



Optimizing Inventory Management Using ABC, XYZ, VED Classification Analysis and the ABC-XYZ-VED Combination at PTX

Kusnadi¹ and R. Eddy Nugroho²

^{1,2}Mercu Buana University, Jakarta

Abstract— Inventory usually refers to the stock of goods or sources of power used by a company. Temporary, term management refers to control and practices for monitoring level inventory, when to replenish and stock, and what products should be ordered. This is possible for guard volume production still tall while minimizing cost. Researchers conducted inventory management analysis research using the ABC, XYZ, VED classification methods and a combination of these three models at PT The results of the research are that the ABC classification in the form of asset values for the incoming raw materials group is A 69%, B 22%, and C 9%. In the XYZ classification, the variability in demand for raw materials is obtained as follows: Class The VED classification obtained is Class V (Vital) with 10 products, E (Essential) 9 products, D (Desirable) 4 products. Analysis of the ABC-VED-XYZ combination sharpens control of the needs of each raw material to support inventory optimization. The results of the analysis can differentiate raw materials with large and small asset values, routine and sporadic needs, and very important and not very important products, meaning that one product has 3 criteria for inventory control.

Keywords— Analysis, inventory management, ABC-XYZ-VED, combination.

INTRODUCTION

In running a business, companies always face demand uncertainty, high uncertainty causes product stocks to be very high or conversely very minimal for certain types of raw materials or products. Uncertainty is not only in the supply of raw materials but also in the supply of finished products to meet sales demand. Uncertainty of external processes such as the availability of supply due to changes in purchasing prices causes factories to hoard raw materials, and uncertainty in deliveries from suppliers causes factories to create reserve stock (safety stock). Uncertainty in internal processes, for example, production machines are damaged or running slowly, causes factories to have large reserves of semi-finished products (WIP).

The policy regarding the procurement of raw materials at the PTX company is currently still being carried out by reviewing inventory, namely; Is it still there, reduced, or empty? The company will only order when it feels supplies are running low. The number of raw materials ordered for each purchase is not based on calculations but only based on estimates.

This condition has the potential to cause an increase in ordering costs due to the lack of control over raw material management. So companies need to make improvements to inventory control of raw materials and finished goods. Control by classifying raw materials in several classification models will show the need for raw materials as effectively as possible.

LITERATURE REVIEW

According to Heizer & Reinder (2016), inventory is one of the largest assets of a company, representing 50% of the total invested. Operations managers around the world realize that good inventory management is critical. Companies can reduce costs by reducing inventory because inventory requires large capital and affects the delivery of goods to customers. The goal of inventory management is to determine the balance between inventory investment and customer service.

Inventory management affects all business functions, especially operations, marketing, and finance. The need for correct safety stock calculations benefits businesses both financially and in customer satisfaction (Pratama Wijaya et al., 2015)

Inventory management is a critical element that determines the success or failure of a business, and its main goals are to provide adequate quality customer service, ensure that organizational resources are available, streamline operations, and minimize inventory investments (Amani & Okdinawati, 2023)

Inventory classification according to Pujawan & Mahendrawathi (2021) is: 1) Raw materials, 2) Work in progress, 3) Finished goods, 4) Maintenance, repair, and operating supplies

ABC classification

ABC classification is a classification process based on the value of a product or material from the total existing value (Greene & Alfakis, 2022). The provisions of the ABC classification are as follows:

- Class A is material that has a cumulative value of 70% of the total value.
- Class B is material that has a cumulative value of 20% of the total value.
- Class C is material that has a cumulative value of 10% of the total value

XYZ Classification

Classification using XYZ analysis aims to identify inventories that have definite (constant) fluctuations in demand and which are uncertain. Greene S 2022, classifies materials into:

- Class X is inventory that has constant demand from period to period. Change Class X requests only range within limits fluctuations in changes in inventory demand. Control material class X is more profitable because the company can predict fluctuations from this material.
- Class Y has a count changing or inconsistent demand.
- Class Z has a high probability of not being used for some period. Estimates for materials with classification class Z are very difficult to predict and sporadic

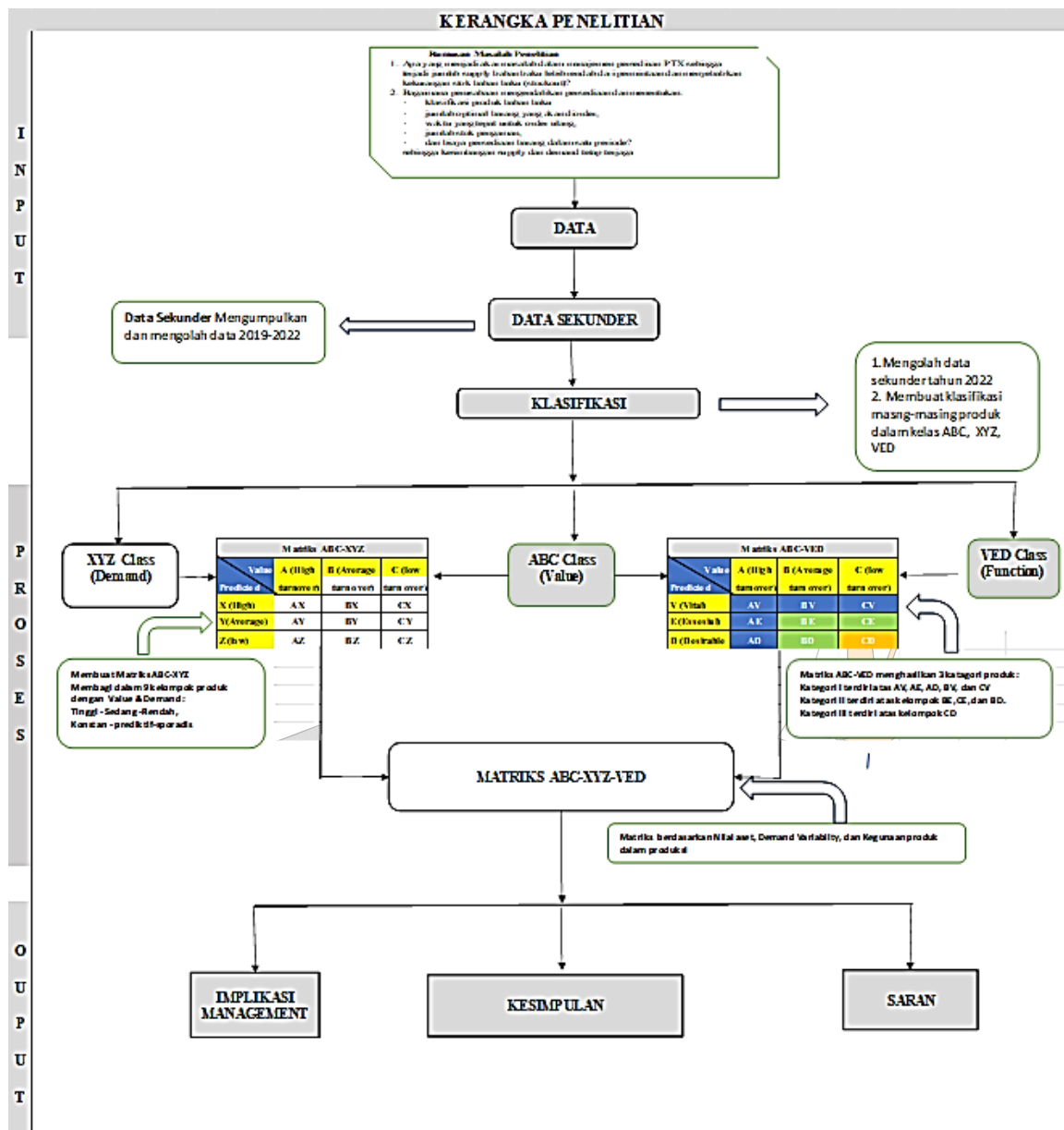
VED classification

VED analysis is a qualitative approach to classifying raw material inventories (Fedriani, 2017). VED analysis is carried out to determine the importance of an element and its impact on manufacturing production and other services. This analysis is used to classify materials and spare parts into three categories – Vital (Critical)

abbreviated V, Essential (Important) abbreviated E, and Desirable (Desirable) abbreviated D. For objects with a large V Inventory is usually stored, while for "D", the quantity minimum supplies are sufficient This analysis is needed by warehouse management to classify goods according to their importance. A simple way to determine and determine the importance of raw material and its impact on production if its availability is empty or lacking.

Framework

The framework explains the logical outline of the research process carried out



RESEARCH METHODS

The type of research used is quantitative descriptive. Quantitative research uses secondary data on raw material supplies in the form of figures with credibility that can be trusted to be valid and accountable. Next, it is analyzed using the inventory classification method and processed with optimal inventory calculations in order to obtain



research results in accordance with the measuring scale that has been previously determined. Meanwhile, the analysis results obtained were then also carried out descriptive analysis of the quantitative data collection (Sugiyono, 2018)

Analysis Method

The method used in this research is:

1. ABC analysis

Product grouping analysis based on total asset value, group A with 70% assets, B 20%, and C 10%.

2. XYZ analysis

Product grouping analysis based on product demand variability, group X is stable demand, Y is unstable but predictable demand, and Z is sporadic demand

3. VED analysis

Analysis of product groupings based on the level of need for the product, group V (Vital) is a very critical product need, E (Essential) is a very important need, and D (Desirable) is a group with unimportant needs

4. ABC-XYZ-VED Combination Analysis

Product grouping analysis is based on a combination of asset value, demand variability, and product function requirements.

RESEARCH RESULT

The research was conducted at PTX

The population in this research is all raw materials owned with an observation period of 2022 with a population of 23 types of raw materials.

ABC analysis

Table 1. ABC Classification Results for Raw Materials Coming Out

No	SKD	JAN	FEB	MARET	APRIL	MAY	JUN	JUL	AGT	SEPT	OKT	NOV	DES	TOTAL (kg)	Harga/ks (Rp)	Total Nilai (Rp)	Klasifikasi ABC	Total Nilai (Rp)	% Value	
1	22038	22787	4131	8606	52030	5806	6308	54380	2106	1047	31323	15291	137225	28008	384200780	35,25%	A	12.681.636.957	67%	
2	3604	4387	5160	4055	2732	2385	3321	4245	8547	3346	5100	1068	43830	68430	2981809630	35,26%	A			
3	30005	6337	7186	7555	2784	32784	9795	2049	4848	730	7337	4264	83837	28000	2389127734	47,80%	A	5		
4	13475	13379	14554	13632	9842	10360	14680	15508	14728	10434	8137	2460	145784	15500	226816743	28,82%	A			
5	0	0	0	1218	3970	3078	2349	2048	3709	0	1638	3378	13636	68430	1344693235	68,90%	A			
6	870	876	676	3718	411	2548	4245	1543	1740	1315	1335	361	14252	68430	1344693235	73,25%	B			
7	13230	10512	8592	3046	7932	6023	9361	10642	12082	3433	9730	4005	103083	10035	1034473935	78,20%	B	5		
8	3000	2300	2210	1210	4625	2875	4300	1000	210	0	0	0	1200	28000	34000000	83,37%	B	5	4.515.272.044	26%
9	4436	956	956	3043	279	2334	1172	383	3109	509	546	818	18638	40000	75046600	87,23%	B			
10	17476	24869	28865	29386	32723	35720	33572	37380	30308	29338	20424	24870	343436	1830	627205911	90,71%	B			
11	3309	2223	3648	3036	3844	4215	2054	1312	4243	3173	2938	3481	42547	11200	476124368	63,22%	C			
12	3128	3327	3518	1180	2878	352	2758	1451	3142	275	3497	507	22245	20564	446384739	95,26%	C			
13	0	1382	972	1436	1495	1918	2369	1769	3634	730	1006	0	14590	15430	22066385	96,72%	C			
14	684	634	505	470	413	400	490	452	648	255	814	316	4078	30500	12440755	87,30%	C			
15	1320	0	2400	4589	4802	6854	6855	6628	1272	1458	1246	1268	48538	2748	13464424	88,35%	C			
16	182	222	227	229	182	202	470	205	279	190	230	212	3117	12238	3108011	88,94%	C			
17	273	375	327	382	145	237	238	259	306	140	378	110	2544	18302	4668271	89,67%	C	13	1.762.825.564	8%
18	0	0	19	26	33	34	33	33	74	27	62	343	135492	30021265	39664%	C				
19	57	130	106	94	89	140	125	132	124	83	55	81	1215	26400	32067268	99,81%	C			
20	36	88	71	81	64	54	62	82	52	37	28	30	627	26400	16647120	98,90%	C			
21	1025	1025	71	0	71	40	50	0	50	41	29	73120	1115	49332	18000	87874000	96,95%	C		
22	1431	21025	1841	31705	4825	421785	82	37485	28641	2375	15215	275	26123	28940	855543213	98,90%	C			
23	0	0	0	0	0	0	0	0	4121	20505	39200	0	30102	15000	451538100	100,00%	C			
Total	29804607	9491113	9079747	8746549	87781	103482113	30986005	1381132	86112	1331127	887022	1889603	108191421		18369794170,82			28.969.794.571		

Source: Data Processed 2023

The results of the classification of outgoing raw materials supplies (raw materials coming out) during 2022 obtained data in table 5 with the following information:

- Class A total of 5 items of raw materials with a value of IDR 12,691,696,957 (67%)
- Class B total of 5 items of raw materials with a value of IDR 4,515,272,046 (24%)
- Class C total raw materials 13 items with a value of IDR 1,762,825,568 (9%)

Total value of raw material use during 2022 IDR 18,969,794,571

Pareto Diagram ABC Analysis

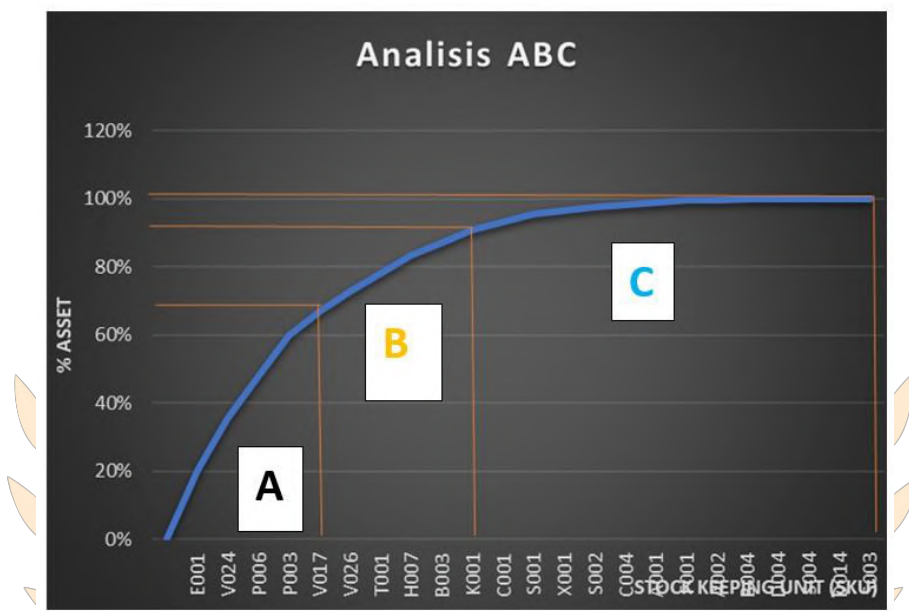


Figure 1. Pareto Diagram ABC Analysis

XYZ analysis

Table 2. XYZ Classification Results for Raw Materials Coming Out in 2022

No	SKU	Month												TOTAL	Classification XYZ			
		JAN	FEB	MARET	APRIL	MAY	JUNI	JULI	AGT	SEPT	OCT	NOV	DES		SD	CV	Rates	
1	K001	2.278,7	4.12,1	89.836	1.103.801	5.8194	879.26	16.888	3.563	1.048,7	2.1.82.8	1.62.05	58.2.21.1	27.586	86%	V		
2	V024	3834	487,2	5.180	487,5	2.77,2	2.80,6	3.82,1	4.78,5	3.04,7	3.886	4.830	1.689	41.635	1.139	80%	K	
3	P006	1.006,5	86,5,2	2.188	2.76,5	2.758	1.2288	9286	4.689	2.82	2.81,2	4.084	88.67,2	4.1.24	58%	V		
4	P003	1.44,7,5	1.14,2,1	1.650,6	1.563,2	958,2	1.03.84	1.888,5	1.550,8	1.42,28	1.08.84	81.9,7	2.98,2	14.5.784	4086	83%	K	
5	V017	0	0	0	1.21,8	1.97,8	30,26	2.24,7	2.27,1	3.27,1	0	1.61,8	3.2,2	375,50	1.130	80%	V	
6	V026	89,0	8.97	788	1.038	4.81	2048	4.287	1.58	1.290	3.91,5	1.91,0	34.20,2	994	74%	V		
7	P001	1.122,0	1.08,5,2	879,2	704,6	799,2	60,21	9983	1.064,2	1.208,7	36.1,1	9.780	40.87	80.808	2.882	83%	K	
8	P002	10.88,4	2.04,7	2.20,1	1.20,1	48,2,5	28,2,5	4.50,1	5.68	2.51	0	0	1.25,7	2800,0	1.287	77%	V	
9	P004	4.42,0	95,6	78,6	308,2	2,70	2.234	1.1,2,1	88	810,7	570	544	8.30	18.470	1.287	83%	K	
10	K001	1.2470	2.880,0	2.880,5	2.9.870	82.22,1	85.2.81	8.55,7	8.22.88	8.200,1	2.18.87	2.080,8	2.69.20	84.8.24	5.008	21%	K	
11	K003	8.83,0	22.2,1	888	2.030	888,8	4.23,5	2.654	5.81,2	4.26,3	8.1,2,1	8.988	888,3	42.54,7	889	25%	K	
12	K001	8.83,0	8.83,7	1.088	1.978	8.83,7	1.978	1.218	1.48,1	8.84,2	2,26	8.82,7	5,3	22.24,1	1.218	66%	V	
13	K001	0	1.88,2	5,7	1.88,6	1.80,5	1.818	2.070	1.26,5	3.058	2.80	1.088	0	14.270	6,2	50%	V	
14	K002	884	6.14	10,1	470	41.9	481	480	48,2	646	2.90	884	4.14	42.270	1.14	88%	K	
15	K004	1.85,0	0	5.80,1	4.50,2	470,5	605,8	605,2	1.2,2	5.470	3.24,5	1.886	485,10	2.11,2	52%	V		
16	A001	0,7	2,2,1	2,2,1	2,2,1	1,9,2	2,30	4,25	2,26	1,9	2,30	2,1,1	3,8,7	1,8,1	51%	K		
17	P001	27,8	27,8	1,7,1	1,7,1	1,4,1	2,87	2,87	2,87	2,87	1,4,1	87,8	1,8,1	27,84	88	82%	K	
18	A002	0	0	0	3,0	2,6	3,0	3,4	3,4	3,0	3,0	2,4	2,7	6,2	34,1	2,2	78%	V
19	K004	5,7	1,80	1,80	94	89	1,41	1,26	1,14	1,24	81	5,7	1,21,1	2,8	28%	K		
20	K004	88	4,0	7,1	4,1	88	58	62	82	5,7	8,7	2,8	8,7	6,2,7	1,6	81%	K	
21	K004	5,2	2,1	4,1	2,1	4,0	5,0	5,2	4,1	2,7	2,7	1,14	4,0,8	8,0	24%	K		
22	K004	1,4	2,1	1,0	1,2	0	5,2	1,0	1,7	2,1	3,5	2,0	2,0,1	1,1	44%	K		
23	K001	0	0	0	0	0	0	0	0	0	0	0	1,0,1	1,1	100%	V		
Total		18969.794,571	18969.794,571	18969.794,571	18969.794,571	18969.794,571	18969.794,571	18969.794,571	18969.794,571	18969.794,571	18969.794,571	18969.794,571	18969.794,571	18969.794,571	18969.794,571	18969.794,571	18969.794,571	

Source: Data Processed 2023

From table 2, the XYZ classification shows the following variability in demand for raw materials:

Class X contains 12 types of raw materials, class Y contains 10 types of raw materials, and class Z contains 1 raw material. The graphic image showing the variability of demand below is an example for Class X:

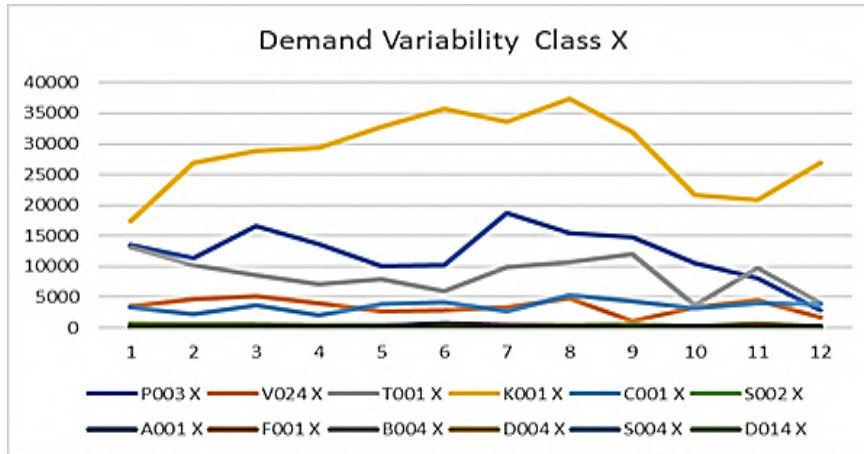


Figure 2. Class X Demand Variability Graph | Source: Processed Data (2023)

Class X contains 12 types of raw materials, 5 raw materials with each quantity more than 5000kg. The graph shows that from month 1 to month 12 the line movement is continuous, always there every month. The other 7 products are less than 1000kg, so the graph cannot be read.

VED analysis

Table 3. Results of VED Classification Analysis

No	Kategori	SKU	Qty (Kg & %)		TOTAL NILAI (Rp & %)	
			(Kg)	(%)	(Rp)	(%)
1		K001	137.214,69		3.842.839.280,00	
2		P006	85.697,42		2.391.527.774,00	
3		V024	41.599,51		2.845.809.425,83	
4		P003	145.784,44		2.259.658.742,50	
5	V	V017	19.656,85	44%	1.344.691.234,57	14.784.485.604
6	43%	V026	16.201,57		1.108.344.319,00	78%
7		B003	18.408,66		749.946.400,00	
8		F001	2.544,95		97.668.271,06	
9		A001	3.437,21		110.808.611,47	
10		A002	340,85		36.021.044,95	
11		T001	103.083,20		1.034.471.935,47	
12		K001	344.426,00		652.509.390,50	
13		K001	22.244,71		444.094.748,60	
14		C001	42.547,27		476.529.368,00	
15	E	K001	14.290,03	582.050	220.066.385,00	3.186.358.474
16	39%	S002	6.078,91	54%	185.406.755,00	17%
17		C004	48.537,63		124.644.633,84	
18		B004	1.215,45		32.087.748,00	
19		D004	626,80		16.547.520,00	
20		S003	101,02		1.515.300,00	
21	D	H007	28.000,00	28.890	980.000.000,00	998.950.492
22	17%	S004	493,32	3%	8.879.760,00	5%
23		D014	295,22		8.595.442,14	
Total			1.081.914		18.969.794.571	

Source: Processed Data (2023)

The results of the VED analysis from table 3 are as follows:

- Vital Products (very important): number 10 (43%), quantity 470,975 Kg (44%) with an investment value of Rp. 14,784,485,604 (78%)

- Essential Products (important): total 9 (39%), quantity 582,050 Kg (54%) with investment value IDR 3,186,358,474 (17%)
- Desirable (desirable) Products; totaling 4 (17%), quantity 28,890 Kg (3%) with investment value Rp. 998,950,975 (5%)

ABC -VED – XYZ Combination Analysis

Table 4. Results of Combination Analysis ABC -VED – XYZ Raw Materials Come Out

No	SKU	TOTAL	Total Harga	ANALISIS			Kombinasi
				ABC	VED	XYZ	ABC VED-XYZ
1	E001	137.214,64	3.842.009.780,00	A	V	Y	AVY
2	V024	41.599,51	2.845.809.425,83	A	V	X	AVX
3	P006	85.697,42	2.399.527.774,00	A	V	Y	AVY
4	P003	145.784,44	2.259.658.742,50	A	V	X	AVX
6	V017	19.656,45	1.344.691.234,57	A	V	Y	AVY
5	V026	16.201,57	1.108.344.319,90	B	V	Y	BVY
7	T001	103.083,20	1.034.471.935,47	B	E	X	BEX
8	H007	28.000,00	980.000.000,00	B	D	Y	BDY
9	B003	18.498,66	739.946.400,00	B	V	Y	BVY
10	K001	343.426,00	652.509.390,50	B	E	X	BEX
11	C001	42.547,27	476.529.368,00	C	E	X	CEX
12	S001	22.244,71	444.094.738,60	C	E	Y	CEY
13	X001	14.290,03	220.066.385,00	C	E	Y	CEY
14	S002	6.078,91	185.406.755,00	C	E	X	CEX
15	C004	48.537,63	124.644.633,84	C	E	Y	CEY
16	A001	3.437,21	110.808.611,47	C	V	X	CVX
17	F001	2.543,95	97.668.271,06	C	V	X	CVX
18	A002	340,85	36.021.044,95	C	V	Y	CY
19	B004	1.215,45	32.087.748,00	C	E	X	CEX
20	D004	626,80	16.547.520,00	C	E	X	CEX
21	S004	493,32	8.879.760,00	C	D	X	CDX
22	D014	295,22	8.555.432,13	C	D	X	CDX
23	S003	101,02	1.515.300,00	C	D	Z	CDZ
Total		1.081.914,21	18.969.794.570,82				

Source: Data processed in 2023

Next, from table 4 an asset graph is created to see the products with the largest asset value, very important, and stable or unstable demand. Figure 4 is the result of the analysis of the ABC-VED – XYZ combination based on the percentage of asset value for each combination group.

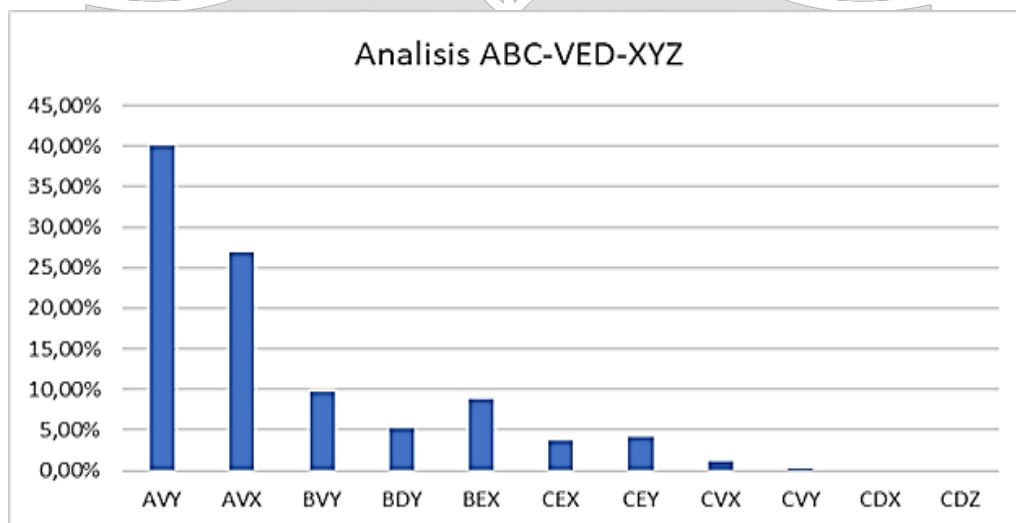


Figure 3. Results of ABC/VED/XYZ Combination Analysis based on % Value

Source: Processed Data (2023)

Figure 3 shows that in the ABC-VED-XYZ combination there are eleven (11) product groups, namely the largest and most important value groups, with easily predictable demand variances of 40% (AVY) and stable 27% (AVX). Two of these eleven groups account for almost 70% or 2/3 of the total raw material assets used for production.

Inventory Management Analysis with the ABC-VED-XYZ Combination

The results of 3 analysis models, researchers carried out a combination analysis of the three (ABC-VED-XYZ). From table 4, the relationship between each model is analyzed with the ABC Model as the center of the relationship. The results are in Figure 3

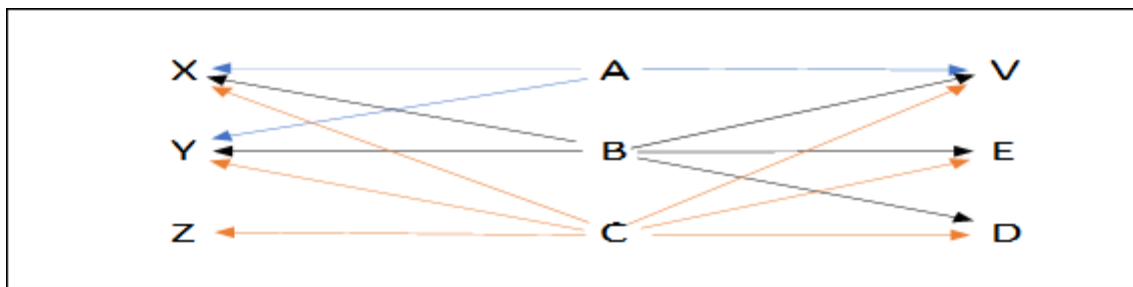


Figure 4. ABC-VED-XYZ Combination Analysis Diagram

Source: Processed Data (2023)

From figure 3 shows:

- Class A, namely a product group with a large asset value, a combination with groups V, X, and Y, namely; main and very important raw material groups (V), stable (X) and predictable (Y) demand variants. Class A consists of the AVY and AVX groups with total assets of 67%
- the medium value product group, a combination with , desired (D) with stable (X) and predictable (Y) demand variants. Class B consists of the BVY, BDX, and BEX groups with total assets of 24%
- Class C, namely the product group with low value, a combination with all XYZ and VED models, there is one CDZ combination result, this type of combination can be read as products with low value, not important, and demand is sudden or sporadic. This product is not important to note in inventory and there is no need to create safety stock. The Class C group is more numerous than groups A and B, consisting of CEX, CEY, CVX, CVY, CDX, and CDZ with an asset value of 9%

CONCLUSION

In accordance with the research objectives, the conclusions of the research results are as follows:

1. ABC classification in the form of asset value for incoming raw materials is A 69%, B 22%, and C 9% with total assets of IDR 20,916,021,547, while raw materials come out or raw materials production in terms of asset value is A 67%, B 24%, and C 9% with total assets of IDR 18,969,794,571, there are the difference or shift in the percentages of A and B in the two groups is because the demand for production (demand) for product A is large



2. XYZ classification shows variability in demand for raw materials as follows: Class X, routine demand contains 12 types of raw materials. Class Y, demand is not routine but predictable, there are 10 types of raw materials. Class Z, sporadic demand for 1 raw material.
3. The VED classification is Class V (Vital) with 10 products, E (Essential) with 9 products, and D (Desirable) with 4 products. Class V is very dominant in terms of asset value and is the main raw material for every production process formula. The availability of this product must always be maintained. Class E is an important product used in the production process, this product must always be available and be a modifier product. Class D is not very important and the asset value is also small, making it a product that is not too important to maintain inventory.
4. Analysis of the ABC-VED-XYZ combination sharpens control of the needs of each raw material to support inventory optimization. The results of the analysis can differentiate raw materials with large and small asset values, routine and sporadic needs, very important and not very important products. One product has 3 criteria in inventory, Example: Product V024 is in the AVX group, meaning the product has a high asset value (A), is very important/critical (V), and is in regular demand (X), this product must be maintained in stock. Product D004 is in the CDZ group, this type of combination can be read as a product with low asset value (C), unimportant (D), and sudden or sporadic demand (Z). This product is not important to note in inventory and there is no need to create safety stock.

SUGGESTIONS

- Research on a combination of three models (ABC, VED, XYZ) was carried out at PTX with a total of 23 types of product items. This combination of analysis models is very suitable for inventories with a larger number of items up to hundreds of items, such as spare parts inventory, large drug stores or pharmacies, supermarkets or wholesale stores, etc. This combination of models can sort products based on asset value, function, demand, and optimal order for all the products or spare parts used in the company.
- Researchers process data manually using the Excel program, which of course takes longer. For implementation in companies, an information system for data processing and analysis can be created first, so that the results obtained are faster and can be immediately followed up by interested parties.

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