,37	7	96
VENTOUSE Ø15MM PLATES SILICONE HAUTE TEMERATURE ARTE0812 (LC12)	4771	12,60	3	101
JOINT SMS CARRE EPDM 51 961391-51	0136	0,95	3	172
JOINT DE PISTON ROUGE H-TPU 12X22X8 FDA	2764	56,50	82	41
CIRCLIPS EXT. INOX D12 221760-12	4886	0,11	5	20
JOINT TORIQUE R39 NITRILE BLANC FDA C249032	2327	6,53	30	20
ACCOUPLEMENT VISSEUSE CODEUR 692-8103	1647	2,18	4	20
POCHE FILTRANTE 50µ 28X10,7 NW25 506104	1235	4,16	31	17
KIT DU CLAPET PRINCIPAL KS-2513 9521003	5008	329,60	84	15
JOINT CLAMP DN51 EPDM 963422-51	0940	1,34	7	19
KIT DE MEMBRANES METALLIQUE KS-2531 9521031	5007	116,25	30	14
TETE D'IMPRESSION A0978	3501	643,00	8	22
JOINT CLAMP D=51 SMS VITON FDA 20.024.13-01	3933	12,90	64	9
PIECE CLAMP POUR TE DE SECURITE 07-019-01	3939	124,60	10	1

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RESSORT RETENTION ENROULEUR BANDE 1032988	4056	338,98	1	7
MANCHON A VISSER GAZ INOX 316 D10 3/8 452324-10	0841	1,06	3	13
REDUCTEUR RV_40 U03D-20	2956	357,50	45	16
LAME COUPELAIZE NO2733.50 0005896	4389	3,73	10	11
GARNITURE 53MM R33 248X AAX1S1 DIAM 53 CARBURE DE SILICIUM 81753148	4457	631,00	24	5
CONNECTEUR M12 COUDE 5 FILS L=5M 612-2257	0636	14,20	2	3
JOINT D ETANCHEITE VITON 2486800000	1748	11,00	20	1
KIT JOINTS POMPE D3 TR5 AF PJDI120HTAF	0305	48,80	8	6

2.4 Rating of Criticality Calculation Parameters for Spare Parts:

Risk ratings are coefficients assigned to each spare part, allowing us to calculate the criticality of each item. Each rating corresponds to one of the criteria mentioned above.

Table 2: Consumption Rating

Consumption	Level
1≤ C ≤11	1
11<C<25	5
25 ≤C <50	7
50≤C ≤181	9

Table 3: Delivery Time rating

D.A	Level
1≤ D. A≤ 20	1
20<D.A≤45	5
45<D.A<80	7
80≤D.A≤195	9

Table 4: Unit Price Rating

P.U	Level
P.U <10	1
10<P.U <50	5
50 <P.U <110	7
110 <P.U≤643	9

3. RESULTS AND DUSCUSSION

3.1 Calculating the Criticality (RPN) of Spare Parts:

We evaluated the criticality (RPN) of spare parts (PDR) using three essential parameters: unit price (P.U), delivery time (D.A), and consumption (C). Criticality represents a measure of the strategic importance of each spare part, considering the potential impact of a failure on operations. This approach allows us to prioritize spare parts based on their contribution to risk management and operational continuity, which is crucial in the

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dynamic context of inventory management for a cosmetics company. The equation used to calculate criticality is as follows:

$$RPN = P.U \times D.A \times C \quad (1)$$

Table .5 shows the results of the criticality calculation for the spare parts stored in the warehouse:

By using this method, we were able to evaluate and classify spare parts based on their respective criticality, facilitating the prioritization of inventory management actions to optimize availability and reduce operational risks.

Table 5: Calculation of Spare Parts Criticality

References	P. U Rating	D.A Rating	C Rating	RPN
4985	7	3	1	21
2944	7	7	1	49
2665	7	1	1	7
0563	3	1	1	3
2092	7	5	1	35
4466	7	5	7	245
3259	7	3	1	21
3177	7	1	5	35
4223	5	5	1	25
3269	5	3	1	15
3136	3	3	9	81
1296	7	5	9	315
2594	7	5	7	245
3461	7	1	5	35
0649	3	3	7	63
0008	7	5	1	35
2968	3	3	7	63
3129	5	3	7	105
4313	7	5	7	245
3440	3	1	1	3
2755	3	5	7	105
4635	1	5	7	35
4651	3	5	7	105
3442	3	1	7	21
4484	1	3	1	3
0560	3	3	5	45
4742	1	1	9	9
3061	3	3	9	81
2162	1	1	7	7
4781	3	3	5	45
2629	5	3	7	105
3176	7	1	5	35
3280	1	1	9	9
2391	1	1	9	9
0664	1	1	9	9

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4771	3	1	9	27
0136	1	1	9	9
2764	5	7	7	245
4886	1	1	7	7
2327	1	3	5	15
1647	1	1	5	5
1235	1	3	5	15
5008	7	7	5	245
0940	1	1	5	5
5007	7	3	5	105
3501	7	1	5	35
3933	3	5	1	15
3939	7	1	1	7
4056	7	1	1	7
0841	1	1	5	5
2956	7	3	5	105
4389	1	1	1	1
4457	7	3	1	21
0636	3	1	1	3
1748	3	1	1	3
0305	3	1	1	3

3.2 Pareto Analysis of Critical Spare Parts:

To identify and prioritize the most critical spare parts (PDR), we conducted a Pareto analysis, an effective method for focusing efforts on the most impactful elements. In this analysis, we used the criticality (RPN) of each PDR. We created a summary Fig 1 that includes each PDR's reference number, individual criticality, cumulative criticality (progressive sum of criticalities ranked in descending order), and cumulative criticality as a percentage. This Fig 1 allowed us to clearly identify the PDRs that contribute most significantly to the total stock criticality, providing a solid basis for management and optimization decisions.

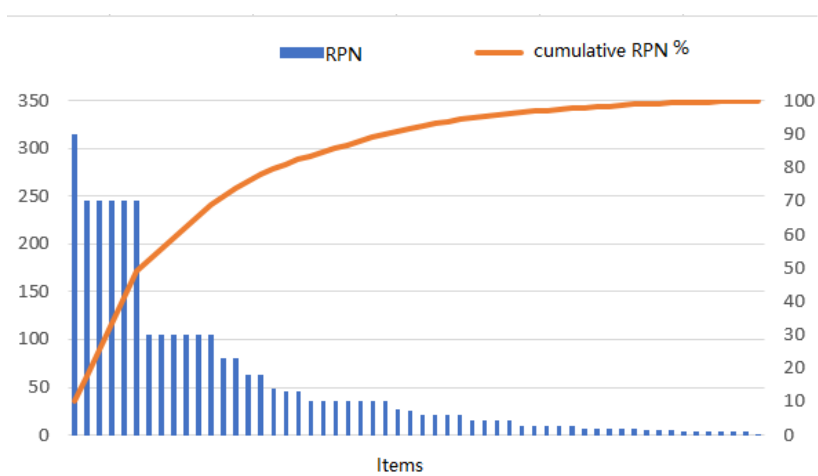

Fig 1: Pareto Diagram

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After conducting an in-depth analysis using the ABC classification method, we identified 17 Class A items, which account for 79.53% of the total value of spare parts (PDR) with high criticality. These strategically crucial items represent only 30% of the total number of PDRs, yet they require special attention to prevent any critical stockouts.

Additionally, we identified 16 Class B items, which collectively make up 94.95% of the total value of PDRs, with criticality levels ranging between 15 and 49. Although these items constitute 58.9% of the total number of PDRs, they still demand careful management to minimize potential operational risks. The remaining 23 items were classified as Class C, representing the spare parts with the lowest criticality in our analysis. The three criticality classes are summarized in Table 6.

Table 6: Prioritization of Spare Parts Based on Criticality Level

RPN Range	Status	Class	Comments
49 ≤RPN ≤315	High	A	Requires appropriate measures to prevent stockouts.
15 < RPN < 49	Moderate	B	Needs to be addressed to avoid potential issues.
RPN ≤15	Low	C	Meeting supply objectives has no significant consequences.

3.3 Inventory performance evaluation

In our study aimed at optimizing spare parts inventory management for our company's cosmetics production, we identified the most critical part: the "40'' 5µ Carbon Filter CFCBZF308038," classified as a Class A item. We then calculated several key performance indicators, such as average inventory, turnover rate, and average coverage. These measures allow us to assess the efficiency of inventory management for this specific part, ensuring adequate availability while minimizing associated costs and risks.

Calculation of Average Inventory (AI):

AI = (Initial Stock + Final Stock) / 2 = (201+150)/2 = 175.5 (u) (2)

Maintaining an average inventory of 175.5 units for spare part reference 1296 ensures adequate availability for cosmetics production operations while requiring regular evaluation to optimize storage costs. It is crucial to continually compare this average inventory with actual consumption data and forecasts to adjust inventory management strategies and ensure they remain effective and cost-efficient.

Turnover Rate (TOR):

TOR = Consumption / Average Inventory = 51/175.5 = 0.3 (3)

A turnover rate of 0.3 for the spare part "40'' 5µ Carbon Filter CFCBZF308038" indicates a low renewal frequency, suggesting potential overstocking and high storage costs. It would be beneficial to analyze the demand in more detail and adjust inventory levels to improve turnover, reduce costs, and optimize inventory management efficiency while ensuring the availability of this critical part.

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Average Coverage (AC):

Average coverage refers to the time period during which the company could operate without replenishing its inventory.

AC = Average Inventory / Consumption = 175.5/25,5 = 7 years (4)

A very high average coverage indicates that the average quantity of products available in stock exceeds demand, which may signal issues such as overstocking or inadequate supply planning.

4. APPLICATION OF THE WILSON MODEL

The Wilson formula, also known as the Economic Order Quantity (EOQ) model, helps determine the most cost-effective solution by calculating the optimal order quantity. Its application serves as an excellent example of implementing efficient inventory management within our company, particularly for slow-moving items. We will apply the Wilson model to the most critical spare part, the "40" 5µ Carbon Filter CFCBZF308038," which is classified as a Class A item. This analysis is based on the assumptions and information detailed in Table 7, allowing us to optimize our inventory management strategy and minimize costs while ensuring adequate availability of this essential part.

Table 7: Parameters Required for Wilson Formula Calculations

Period	θ	9ans
Consumption during the period	C	51 pièces
Unit purchase price	P	165.40 €
Delivery lead time	D	48 jours
Order placement cost	CL	100.00 €
Holding cost rate	t	25%
Service level rate	T	95%

Note: Given the incomplete information, we will proceed with a simulation based on the holding cost rate, order placement cost, and service level to evaluate stock management performance.

4.1 Economic Order Quantity (EOQ):

The Economic Order Quantity, determined by the Wilson model, represents the optimal order quantity that minimizes the total costs associated with inventory management. This optimal quantity is calculated by considering the order placement cost, holding cost, and demand rate. The objective is to ensure efficient inventory management while adequately meeting demand.

Cp = P x t = 165.40 x 0,25 = 41,35 € (5)

Therefore:

QE = √(2xCxCL/Cp) = √(2x51x100/(41,35)) = √(246,67) = 15,7 units (6)

Approximately, the Economic Order Quantity will be 16 units.

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4.2 Number of Orders (NE):

The number of orders represents the ideal replenishment frequency as defined by the Wilson model to minimize the total inventory management costs.

$$NE = \sqrt{\frac{CxCp}{2xCl}} = \sqrt{\frac{51x41,35}{2x100}} = \sqrt{10,54} = 3,24 \quad (7)$$

Approximately, the number of orders will be 3 over 9 years.

Alternatively, the number of orders can be directly calculated using the following formula:

$$NE = \frac{\mathrm{C}}{\mathrm{QE}} = \frac{51}{16} = 3,18 \quad (8)$$

4.3 Replenishment Period (TE):

The replenishment period represents the time during which goods are consumed or sold before a new order is triggered to restock them. Effectively managing this period is crucial to maintaining optimal stock levels while adequately meeting demand.

$$TE = \theta\sqrt{\frac{(2\times CL)}{C\times Cp}} = 12\sqrt{\frac{2\times 100}{51\times 41,35}} = 25,8 \text{ months} = 786 \text{ days} \quad (9)$$

Alternatively, this can be obtained directly using the following formula:

$$TE = \frac{\theta}{\mathrm{NE}} = \frac{7\ x\ 365}{\sqrt{10,54}} = 786 \text{ days} \quad (10)$$

4.4 Analysis of Optimal Costs via the Wilson Model:

We have:

- Initial Stock: Assume zero. (SI = 0).
- Final Stock: SF = Quantity purchased / Number of orders
- Average Stock: SM = (SI + SF) / 2. (11)
- Value of Average Stock: VSM = P * SM. (12)
- Order Costs: : CLC =N x CL (13)
- Holding Costs: CPC = VSM x Cp (14)
- Economic Lot per Order: LQE = Total period consumption divided by the Number of orders.
- Total Cost: CT = CLC + CPC. (15)

A graphical visualization (Figure 2) simplifies the understanding of the Wilson model by illustrating the intersection between the holding cost curve and the ordering cost curve. This intersection is represented by a point symbolizing the Economic Order Quantity (EOQ) and the Number of Orders (NE). This point also corresponds to the inflection point of the total cost curve.

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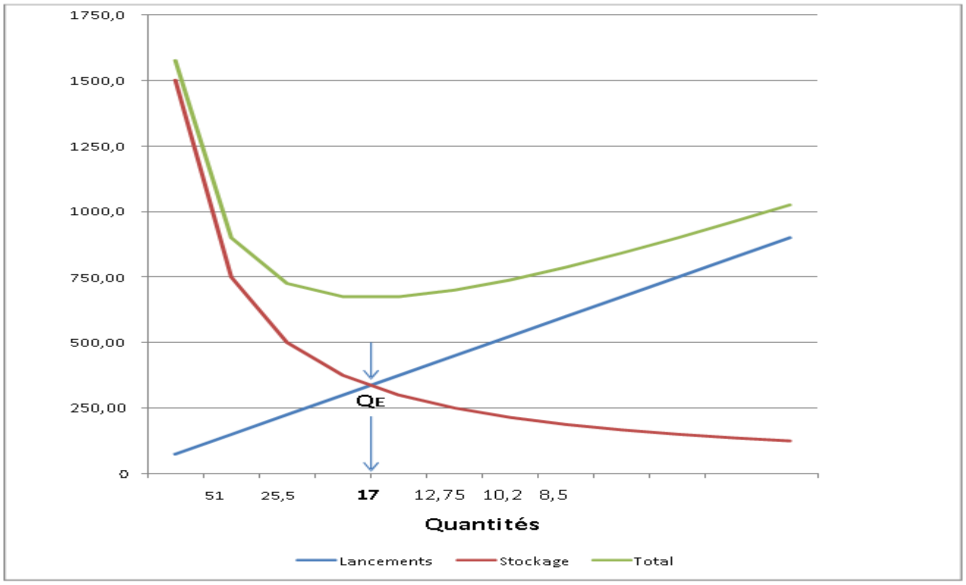

Figure 2: Wilson Model Graphical Diagram

4.5 Interpretation

Based on our application of the Wilson model, the most economical solution for the "40" 5µ Carbon Filter cfcbzf308038" would be to place three orders over a seven-year period for a total of 17 units. This strategy would result in an optimized total cost of €651.47. For any other order quantities (EOQ), the total cost increases, confirming that the optimal number of orders is indeed three. The calculations could have been concluded at line 4, corresponding to four orders. Regarding the Class B items, it is advisable to replenish them using the Wilson model as well, since they also require careful monitoring to avoid the risks of overstocking or understocking.

For Class C items, two methods were selected based on their size and initial quantity:

- For large items with low quantities, where the quantity is significant, it is recommended not to exceed two units. The chosen method is a one-for-one replenishment strategy, meaning a new unit is supplied as soon as one unit is removed from stock.
- For small items with large quantities, where the count exceeds 10 units, the appropriate replenishment method is the two-bin system. When the first bin is emptied, it is replenished from the second bin; subsequently, new stock is ordered to refill the second bin.

5. STRATEGIES FOR EFFECTIVE INVENTORY MANAGEMENT

In our study, we presented a spare parts inventory management policy. This policy is subject to continuous improvements and can also serve as a basis for managing all spare parts. In this regard, we suggest considering the following elements:

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5.1 ABC Classification

It is crucial to classify spare parts to determine the management policy for each item. Classification criteria should not be limited to the item's value, but it is necessary to define new criteria internal to the company, such as the financial impact of an item shortage on production, the need for specific storage conditions for certain items, item availability, etc. This will allow for the application of the appropriate replenishment method.

5.2 Performance Indicators

No management system can endure and satisfy if it is not monitored by relevant and consistent indicators, which are:

Service Rate: To track the evolution of this indicator, it is necessary to record the number of satisfied requests and divide it by the total number of orders.

The goal is to increase this ratio. To do this, each time an order is satisfied, it is recorded in an Excel file. By then dividing the total number of satisfied orders by the total number of orders, we obtain the service rate.

Orders satisfied by borrowing or by substitute material are considered unsatisfied orders.

Turnover Rate: The use of this indicator helps identify materials with excess storage. The objective is to increase the turnover rate to avoid overstocking.

Average Stock Coverage: The average coverage corresponds to the period during which the company can operate without needing to replenish its stocks.

5.3 Implementation of a Computerized Inventory Management System

ERP (Enterprise Resource Planning) systems centralize all stock-related information, facilitating real-time monitoring. The adoption of technologies such as barcodes and RFID (Radio Frequency Identification) can automate stock data collection and reduce human errors.

- Invest in a specialized inventory management system to monitor stock levels in real-time.
- Implement an automated replenishment process to reduce human errors and processing times.

5.4 Historical Data Analysis

- Conduct a detailed analysis of historical data on sales, demands, and spare parts life cycles.
- Identify demand trends for each spare part, focusing on seasonal or cyclical variations.

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5.5 Risk Management

- Anticipate potential breakdowns by maintaining a safety inventory for critical spare parts.
- Develop contingency plans to manage spare parts shortages and thus minimize unplanned downtime.

5.6 Staff Training

- Ensure that personnel responsible for inventory management are trained in best inventory management practices and the tools used.
- Encourage a culture of responsibility and commitment to ensure effective execution of the inventory management strategy.

5.7 Supplier Management

- Identify essential suppliers and establish strong relationships with them to ensure quick delivery times and competitive prices.
- Explore partnerships or long-term contracts to ensure the availability of essential spare parts.

6. CONCLUSIONS

This study has made significant contributions to the field of spare parts inventory management in the cosmetics manufacturing industry. By implementing a comprehensive approach that combines criticality-based classification, performance indicator analysis, and the application of the Wilson Economic Order Quantity (EOQ) model, we have demonstrated a practical and effective method for optimizing spare parts inventory.

The research highlights the importance of tailoring inventory management strategies to the specific needs of the cosmetics industry, where product quality and production continuity are paramount.

The multi-criteria classification system developed in this study, which considers factors such as unit price, lead time, and consumption rate, provides a nuanced understanding of spare parts criticality.

This approach allows for more targeted and efficient inventory management practices. The application of the Wilson EOQ model to the most critical spare parts has shown promising results in reducing both ordering and holding costs while maintaining adequate stock levels.

However, it is important to acknowledge the limitations of this model, particularly its assumptions of constant demand and fixed costs, which may not always align with the dynamic nature of the cosmetics industry.

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Looking forward, there are several avenues for future research and improvement:

- Developing more adaptive models that can account for seasonal variations and unexpected demand fluctuations in the cosmetics industry.
- Exploring the integration of advanced technologies such as artificial intelligence and machine learning to enhance demand forecasting and inventory optimization.
- Investigating the potential of real-time inventory tracking systems to further improve responsiveness and reduce stockouts.
- Conducting longitudinal studies to assess the long-term impact of these inventory management strategies on overall operational efficiency and financial performance.
- Expanding the scope of the study to include a wider range of cosmetics manufacturers to validate the generalizability of the findings.

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