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Achieving cost efficiency through increased inventory leanness: Evidence from manufacturing industry

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Abstract
Inventory management's fundamental problem starts with maintaining equilibrium among the operating efficiency, cost of investment, and other allied costs with extensive inventories to keep the actual conflicts at the minimum while optimizing the inventory holding levels. But, inventory management practices have not been well exploited in various manufacturing industries yet. In this study, inventory management tools, i.e., ABC and VED analysis, have been applied in the manufacturing industry, considering 146 items as raw material for an assembly. A total of 15 items under 'AV' class have been identified that consume 82.05 % of the total cost, and these items need strict control and frequent ordering. Sigma level of suppliers is also calculated, which comes out to be 2.36, and it must be improved to reduce the overall inventory cost.

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1. Introduction

Inventory is requisite for any manufacturing industry as a service to production and operations management. Inventory is the stock of essential items to meet future demands, including raw materials, tools, finished or semi-finished products and spare parts, etc. (Muller, 2019; Kumar and Kumar, 2018; 2015; Wolniak, 2020). In an industrial system, materials with the right quality & right quantity are prerequisites at the right place and the right time in the most economical way. Effective inventory policies lead to improved competitiveness and organizational performance (Hashmi et al., 2020; Atnafu et al., 2018; Brent and Travis, 2008). The inventory theory is based on determining the optimum policy for purchasing raw materials, spares, etc., to meet future demand and attempts to form an equilibrium between the opposing costs surrounding inventory management issues. The leaner inventory leads to about 60.90% cost-efficient procurement practices (Tasdemir and Hiziroglu, 2019; Chouhan et al., 2017). However, inventory is an idle resource to the industry and must be maintained for its efficient and smooth functioning. The various inventory types include raw materials, finished products, work-in-process (WIP), consumables, service, repair, replacement, spare items, and buffer/safety inventory (Shin et al., 2015). Rajeev (2007) recognized that inventory has a pivotal role in enhancing the industry's competitiveness and probed into the relationship between inventory management performance and SMEs' economic performance. Singh et al. (2008), Balon and Roszak (2020), Tran et al. (2020) proved that the implementation of lean and quality management enhances the firm's performance and considerably affect all the parameters except inventory levels of finished items, lead time, total production cost, customer cost complaints, rework, etc. Dong et al. (2009) and Elmaghraby and Keskinocak (2003 focused on inventory management as a critical research aspect in the dynamic pricing and closed-loop supply chain for sustainable development. Jing-wen and Tie-jun (2009) found some shortcomings with the traditional ABC classification based on only one criterion, i.e., annual usage of items, which is sometimes not necessarily the most important thing. Saedi et al. (2016) proposed a stochastic model to locate the ideal stock approach for a medicinal services office to proactively minimize the impact of medication deficiencies in the vicinity of unverifiable disturbances & interest. Ye and You (2016) proposed a framework to resolve common supply chain issues with the multi-sourcing ability, tentative demand, and stochastic lead time. Baykasoğlu et al. (2016) applied the generally used fuzzy

multi-attribute decision-making approaches and found an association among classes of spare parts acquired by benchmarked methods. Singh and Verma (2018) offered an overview of various inventory management practices and the manufacturing sector issue.

The reduced costs, eradication of non-value-added activities (NVAs), demand forecasting, and process integration are fundamental to modern manufacturing enterprises (Mor et al., 2021, 2019; Chen and Simchi-Levi, 2004). Beemsterboer et al. (2016), Pauls-Worm et al. (2016) considered a general class where the order quantity of the products is permitted to differ where the closed-form expressions are used to determine the optimal order numbers. Approx. 25% of savings were achieved. Weerasinghe and Zhu (2015) worked out on the cost minimization problem for storage capacity constraints and a related infinite-horizon discounted control problem with a regime-switching inventory model. Jaarsveld et al. (2015) conducted case research at a repair shop. Authors revealed how data might be obtained to implement the approach as an automated method for decision support. Kouki et al. (2015) proposed a model to calculate the best (*r, Q*) parameters that reduce the total cost, and it can be applied in automated store ordering systems. Çelebi (2015) carried out a case study and revealed that the proposed inventory management provides substantial cost savings to the enterprise. Execution of lean production principles offers significant efficiency and quality by 23% (Jayanth et al., 2020). Criteria like the reliability of delivery and product quality have increased importance. Suesut and Monghion (2004) suggested that inventory and demand-forecasting can be linked with automation systems, computer networks, and information technology to reduce errors and lead-time and enhance the production system's reliability. Yang and Niu (2009) concluded that stock classification techniques like ABC analysis, VED analysis, and FSN analysis are instrumental in inventory management of spare parts, capital equipment, etc.

This paper discusses the inventory management problem in the manufacturing industry. The investigations like ABC and VED is carried out on 146 items supplied by various suppliers for an assembly. Section 1 of this paper provides the comprehensive background of 'inventory management' detailing its emergence, literature, and need; Section 2 is the research methodology part concerning items taken and their classification. Section 3 starts with the study's scope detailing the problem formulation, objectives of the study, and data collection. Section 4 deals with the results and discussion part, including ABC and VED analysis, sigma level analysis. Finally, Section 5 concludes the findings of the study to compare and contrast the issues & suggestions.

1.1. Inventory: Need, Cost and Measures

Michel Bergerac revealed that 'every management mistake ends up in inventory'. Inventories are required by units irrespective of their size, and no inventory of the essential materials can be very costly for an enterprise. Simultaneously, large inventory can prove equally costly because of the associated capital, cost of storage, cost of uselessness, etc. (Zomerdijk and Vris, 2003). Maintaining an apt inventory level is essential for predictability, the unreliability of supply, price protection, fluctuations in demand, quantity discounts, lowering ordering costs, maintaining efficient product flow, keeping better customer association, ensuring beside scarcity of materials in the market, have optimum utilization of men and machines, and also to decrease the purchasing costs (Barry, 2016; Carmine et al., 2007).

The inventory costs usually fall into three groups, as follows.

i. Inventory carrying costs: It includes the cost of keeping stocks and interest payable on the capital associated with supplies. It varies directly with the size of the stock and the time. The various components of the stock holding cost are:
   - Capital costs associated with inventory can be up to 15-20% of the total investment.
   - Cost of storage space 1-3%.
   - Deterioration, uselessness, damage, and depreciation costs up to 1%.
   - Pilferage for valuable items may be up to 1% of the stock value.
   - Labor costs to receive, quality checks, retrieve, select, pack, ship, record keeping, etc., may vary between 1-2% of the stock value.

ii. Ordering costs: Irrespective of the actual value of items, these costs include salaries of purchasing the product, cost of paperwork, costs of accelerating the inventory, etc.

iii. Stock-out costs: The losses grieved due to the inability to meet demand or delay meeting the demand.

Different measures for inventory control are as follows.

- Stock classification techniques such as ABC, VED classification, etc.
- Selecting appropriate forecasting techniques to predict future demand.
- Using automatic data capture techniques like Barcoding for fast, error-free part number entry and ordering.
- Efficient supplier management promotes shorter lead times and a Just-in-Time Inventory management system (Singh et al., 2018; Reynolds, 1989).
- Standardization and diversity control.

2. Materials & Methods

The classification of stock items is based on the fact that a small number of items often account for most of the demand in actual inventories. A small number of purchased items absorb most of the inventory budget (Vencheh, 2010; Zhou and Fan, 2007).

The term 'ABC Inventory Analysis' was first devised in the early fifties by HF Dickie in an implementation project at General Electric Company. ABC classification is the most popular stock classification technique (Chen et al., 2008; Liiv, 2006; Nig, 2007). It had originated from the Italian economist Vilfredo Pareto's famous Pareto principle. The category usually follows the *80-20 principle*; roughly 80% of the total annual usage comes from 20% of SKUs. The lean production

tools such as the fishbone diagram, Pareto chart, layout optimization, takt time management, value stream mapping, etc., leads to significant improvements and efficiency gains (Nallusamy, 2020, 2017; Lefever et al., 2016). This opinion suggests that the number of items in category 'A' is extensively smaller than the total SKUs. Although exact values vary among various industries, the 80-20 Pareto principle applies to many real-world situations. It categorizes inventory into three different classes, i.e., 'A' items of prime importance and high usage value, 'B' items of secondary importance and medium usage value, 'C' items of least importance, and low usage value. The classical ABC analysis has carped because this depends on a single criterion, i.e., the annual usage. However, other stock-keeping units (SKUs) attributes are also significant (Thinakaran et al., 2019; Chen et al., 2006) (Table 1). The SKU with higher substitutability should get less attention. Other measures include availability, average unit cost, lead time, repairability, substitutability, criticality, scarcity, and obsolescence.

VED stands for vital, essential, and desirable, respectively. This classification type is best appropriate for spare parts, where spares do not follow a predictable demand pattern, such as raw materials. This classification can be done in consultation with the user department for a better understanding of items. A questionnaire was circulated to the departments in the current study, and the items are classified as vital, essential, desirable categories based on the responses. The criticality has been defined based on the non-functionality of an item, as it shuts the process entirely. There is no standby unit as spare, then the item is specified as vital.

Table 1. Classification for ABC Items

'A' Class Items (High consumption value)	**'B' Class Items** (Medium consumption value)	**'C' Class Items** (Low consumption value)
Very strict control is recommended and Ordering strictly as per optimal EOQ only	Moderate control: Deviate from optimal EOQ and safety stock level to reduce operating cost	Strict control is not important and holds quantities large enough to rule out stock-outs
Frequent ordering	Low safety stock	High safety stock
Maximum follow up and expediting	Order once in three months	Bulk ordering, once or twice in a year
Accurate forecasts in material planning	Periodic follow-up	Rough estimates for planning
Have alternate sources of supply	Estimates can be based upon past data and present plans	Can be fully delegated

3. Problem Formulation

The study has been conducted in an Indian manufacturing industry. At present, no scientific methods have been adopted for inventory management in the industry. The industry has a tremendous scope of savings if the modern means of inventory management are applied. More workforce is engaged in stores, and the cases of wrong delivery are more. Also, the rejection and reworked material add significant loss of economy to the industry. This study aims to formulate the ABC and VED measures for selected items in the manufacturing industry and calculate the suppliers' Sigma level. Bill of Materials (BOM) of the material was taken, involving 146 items citing the units of consumption and cost per unit. Some of the data have been omitted from the BOM for privacy purposes. The data is collected to know the number of rejected items of each supplier. Data from different stores is collected to identify stores, their location, and data entry workers.

4. Results & Discussion

After omitting standard items, ABC and VED analysis was conducted on the remaining items. 'A' Class items, i.e., 10% of the total items, consume 82.05% of the total cost. 'B' class items, i.e., 20% of the total items, consume 9.83% of the total cost. The remaining 'C' class items, i.e., 70% of the total items, consume about 8.12% of the total cost.

The results show that 'A' Class items account for above 80% of the stock's total value, and proper control over this class of items can resolve excess monthly inventory problems for the industry to a large extent. For this, the 'A' Class items need frequent ordering (Fig. 1). 'V' class items comprises of 12.3% of the total , numbered as: 3, 6, 7, 8, 16, 30, 47, 70, 76, 81, 91, 93, 107, 142, 143, 144, 145 and 146. 'E' class items includes 12.3% of the total, numbered as: 1, 5, 12, 13, 18, 22, 61, 62, 79, 83, 120, 124, 125, 126, 128, 139, 140 and 141. 'D'

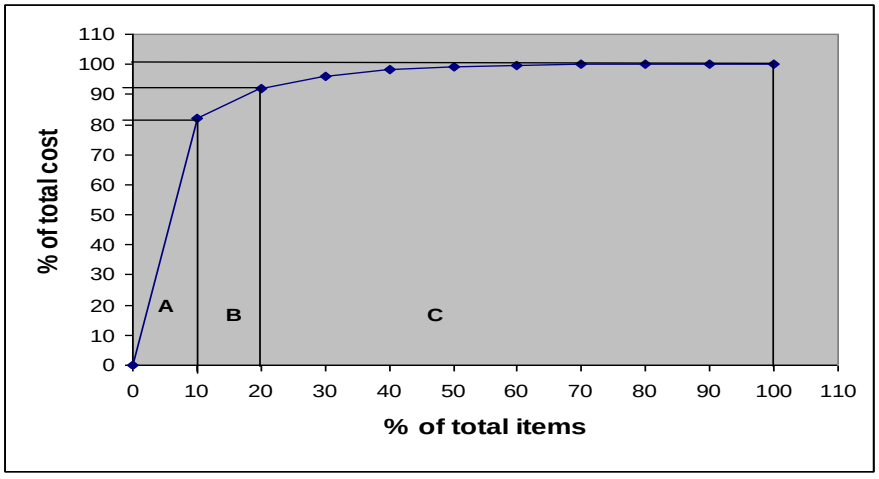

Fig. 1. ABC Analysis

class items covers 75.3% of the total, numbered as: 2, 4, 9, 10, 11, 14, 15, 17, 19, 20, 21, 23, 24, 25, 26, 27, 28, 29, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 43, 44, 45, 46, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 63, 64, 65, 66, 67, 68, 69, 71, 72, 73, 74, 75, 77, 78, 80, 82, 83, 84, 85, 86, 87, 88, 89, 90, 92, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 108, 109, 111, 112, 113, 114, 115, 116, 117, 118, 119, 121, 122, 123, 127, 129, 130, 131, 132, 133, 134, 135, 136, 137 and 138 (refer to Annexure I for details). ABC analysis shows that 10% of items are essential because these consume maximum cost. Some of the 'B' and 'C' class items are also present in the store, which are necessary for smoothe functioning of the allied operations and proper management of these items is needed.

4.1 Sigma level of Suppliers

The Sigma level of suppliers is determined based on the incoming item's suppliers, where the:

- Data is assumed to be normal
- Rejected and reworked items are treated as defectives.

Total numbers of items received from suppliers = 9496211
Total numbers of items rejected = 18459

Defectives per million opportunities (DPMO) = 19438.5
Sigma (σ) level of Suppliers = 2.36

The Sigma level obtained from the study is not up to the standard desired value, and it needs more focus on the suppliers having quality issues. Just-in-Time (JIT) is one such tool that aids in improving the inventory level of supplied items.

There are many methods to systematically analyze the inventory levels, systematic material planning, and decrease costs. ABC analysis is simple and identifies the items having a considerable impact on the industry's total inventory cost. In contrast, combined ABC and VED analysis offers better inventory control. Such research studies provide significant benefits to the industry with almost nil investment. Thus, this study's results reveal that a total of 15 items under 'AV' class have been identified that consume 82.05 % of the total cost, and these items need strict control and frequent ordering.

5. Conclusions

Managing appropriate inventory levels in an organization leads to proper resource & cost management. In this line, the current study is conducted in a manufacturing industry. The study's outcomes reveal that inventory planning helps minimize idle time & wastages, reducing processing costs & defects to improve the product quality and data storage speed. It is observed that the Sigma level of suppliers is much high due to rejection/rework items, and it must be improved to reduce the overall inventory cost. The items must be first classified based on cost, requirement, lead time, etc., and then manage to sustain in the current global business environment. Effective inventory management practices will help the manufacturing industry achieve cost efficiency, manage stock-outs, and achieve corporate goals more efficiently.

This study has some limitations, such as the current analysis is conducted in the context of the Indian manufacturing industry and the structures of the manufacturing sector may vary region-wise. The demand & cost of spare parts may also vary industry-wise. Similar studies may be conducted in other manufacturing industries for inventory and cost analysis. Impact assessment and implementation of advanced inventory management and other lean tools can be studies for future research. Further, other inventory management techniques such as HML, FSN, SDE, etc., may also be tested, followed by a comparative study.

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Annexure – I. ABC and VED Analysis of Items

BOP Details								
Item No.	Price (INR)	Monthly Requirement	Annually Requirement	Total Cost	Cumulative Cost	Percentage Total Cost	ABC Analysis	VED Analysis
1	96.0	25874	310488	29806848	29806848	14.0	A	E
2	369.0	6000	72000	26568000	56374848	26.5	A	D
3	2.8	690014	8280168	22770462	79145310	37.2	A	V
4	58.0	25000	300000	17400000	96545310	45.4	A	D
5	32.4	36978	443736	14377046	110922356	52.2	A	E
6	26.5	41000	492000	13038000	123960356	58.3	A	V
7	29.5	34000	408000	12036000	135996356	64.0	A	V
8	29.0	27000	324000	9396000	145392356	68.4	A	V
9	1.3	457123	5485476	6856845	152249201	71.6	A	D
10	9.0	45753	549036	4941324	157190525	74.0	A	D
11	18.9	19000	228000	4309200	161499725	76.0	A	D
12	22.2	15652	187824	4169693	165669418	78.0	A	E
13	57.0	6000	72000	4104000	169773418	79.9	A	E
14	76.0	2587	31044	2359344	172132762	81.0	A	D
15	13.4	14000	168000	2251200	174383962	82.1	A	D

BOP Details								
Item No.	Price (INR)	Monthly Requirement	Annually Requirement	Total Cost	Cumulative Cost	Percentage Total Cost	ABC Analysis	VED Analysis
16	70.9	2365	28380	2012142	176396104	83.0	B	V
17	113.2	1400	16800	1901760	178297864	83.9	B	D
18	17.3	8491	101892	1757636	180055500	84.7	B	E
19	15.5	8600	103200	1599600	181655100	85.5	B	D
20	15.8	8050	96600	1526280	183181380	86.2	B	D
21	95.0	1250	15000	1425000	184606380	86.9	B	D
22	20.8	5689	68268	1416561	186022941	87.5	B	E
23	25.5	4571	54852	1398726	187421667	88.2	B	D
24	6.1	19000	228000	1390800	188812467	88.8	B	D
25	26.0	4000	48000	1248000	190060467	89.4	B	D
26	17.2	5875	70500	1212600	191273067	90.0	B	D
27	5.8	16000	192000	1104000	192377067	90.5	B	D
28	6.9	12000	144000	993600	193370667	91.0	B	D
29	31.0	2581	30972	960132	194330799	91.4	B	D
30	28.0	2830	33964	950991	195281790	91.9	B	V
31	64.0	1200	14400	921600	196203390	92.3	B	D
32	17.5	3574	42888	750540	196953930	92.7	C	D
33	16.8	3602	43224	724002	197677932	93.0	C	D
34	22.3	2650	31800	709140	198387072	93.3	C	D
35	9.8	5879	70548	687843	199074915	93.7	C	D
36	21.2	2700	32400	686880	199761795	94.0	C	D
37	22.5	2300	27600	621000	200382795	94.3	C	D
38	13.3	3600	43200	572400	200955195	94.6	C	D
39	31.7	1488	17856	566035	201521230	94.8	C	D
40	5.7	8000	96000	542400	202063630	95.1	C	D
41	10.5	4299	51583	541622	202605252	95.3	C	D
42	5.5	8000	96000	528000	203133252	95.6	C	D
43	80.0	500	6000	480000	203613252	95.8	C	D
44	26.1	1500	18000	469800	204083052	96.0	C	D
45	8.6	4500	54000	464400	204547452	96.2	C	D
46	65.5	500	6000	393180	204940632	96.4	C	D
47	11.0	2900	34800	382800	205323432	96.6	C	V
48	60.0	500	6000	360000	205683432	96.8	C	D
49	120.0	250	3000	360000	206043432	96.9	C	D
50	19.4	1485	17820	345708	206389140	97.1	C	D
51	13.0	2200	26400	343200	206732340	97.3	C	D
52	7.6	3400	40800	310080	207042420	97.4	C	D
53	2.0	12000	144000	288000	207330420	97.6	C	D
54	9.6	2500	30000	288000	207618420	97.7	C	D
55	17.4	1250	15003	261052	207879472	97.8	C	D
56	5.9	3600	43200	252720	208132192	97.9	C	D
57	10.6	1800	21600	227880	208360072	98.0	C	D
58	5.8	3250	39000	224250	208584322	98.1	C	D
59	11.4	1587	19044	216149	208800472	98.2	C	D
60	13.3	1350	16200	214650	209015122	98.3	C	D
61	4.2	4300	51600	214140	209229262	98.4	C	E
62	48.7	365	4380	213306	209442568	98.5	C	E
63	8.8	2011	24132	211155	209653723	98.6	C	D
64	0.4	42000	504000	185613	209839336	98.7	C	D
65	6.0	2500	30000	180000	210019336	98.8	C	D
66	5.5	2500	30000	165000	210184336	98.9	C	D
67	1.4	10000	120000	162043	210346379	99.0	C	D
68	25.4	500	6000	152100	210498479	99.0	C	D
69	118.0	100	1200	141600	210640079	99.1	C	D

BOP Details								
Item No.	Price (INR)	Monthly Requirement	Annually Requirement	Total Cost	Cumulative Cost	Percentage Total Cost	ABC Analysis	VED Analysis
70	38.7	257	3084	119351	210759430	99.2	C	V
71	9.5	1000	12000	114000	210873430	99.2	C	D
72	1.9	5000	60000	111600	210985030	99.3	C	D
73	7.4	1200	14400	106560	211091590	99.3	C	D
74	0.4	19000	228000	99659	211191248	99.4	C	D
75	13.8	587	7044	96855	211288103	99.4	C	D
76	0.8	10000	120000	93744	211381847	99.5	C	V
77	11.0	700	8400	92400	211474247	99.5	C	D
78	30.0	254	3048	91440	211565687	99.5	C	D
79	0.5	10500	126000	67964	211633652	99.6	C	E
80	8.2	600	7200	59040	211692692	99.6	C	D
81	1.0	4200	50400	51090	211743782	99.6	C	V
82	41.1	100	1200	49320	211793102	99.7	C	D
83	19.8	200	2400	47520	211840622	99.7	C	D
84	12.1	300	3600	43560	211884182	99.7	C	D
85	4.6	600	7200	32760	211916942	99.7	C	D
86	2.3	1200	14400	32409	211949351	99.7	C	D
87	8.9	300	3600	32040	211981391	99.7	C	D
88	35.0	75	900	31500	212012891	99.8	C	D
89	10.1	254	3048	30785	212043676	99.8	C	D
90	20.5	124	1488	30504	212074180	99.8	C	D
91	0.4	5700	68400	30088	212104268	99.8	C	V
92	16.4	147	1764	28930	212133198	99.8	C	D
93	0.9	2500	30000	27621	212160819	99.8	C	V
94	30.0	75	900	27000	212187819	99.8	C	D
95	1.5	1254	15048	22168	212209986	99.8	C	D
96	35.0	50	600	21000	212230986	99.9	C	D
97	17.0	100	1200	20400	212251386	99.9	C	D
98	1.7	1000	12000	20255	212271642	99.9	C	D
99	5.4	300	3600	19584	212291226	99.9	C	D
100	13.9	100	1200	16680	212307906	99.9	C	D
101	50.0	25	300	15000	212322906	99.9	C	D
102	9.8	125	1500	14700	212337606	99.9	C	D
103	11.0	100	1200	13200	212350806	99.9	C	D
104	1.5	700	8400	12890	212363696	99.9	C	D
105	1.4	698	8376	11311	212375006	99.9	C	D
106	1.0	800	9600	9723	212384729	99.9	C	D
107	30.0	25	300	9000	212393729	99.9	C	V
108	6.9	100	1200	8256	212401985	99.9	C	D
109	1.8	350	4200	7734	212409719	99.9	C	D
110	0.5	1350	16200	7684	212417402	99.9	C	D
111	25.4	25	300	7620	212425022	99.9	C	D
112	5.9	100	1200	7080	212432102	100.0	C	D
113	5.9	100	1200	7044	212439146	100.0	C	D
114	22.9	25	300	6870	212446016	100.0	C	D
115	5.5	100	1200	6600	212452616	100.0	C	D
116	0.5	1000	12000	5892	212458509	100.0	C	D
117	1.4	350	4200	5800	212464309	100.0	C	D
118	1.4	350	4200	5672	212469981	100.0	C	D
119	4.3	100	1200	5196	212475177	100.0	C	D
120	1.4	258	3096	4276	212479452	100.0	C	E
121	13.2	25	300	3960	212483412	100.0	C	D
122	13.1	25	300	3930	212487342	100.0	C	D
123	3.2	100	1200	3852	212491194	100.0	C	D

BOP Details								
Item No.	Price (INR)	Monthly Requirement	Annually Requirement	Total Cost	Cumulative Cost	Percentage Total Cost	ABC Analysis	VED Analysis
124	0.3	1200	14400	3830	212495025	100.0	C	E
125	0.3	1000	12000	3480	212498505	100.0	C	E
126	2.7	100	1200	3241	212501745	100.0	C	E
127	17.0	15	180	3060	212504805	100.0	C	D
128	0.5	500	6000	2946	212507752	100.0	C	E
129	2.5	100	1200	2940	212510692	100.0	C	D
130	1.4	175	2100	2836	212513527	100.0	C	D
131	2.3	100	1200	2796	212516323	100.0	C	D
132	2.1	100	1200	2578	212518901	100.0	C	D
133	1.7	100	1200	2026	212520927	100.0	C	D
134	1.4	100	1200	1620	212522547	100.0	C	D
135	1.2	100	1200	1440	212523987	100.0	C	D
136	1.0	100	1200	1215	212525203	100.0	C	D
137	0.9	100	1200	1105	212526307	100.0	C	D
138	0.8	100	1200	900	212527207	100.0	C	D
139	0.7	100	1200	847	212528055	100.0	C	E
140	0.5	100	1200	651	212528705	100.0	C	E
141	0.5	100	1200	651	212529356	100.0	C	E
142	0.4	100	1200	525	212529880	100.0	C	V
143	0.4	100	1200	491	212530371	100.0	C	V
144	0.4	100	1200	442	212530813	100.0	C	V
145	0.4	100	1200	442	212531255	100.0	C	V
146	0.3	100	1200	405	212531660	100.0	C	V

通过提高库存精益度来实现成本效益：来自制造业的证据

關鍵詞
库存管理 ABC，VED 分析
制造业 精益生产

摘要
库存管理的基本问题始于在拥有充足库存的情况下保持运营效率，投资成本和其他相关成本之间的平衡，以在将实际冲突最小化的同时优化库存量。但是，库存管理实践尚未在各种制造业中得到很好的利用。在这项研究中，库存管理工具（即 ABC 和 VED 分析）已用于制造业，其中考虑了 146 种物料作为装配的原材料。总共确定了 15 项“ AV”类物品，占总成本的 82.05%，这些物品需要严格控制和频繁订购。还计算了供应商的西格玛水平，得出的是 2.36，必须对其进行改进以降低总体库存成本。