

## Optimizing Child Part Inventory Management Using ABC Analysis and Safety Stock Calculation at PT ZYX

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### ABSTRACT

Efficient inventory management is essential for facilitating seamless manufacturing at PT ZYX, especially in managing child part stocks from several vendors. Suboptimal inventory management may result in stock deficits or surpluses, affecting production continuity and operational expenses. This study seeks to evaluate kid part inventory according to its strategic significance and establish safety stock levels for category A goods. The ABC classification approach was utilized to categorize inventory according to significance, and safety stock analysis was performed to determine ideal stock levels for essential items. The findings reveal that among 35 child components, 8 things are classified as category A, 4 items as category B, and 23 items as category C. The maximum safety stock value was identified in child component ID 70025 at 2,891 pieces, whilst the minimum was recorded for ID 70002 at 248 pieces. These findings offer a systematic inventory management strategy that enables the organization to enhance stock control, reduce expenses, and increase operational efficiency. The adoption of ABC categorization and safety stock analysis is anticipated to improve inventory management, facilitating a more efficient supply chain and superior resource allocation.

### Keywords

Inventory Management, ABC Analysis, Safety Stock, Supply Chain Optimization

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### INTRODUCTION

PT ZYX is a corporation involved in the production, processing, and distribution of plastic products. Inventory management at PT ZYX is essential for facilitating efficient manufacturing and satisfying consumer demand. In numerous organizations, inventory is essential as it directly facilitates production and delivery operations [1]. Effective inventory management facilitates the anticipation of supply delays and variations in client demand [2]. Besides raw materials, which are essential for the production process, PT ZYX also necessitates different auxiliary components to produce finished goods for clients. A supporting component is kid parts, which differ in type and are procured from many providers. PT ZYX must adeptly control kid part inventories to avert both surplus and shortages, which could impede manufacturing, due to varying usage levels and supplier discrepancies. The organization must adopt inventory management solutions grounded in inventory control theories to resolve this issue. This research seeks to optimize service levels while reducing expenses. All manufacturing firms necessitate raw material inventory to maintain uninterrupted output in alignment with consumer demand [3].

Numerous research have investigated inventory control techniques to enhance efficiency and cost management. Pratiwi and Saifudin's research demonstrated that ABC analysis enhanced inventory planning and control at Dyriana Bakery. The research categorized inventory into Category A (20% of total items, Rp 3,848,136,214), Category B (26% of all things, Rp 770,801,302), and Category C (54% of total items, Rp 218,811,977) [4]. Fatimah et al. illustrated that the integration of ABC and VEN analysis with Economic Order Quantity (EOQ) computations resulted in monthly cost reductions of Rp 1,207,743 (8.21%) [5]. A further study by Sulfajrin and Lantara employed ABC analysis on spare parts inventory, systematically categorizing spare parts according to their strategic significance, thus enhancing procurement planning [6].

This research builds upon prior studies by implementing ABC Analysis in a plastic product manufacturing firm. The goal is to identify inventory items of strategic significance and improve inventory management efficiency by establishing optimal safety stock levels. The results of this study are anticipated to assist firms in reducing inventory expenses and enhancing operational efficiency.

### **ABC Analysis**

ABC analysis is an inventory categorization technique predicated on capital absorption rates, employing Pareto principles to categorize items into three groups: A, B, and C. [7], [8]. Category A comprises 20% of items yet represents 80% of overall inventory value, necessitating stringent oversight and regulation due to its substantial investment cost. Category B comprises 30% of items, accounting for 15% of the overall value, necessitating moderate oversight. Category C constitutes 50% of items yet accounts for merely 5% of overall value, requiring minimal supervision [9]. The ABC technique improves inventory planning by emphasizing utilization and investment value, hence enabling effective record-keeping and reporting systems [10].

### **Inventory**

Inventory is an essential asset for a firm, directly influencing operational continuity and production efficiency. Effective inventory management guarantees seamless production operations, improving service quality and adaptability to varying client demand. Maintaining adequate inventory levels advantages organizations by minimizing shortages, averting overstocking, and enhancing customer satisfaction [11].

The principal aim of inventory management is to satisfy consumer demand efficiently and precisely, resulting in increased sales and enhanced revenue [12]. Inventory includes raw materials, work-in-progress items, and finished commodities designated for use or shipment within a defined period [13]. It encompasses materials, components, sub-assemblies, work-in-process (WIP), final goods, and maintenance and operations supplies [14].

### **Safety Stock**

Safety stock is a strategic inventory control mechanism designed to mitigate stock shortages during unexpected fluctuations in demand [15]. It serves as a buffer stock to compensate for demand uncertainties, ensuring that customer needs are met without disruption [16]. Additionally, safety stock plays a crucial role in supply chain stability by reducing the risk of stockouts caused by unpredictable lead times. By maintaining extra inventory beyond the reorder point, companies can prevent supply chain disruptions and maintain smooth operations [17].

## METHOD

In this study, the authors analyzed the inventory of child parts from a single supplier using the ABC method and determined safety stock levels for Category A child parts at PT ZYX.

### Data Collection Stage

The data collection process involved two primary techniques:

#### 1. Observation

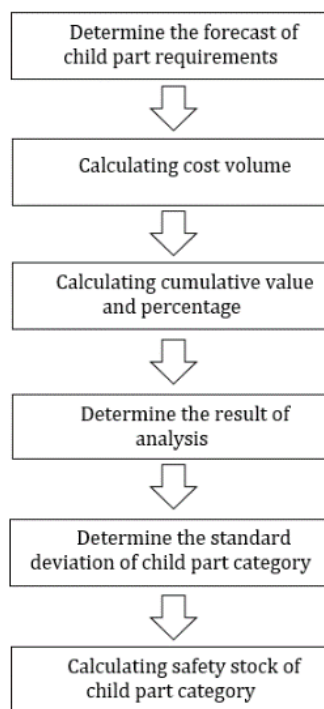
The data collection was conducted through direct observation, where quantitative data were recorded. Quantitative data refer to numerical information that can be measured and analyzed, obtained directly from PT ZYX. The data used in this research include child part requirement forecasts and other relevant inventory data.

#### 2. Literature Study

This stage was conducted to complement the collected data through library research and expert consultations in relevant fields. Literature studies were used to enhance the research framework and validate findings.

### Data Processing Stage

In this data processing stage, there are several steps that are carried out, as shown in [Figure 1](#):



[Figure 1](#). Data Processing Stage

## RESULT AND DISCUSSION

### Child Part Needs Forecast

The analysis was conducted using child part forecast data from a single supplier, based on historical records obtained from the Production Planning and Inventory Control (PPIC) department. The data considered for analysis span a three-month period, specifically October, November, and December. The forecast values were determined by calculating the average demand across these months to establish a more accurate projection of child part requirements, as shown in [Table 1](#).

*Table 1. Child Part Needs Forecast*

No	ID	Forecast		
		October	November	December
1	70001	800	600	800
2	70002	1,850	2,000	2,150
3	70003	7,500	8,000	9,000
4	70004	4,000	4,000	4,500
5	70005	480	1,200	780
6	70006	18,500	20,000	21,500
7	70007	15,000	16,000	18,000
8	70008	15,000	16,000	18,000
9	70009	800	600	800
10	70010	5,900	5,800	6,400
11	70011	2,800	3,200	4,200
12	70012	800	600	800
13	70013	3,000	2,800	4,400
14	70014	1,400	1,600	2,200
15	70015	5,100	5,000	5,000
16	70016	2,214	2,160	2,808
17	70017	6,588	6,426	8,370
18	70018	2,214	2,160	2,808
19	70019	2,214	2,160	2,808
20	70020	4,440	4,260	5,580
21	70021	4,440	4,260	5,580
22	70022	2,214	2,160	2,808
23	70023	486	1,188	756
24	70024	1,350	3,456	2,214
25	70025	2,280	5,760	3,660
26	70026	480	1,200	780
27	70027	486	1,188	756
28	70028	120	120	120
29	70029	1,173	1,530	969
30	70030	1,173	1,530	969
31	70031	1,173	1,530	969
32	70032	1,200	1,560	960
33	70033	1,260	1,680	1,050
34	70034	1,188	1,512	972
35	70035	1,188	1,512	972

### Volume Cost Calculation

The annual demand is calculated by taking the average historical data from the PPIC department (as indicated in [Table 1](#)) and multiplying it by 12 to determine the expected yearly requirement. The resultant figures are subsequently multiplied by the unit price of each component to get the annual volume cost. The approach of use a three-month average for annual forecasting is still applicable, as it relies on prior PPIC data and is endorsed by the PPIC

team. These recommendations suggest that the technique offers an accurate depiction of annual requirements. Presented herein is an illustration of the volume cost computation:

- a. Needs per year of child part with ID 70021

$$Y (\text{unit}) = \bar{X} \times 12 \quad (1)$$

$$Y (\text{unit}) = \left( \frac{4,440 + 4,260 + 5,580}{3} \right) \times 12$$

$$Y (\text{unit}) = 57,120 \text{ pcs}$$

- b. Annual volume of child part with ID 70021

$$V = Y \times P \quad (2)$$

$$V = 57,120 \times 19,000$$

$$V = 1,085,280,000$$

The comprehensive results, derived from the computations, are delineated in [Table 2](#), particularly within the yearly volume portion. The results demonstrate that specific kid components display markedly elevated annual values relative to others. This discrepancy indicates that not all things contribute uniformly to the overall inventory value. Due to this fluctuation, stringent inventory management is required for high-value commodities to maintain controlled and optimum inventory costs. Employing efficient monitoring tactics for these essential components can augment cost efficiency and promote overall inventory performance.

### Calculation of Cumulative Value and Cumulative Percentage

Based on the annual cost volume, the cumulative value and cumulative percentage of each child part are calculated. The cumulative percentage serves as the basis for classifying child parts into ABC categories. The following is an example of cumulative percentage calculations for Child Part ID 70021 and Child Part ID 70020:

- a. Cumulative percentage of a child part ID 70021

$$\text{Cumulative \%} = \frac{\text{Kum } v \text{ per child part}}{\Sigma v} \times 100\% \quad (3)$$

$$\text{Cumulative \%} = \frac{1,085,280,000}{8,528,452,560} \times 100$$

$$\text{Cumulative \%} = 12.73\%$$

- b. Cumulative percentage of a child part ID 70020

$$\text{Cumulative \%} = \frac{\text{Kum } v \text{ per child part}}{\Sigma v} \times 100\%$$

$$\text{Cumulative \%} = \frac{2,027,760,000}{8,528,452,560} \times 100$$

$$\text{Cumulative \%} = 23.78\%$$

## ABC Classification Results

*Table 2. ABC Classification Results*

ID	Requirement per month (Pcs)	Unit Price (Rp)	Annual Volume	Cumulative	Cum %	Class
70021	4,760	19,000	1,085,280,000	1,085,280,000	12.73%	A
70020	4,760	16,500	942,480,000	2,027,760,000	23.78%	A
70017	7,128	10,000	855,360,000	2,883,120,000	33.81%	A
70025	3,900	16,000	748,800,000	3,631,920,000	42.59%	A
70002	2,000	29,660	711,840,000	4,343,760,000	50.93%	A
70018	2,394	18,500	531,468,000	4,875,228,000	57.16%	A
70019	2,394	18,000	517,104,000	5,392,332,000	63.23%	A
70016	2,394	17,200	494,121,600	5,886,453,600	69.02%	A
70022	2,394	15,000	430,920,000	6,317,373,600	74.07%	B
70024	2,340	14,000	393,120,000	6,710,493,600	78.68%	B
70027	810	24,500	238,140,000	6,948,633,600	81.48%	B
70026	820	22,000	216,480,000	7,165,113,600	84.01%	B
...	...	...	...	...	...	...
70001	733	3,440	30,272,000	8,414,036,960	98.66%	C
70004	4,167	572	28,600,000	8,442,636,960	98.99%	C
70008	16,333	130	25,480,000	8,468,116,960	99.29%	C
70013	3,400	520	21,216,000	8,489,332,960	99.54%	C
70014	1,733	800	16,640,000	8,505,972,960	99.74%	C
70028	120	7,200	10,368,000	8,516,340,960	99.86%	C
70012	733	750	6,600,000	8,522,940,960	99.94%	C
70009	733	330	2,904,000	8,525,844,960	99.97%	C
70005	820	265	2,607,600	8,528,452,560	100.00%	C

### Calculation of Standard Deviation of Chil Part Category A

Using historical data from [Table 1](#), the standard deviation of child part usage is calculated to determine variability in demand. [Table 3](#) shown the Standard Deviation for all Child Part IDs. This calculation is crucial for Category A child parts, as they have the highest inventory value and require precise management. The following is an example of a standard deviation calculation for Child Part ID 70021:

$$\text{Standard Deviation} = \sqrt{\frac{\sum(x - \bar{x})^2}{n-1}} \quad (4)$$

$$\text{Standard Deviation} = \sqrt{\frac{(4,440 - 4,760)^2 + (4,260 - 4,760)^2 + (5,580 - 4,760)^2}{3 - 1}}$$

$$\text{Standard Deviation} = 715.82$$

**Table 3.** Standard Deviation of Child Part Category A

ID	Forecast			STDV
	October	November	December	
70021	4,440	4,260	5,580	715.82
70020	4,440	4,260	5,580	715.82
70017	6,588	6,426	8,370	1078.65
70025	2,280	5,760	3,660	1752.37
70002	1,850	2,000	2,150	150.00
70018	2,214	2,160	2,808	359.55
70019	2,214	2,160	2,808	359.55
70016	2,214	2,160	2,808	359.55

### Safety Stock Calculation of Child Part A

The safety stock for each Category A child part is determined by multiplying the standard deviation of demand by the desired service level factor ( $Z_{\alpha} = 95\%$ ). Table 4 shows the Safety Stock Child Part Category A for all Child Part IDs.

The following is an example of safety stock calculation for Child Part ID 70021:

$$\text{Safety Stock} = SD \times Z \quad (5)$$

$$\text{Safety Stock} = 715.82 \times Z (95\%)$$

$$\text{Safety Stock} = 715.82 \times 1.65$$

$$\text{Safety Stock} = 1,181 \text{ pcs}$$

**Table 4.** Safety Stock Child Part Category A

ID	STDV	SS
70021	715.82	1,181
70020	715.82	1,181
70017	1078.65	1,780
70025	1752.37	2,891
70002	150.00	248
70018	359.55	593
70019	359.55	593
70016	359.55	593

According to Table 4, the safety stock values fluctuate based on the standard deviation (SD) of each component. Child Part ID 70025 possesses the highest safety stock at 2,891 units, with a standard deviation of 1,752.37, markedly exceeding that of other components. This signifies increased fluctuation in consumption, necessitating a greater safety stock. In contrast, Child Part ID 70002 possesses a significantly reduced safety supply of 248 units, with a standard deviation of merely 150.00, signifying diminished demand unpredictability. These findings underscore the necessity of adjusting safety stock in response to demand variations to achieve optimal inventory management.

## CONCLUSION

### Conclusions

This study effectively classified 35 kid components into three categories by ABC analysis: Class A (high-priority) includes 8 child parts, Class B contains 4 child parts, and Class C encompasses 23 child parts. The safety stock assessment for Category A child parts revealed that Child Part ID 70025 necessitated the greatest safety stock of 2,891 units, whilst Child Part ID 70002 required the lowest at 248 units, indicating variations in demand volatility. The results indicate that ABC classification, along with safety stock computations, offers an efficient inventory management strategy by allowing firms to prioritize procurement choices and enhance stock levels. Utilizing this approach reduces excessive inventory expenses while maintaining service level dependability. Future study may investigate multi-supplier inventory management strategies, optimization of demand forecasting, and real-time stock monitoring with IoT-based tracking systems to further improve operational efficiency.

### Future Work

Future research can enhance safety stock determination by utilizing Monte Carlo simulation to model demand variability and optimize inventory levels. This method allows for probabilistic analysis, improving stock accuracy and minimizing shortages. Additionally, integrating advanced forecasting techniques could further refine inventory management strategies for manufacturing industries.

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