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Escuela Académico Profesional de Ingeniería Industrial

Tesis

# Inventory Management Using the Abc Classification Method In the Warehouse of Tectum, Peru

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# Inventory Management Using the ABC Classification Method in the Warehouse of Tectum, Peru

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Abstract —Inventory management has a valuable role because it identifies the loss of raw materials and maintains the economic sustainability of companies in the market. This research aims to measure inventory control and provide analysis through appropriate methodologies, such as the ABC classification system and the weighted moving average, improving warehouse management and the sales level of the company Tectum. For this purpose, the preliminary diagnosis was made employing a survey, considering The permanence at work, economic situation, classification of products according to importance, frequency of registration of inputs and outputs, knowledge of inventory management and control, and its application; which gave as a primary result that, despite not knowing the storage of products thoroughly, if they know their benefits, so they keep a record where they are classifying the products by importance. For the ABC classification analysis, 30 products derived from Aluzinc were used, of which 13 belong to group A, the most essential product, the prepainted Aluzinc Red RAL 3020 (0.30mm). In addition, it is known which products have higher rotation, considering the relevance in obtaining profits in the company, and that some products could be eliminated due to the lack of circulation. Therefore, with the ABC classification system and the weighted moving average, it is ensured that the available products are delivered on time to meet the demand and avoid production delays.

### Keywords—Inventory management, ABC classification, demand forecasting, Aluzinc.

### I. INTRODUCTION

A company's inventory management is an activity related to the value chain, following the company's strategies and, at the same time, getting used to its customers [1]. Therefore, inventory management aims to provide accurate and efficient information to manage resources better and thus calculate their practical benefit by making a sale. Also, using the product can prevent theft and damage, which is an advantage for the company [2].

The economic growth in Peru has enabled companies, mainly in the construction sector, to face a growth in demand, which is reflected in the increase of annual imports; 2022 was the highest in the last 20 years, with a growth of 18.1% compared to 2021 [3].

In addition, imports allow companies to access cheaper and more efficient products [4]. So, in Huancayo, approximately since 2019, there has been an increasing number of companies engaged in the marketing and processing of Aluzinc coverings, which serve as a coating for roofs of houses and various businesses. Those that intend to apply the best tools for correct and continuous business growth, however, have been affected in the inventory control since it does not have an adequate rotation and the products are not fully classified according to their characteristics nor are they grouped and valued, which delays the elaboration of orders. Therefore, not adequate management of inventory having management influences the accounting since not having accurate information, there are differences with the actual stock, which causes some sales not to come to fruition, generating a direct impact on the company's results [5].

As is known, every company or commercial organization must implement control and inventory policies for optimal product management. The most used systems are the ABC (Activity Based Costing) system, the Economic Order Quantity (EOQ) model, and the Just in Time (JIT) system [2]. For example, [6] the use of the Economic Order Quantity (EOQ) model and the continuous review model with uncertain demand and standard deviation (q, R) was applied to establish inventory policies in a steel trading company, generating a 30% saving in total logistics costs. On the other hand, when the company tried to apply the Just in Time system [7], it faced several limitations, such as the uncertainty level of the raw material and the lack of capacity of the suppliers to supply orders in shorter times. Finally, [8] the ABC methodology is the most preferable alternative to carry outstanding inventory management since he implemented it in his company dedicated to the sale of construction materials, with which he was able to identify the items that represent more excellent utility and at the same time what could generate future risks, in addition to ensuring progress in business administration and have a persistent growth in the financial aspect.

Besides, his research [9] determined home appliance companies' inventory control and valuation methods. Through a survey, he found that 20% of the

companies have not implemented inventory policies, and 60% apply the ABC system because the level of inventory turnover optimizes resources and improves profitability. Thus, the ABC methodology and the weighted moving average were used to carry out this research since, according to the problem posed, the main objective of the ABC method is to favor the most essential products in the company's warehouse based on the impact it will have on its profits [10].

#### A. ABC classification system

For [11], the ABC system is a method with which it is possible to control the products that have a higher price than the lower ones in the inventory, for example, if the products are classified by their value, from highest to lowest, an accumulated distribution would be obtained. Concerning the benefits analysis, a new perspective is provided for evaluating cost behavior. These increase the reliability and usefulness of costing information in decision-making and reduce waste and activities that do not add value to the product.

According to [12], it is essential to implement an inventory control system since the existence of an inventory inspection that defines the value of each item intended for sale means that the costs incurred are not significant or unnecessary due to carelessness on the part of the company. On the other hand, according to [13], the ABC classification allows us to know which products are the most active. Therefore, an analysis of average stocks, frequency of departures, number of orders, and sales volume, among others, should be performed.

For the implementation of the ABC classification system, there are three categories mentioned by [8]:

- Type A: Products in this category represent 80% of the total value of the stock, so monitoring and controls are more frequent. In general, the products tend to be quick and direct access.
- Type B: They represent 30% of the total inventory and account for 15% of the total revenue value; inspections are carried out periodically, and their access is indirect concerning type A products.
- Type C: Involves 5% of the total value of the stock; the monitoring performed is almost low or null, less achievable since they are the goods with less customer demand.

#### B. Demand forecast analysis

Caba [14] explains that forecasting refers to predicting the future using historical data employing a mathematical model. When applying a forecasting technique, there should not be a superior technique. Still, an analysis is carried out to define it according to the relationship between the business line and the company's current situation. On the other hand, Saldarriaga mentions that it is a process that collects, stores, and processes a long-term precaution with a higher accuracy using statistical methods and past information, thus reaching the same conclusion as Caba, as he states that forecasting is the most important part of demand management [15].

### C. Moving averages

This model can be used with companies or businesses whose market demands are constant over time. According to [14], he mentions that a fourmonth moving average is realized as "the sum of the demand over the last four months divided by 4. With each passing month, the most recent month's data is added to the sum of the previous three months' data"; where the first month is omitted, this whole calculation tends to smooth out short-term irregularities.

The simple moving average that serves as a valuation of the next period's demand is expressed as follows:

Moving averages = 
$$\frac{\Sigma Demand for n previous periods}{n}$$
(1)

where n is the number of periods in the moving average. For example, four, five, or six months for a moving average of four, five, or six periods.

#### D. Weighted moving averages

Masini and Vazquez indicate that the weighted moving average uses the weights with the analyst's relative assessment of the estimated information from the most recent and the oldest data in formulating a forecast [16]. There is a trend or pattern with which it is possible to increase the relevance in recent values to generate greater sensitivity during the changes, which is due to the recent periods because they could have greater weight. The definition of the weights used is usually done arbitrarily because there is no way to determine it.

According to the same author, the weighted moving average is mathematically expressed as follows:

$$Moving \ averages \ = \ \frac{\Sigma \ (weight \ for \ period \ n) \ (demand \ for \ period \ n)}{\Sigma \ weight}$$
(2)

Concerning the above, simple moving averages, such as weighted averages, will mitigate abrupt variations in the demand pattern, thus providing stable estimates [13].

#### II. METHODOLOGY

The study is descriptive, exploratory, and historical. It was conducted in a company dedicated to marketing and producing Aluzinc coatings in Huancayo. The ABC methodology was mainly analyzed as an inventory management and control system. In addition, it was valued as a data collection technique. This survey will serve to understand the company's current situation and mainly evaluate the inventory in the organization. A. Diagnosis and survey results regarding warehouse inventory were applied to the company.

The survey was applied to six employees: five warehouse operators, the warehouse, and the production manager. The number of workers is because it is a small company. The result of the seven questions of the survey is as follows:

Table I: Results of the first question: How long have you been working?



### Figure 1. Permanence of employees in the company.

The purpose of the first question was to determine how long the employees have been working in the company and how much they know about the processes applied in the company, mainly about inventory management. As a result, 90% have worked for over a year.

Table II: Results of the second question: Do you consider that this company currently has problems with product output?



# Figure 2: Workers' perception of product output.

According to the results obtained in this question, it is estimated that there could be current problems with product sales. However, they do not recognize the specific reason for the situation. Table III: Results of the third question: Based on your perception regarding the output of products in the last six months, you consider that this company maintains an economic situation.



Figure 3: Perception of workers regarding the economic situation.

Excellent

Good

To determine the current economic situation of the company, the question was posed, taking into consideration product sales in the last six months, obtaining as a result that the collaborators interpret that the economic situation has been maintained at a permanent level, although not excellent.

Table IV: Results of the fourth question: Does the company classify a product according to the number of times it is sold concerning its importance?



# Figure 4: Perception of workers regarding product classification.

This question was generated to define whether the company applies an ABC classification for the inventory control generated through sales. A positive answer was obtained: if its products are classified according to their importance in the products handled by the company.

Table V: Results of the fifth question: Does this company record incoming and outgoing goods?

Frequency n %



Figure 5: Perception of workers regarding product classification.

The objective of this question is to find out if the company's workers are aware of the consequences that can be caused by an inadequate inventory procedure, concluding that the knowledge is low even though the workers are aware of its importance.

Table VI: The results of the sixth question: Do you think it is necessary to implement an inventory management and control system for this company?



# Figure 6: Employee perception of implementing an inventory management and control system in the company.

The relationship between this question and the previous one is that all employees answered in the affirmative, allowing improving the company with an inventory management and forecasting system.

### *B. Proposal for the implementation of the ABC classification in the company.*

The ABC classification analysis procedure identifies the products with the highest inventory turnover and those with a higher and lower percentage of the total inventory cost. For Tectum, the products considered as products are the various Aluzinc coils of different colors and thicknesses.

Table VII: Product Description.

N⁰	Product	Total	%	Classification
	Description			

		Red pre-painted	S/ 594		
	1	Aluzinc RAL 3020	064.40	19.072%	A
		(0.30 MM)			
•		Red pre-painted			
	2	Aluzinc RAL 3003	S/ 296	28.602%	А
	-	(0.30MM)	838.80	201002/0	
		(0.001111)			
		Blue pre-painted	5/258		
	3	Aluzinc RAL 5002	5/ 250 679 85	36.907%	А
		(0.30MM)	075.05		
-		81			
	4	Aluzing RAL 5002	S/ 223	44 077%	^
	4	(0.35MM)	338.05	44.07778	A
		(0.5514141)			
		Green pre-			
	5	painted Aluzinc	S/ 165	19 383%	۵
	J	RAL 6035	269.98	49.38376	A
		(0.28MM)			
		Plue pro painted			
	6	Aluzing RAI 5017	S/ 157	54 443%	۵
	0	(0 30MM)	628.00	34.44370	~
		(0.501111)			
	7	Smooth natural	S/ 152	50 227%	^
	,	Aluzinc (0.30 MM)	123.40	33.32776	A
	0	Blue pre-painted	S/ 144	62.05.49/	•
	o		138.70	03.954%	А
		(0.55101101)			
1		Red pre-painted			
	9	Aluzinc RAL 3020	5/ 113	67.598%	А
		(0.35 MM)	495.80		
	10	Red pre-painted	S/ 111	74 4760/	•
	10		449.49	/1.1/6%	А
		(0.35 10101)			
-		Red pre-painted			
	11	Aluzinc RAL 3020	S/ 98	74.324%	А
		(0.40 MM)	039.76		
		White pre-	s/00		
	12		3/ 30 16/ 20	77.218%	А
		(0.30MM)	104.20		
		(0.001111)			
	12	Smooth natural	S/ 85	79.964%	^
	15	Aluzinc (0.40 MM)	518.42	75.50470	~
-					
		white pre-	s/ 80		
	14		3/ 80 919 28	82.562%	В
		(0.40MM)	515.20		
		,			
		Green pre-			
	15	painted Aluzinc	S/ 79	85 104%	в
	10	RAL 6035	187.60	00120170	5
		(0.30MM)			
-		Smooth natural	\$/ 70		
	16	Aluzinc (0.35 MM)	076.63	87.354%	В
		Blue pre-painted	5/67		
	17	Aluzinc RAL 5002	867.54	89.533%	В
		(0.40MM)			
•		Red pre-painted			
	18	Aluzinc RAI 3009	S/ 61	91.509%	В
		(0.35MM)	555.82	52.505/0	-
		. ,			
		Red pre-painted	S/ 53		
	19	Aluzinc RAL 3009	357.40	93.222%	В
		(0.30MM)	-		

20	Red pre-painted Aluzinc RAL 3002 (0.40 MM)	S/ 32 840.60	94.276%	В
21	Grey pre-painted Aluzinc RAL 7040 (0.40 MM)	S/ 29 432.00	95.221%	С
22	Blue pre-painted Aluzinc RAL 5017(0.40 MM)	S/ 28 414.10	96.133%	С
23	White pre- painted Aluzinc RAL 9003 (0.28MM)	S/ 26 985.70	97.000%	С
24	Red pre-painted Aluzinc RAL 3002 (0.35 MM)	S/ 26 257.03	97.843%	с
25	Red pre-painted Aluzinc RAL 3009 (0.50MM)	S/ 24 770.10	98.638%	С
26	Blue pre-painted Aluzinc RAL 5009 (0.28MM)	S/ 20 353.75	99.291%	С
27	Green pre- painted Aluzinc RAL 6035 (0.40MM)	S/ 14 258.40	99.749%	С
28	White pre- painted Aluzinc RAL 9003 (0.5MM)	S/6 561.00	99.960%	С
29	Red pre-painted Aluzinc RAL 3020 (0.28 MM)	S/ 1 140.00	99.996%	с

Table VII shows the results of the ABC classification analysis. Of the company's 29 products, 13 belong to classification A, 7 belong to classification B, and 9 belong to classification C.



#### Figure 7: Classification ABC method.

According to Figure 7, the last product to enter the A classification is Smooth Natural Aluzinc (0.40mm), with 79.964% representation, approaching 80%.

#### **III. RESULTS**

### A. Proposed demand forecasting by weighted moving average methods.

After applying the ABC classification analysis, the demand forecast was made for the three most

representative products of classification A. The following tables were used to analyze Aluzinc's prepainted red RAL 3020, RAL 3003, and RAL 5002 products.

Table VIII: Demand forecast for the product Aluzinc pre-painted red RAL3020.

T1	70.61%		T1	0.64460
T2	0.00%		T2	0.00000
T3	29.39%		Т3	0.00000
			T4	0.00000
			Т5	0.00000
			<b>T6</b>	0.35540
				1.00000
Red	pre-painted Aluzi	nc RAL 3020 (0.3	30 MM)	
	DEMAND F	ORECAST		
1	1 000.92			
2	1 017.62			
3	3 160.98			
4	4 531.51			
5	1 698.58			
6	2 088.95		2,088.95	2088.95
7	993.34	1387.6061	-394.27	394.2660998
8	303.30	1 008.990871	-705.69	705.6908708
9	1 788.12	2 145.359837	-357.24	357.2398369
10	4 422.91	3 556.508513	866.40	866.4014866
11	5 745.62	2 666.807487	3 078.81	3 078.812513
12	2 951.37	3 388.531332	-437.16	437.1613319
13	4 203.43	1 689.224299	2,514.21	2 514.205701
14	6 081.93	1 689.407092	4,392.52	4 392.522908
15	2 382.67	3 314.141037	-931.47	931.4710374
16	3 697.81	3 697.808186	0.00	0.001814251

Table VIII shows the variation in demand for the Aluzinc prepainted red RAL 3020 products over the 16 periods from January 2022 to April 2023.



# Figure 8: Demand forecast for the product Aluzinc pre-painted red RAL 3020.

Figure 8 compares the actual annual demand and the forecasted demand for the product Aluzinc prepainted red RAL 3020, whose forecast line is within the trend behavior of the actual demand line.

Table IX: Demand forecast for the produc	t
Aluzinc pre-painted red RAL 3003	

T1		19.12%	T1	0.19116
T2		0.10%	T2	0.00100
T3		80.78%	T3	0.80784
				1.00000
Red	pre-painte	ed Aluzinc RAL 300	03 (0.30MM)	)
DEN	IAND	FORECAST		
1	198			
2	3 469.2 9			
3	5 018.2 7			
4	2 457.2 8	4 095.279134	-1 638.00	1 637.99913 4
5	1 216.0 6	2 653.296642	-1 437.24	1 437.23664 2
6	1 942.8 9	1 944.130974	-1.24	1.2409739 12
7	498.9 5	2 040.493874	-1 541.54	1 541.54387 4
8	41.9	637.4765549	-595.58	595.57655 49
9	132.9	405.7499412	-272.85	272.84994 12
10	1 125.3 7	202.7830497	922.59	922.58695 03
11	2 800.6 9	917.2616131	1 883.43	1 883.42838 7

Table IX shows the variation in demand for the 11 periods from June 2022 to April 2023 for the Aluzinc prepainted red RAL 3003 product.



Figure 9: Demand forecast for the product Aluzinc pre-painted red RAL 3003.

Figure 9 compares the actual annual demand and the forecasted demand for the product Aluzinc prepainted red RAL 3003, whose forecast line is within the trend behavior of the actual demand line.

# Table X: Demand forecast for the product Aluzinc pre-painted blue RAL 5002.

T1		37.10% <b>T</b>	1	0.37103
T2	0.01% <b>T2</b>			0.00010
Т3		62.89% <b>T</b> .	3	0.62887
				1.00000
Blue pre-	painted Alu	zinc RAL 5002 (	0.30MM)	
DEMAN	D F	ORECAST		
1	983.86			
2	1572.38			
3	1109.25			
4	681.81	1 062.772592	-380.96	380.9625918
5	881.77	1 012.282912	-130.51	130.5129124
6	1418.25	966.15242	452.10	452.09758
7	715.25	1 144.953396	-429.70	429.7033959
8	250.06	777.1045907	-527.04	527.0445907
9	285.06	683.5426485	-398.48	398.4826485
10	1 220.72	444.6708524	776.05	776.0491476
11	1 057.59	860.4803101	197.11	197.1096899
12	1 070.95	770.9728013	299.98	299.9771987
13	1 780.96	1 126.518168	654.44	654.4418322
14	1 507.96	1 512.495437	-4.54	4.535436872
15	596.72	1 345.842522	-749.12	749.1225219
16	1 036.13	1 036.202323	-0.07	0.072323372

Table 10 shows the variation in demand for the 16 periods from January 2022 to April 2023 for the prepainted Aluzinc Blue RAL 5002.



# Figure 10: Demand forecast for the product Aluzinc pre-painted blue RAL 5002.

According to Figure 10, the comparison between the actual annual demand and the forecasted demand of the product Aluzinc pre-painted Blue RAL 5002, whose forecast line is within the trend behavior that marks the line of the actual demand.

#### **IV. CONCLUSIONS**

It can be concluded that the company does not use the inventory correctly, so it has maintained solvency difficulties during this time. The current problem with the products is that there is no periodic rotation; for that reason, the warehouse does not advance and continues to cause damage. In addition, this led to the company's deterioration and increased costs. It is shown that the items are handled by experience, and the inventory is kept inadequately. Therefore, systematic control is needed to get accurate stock data. In this way, it is possible to know which items have a primary alternation and to realize which item is valid for sale.

As previously mentioned, it is also verified that there is little demand for some products, which were not paid attention to at the time of establishing the ABC methodology since the company works with these products under advance purchase orders. In this way, which products have a higher turnover, considering their relevance to the company's profitability is known. Likewise, some products in the company could be eliminated due to the lack of circulation. When a demand forecast is used, it allows the manager to reduce the anxiety about the quantity of products requested by the customer; this tool, together with the ABC classification, ensures that the products in inventory meet the demand promptly, avoiding production delays.

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