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Selective Inventory Control Using ABC And FSN Analysis in Retail Sector: A Case Study

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Abstract: ***Inventory is the most important assets of any Enterprises whether it is micro, small or medium. The efficient use of selective inventory control model will result high flexibility and control over surplus and deadstock inventory. The aim of this study is to identify various factors that affect the enterprises performance in urban region. The study is conducted in A2Z Pharmacy store in an urban region. Data that has been collected is of primary type and has been collected from the database of the pharmacy store. ABC and FSN analysis methods are used on 190 types of medicine. ABC-FSN matrix is prepared using ABC and FSN combined analysis. On the basis of combined analysis and priority matrix there are three sub-categories in which some sub-category element has to be eliminated by anyhow and some sub-category element has to be maintained with minimum stocks (i.e. safety stock) and some sub-category elements has to be maximised or maintained.***
Keywords: Inventory management, Selective control model, Pharmacy, Retail sector, ABC analysis, FSN analysis, ABS - FSN matrix, Urban region.

I. INTRODUCTION

The term ‘inventory’ originates from the French word ‘Inventaire’ and Latin word ‘Inventariom’ which implies a list of things found. The term ‘Inventory’ can be defined as, “The term inventory includes material like- raw, in process, finished packaging, spares and others; stocked in order to meet an unexpected demand or distribution in future (R. Hukum, 2019).

The inventory is the assets of any company or enterprises. The effective use of inventory may lead to high customer satisfaction and to meet demand. The proper management of these inventory is most considerable variable of the enterprise.

The main objective of inventory control is to strike balance between out of stock and overstock. Due to out of stock there are financial loss and non-financial loss. Out of stock of inventory may lead to production breakdown due to unavailability of raw material, increased fixed cost due to non-using of human resources, which directly or indirectly causes financial losses. Out of stock can also lead to non-financial losses such as reputation loss, not meeting customer’s expectations or demand which causes customer loss. Due to overstock carrying cost increases, shortage of space for other items causes cash flow breakdown, cost of expired product which directly or indirectly causes financial losses.

The most important output of inventory management is to satisfy customer’s expectation of product availability with the amount of each items that will optimise the enterprise net costs. Inventory management is a crucial process that any business must undertake with paramount care. The common mistakes that any enterprise do is evaluation of entire inventory at the same level (Girija & Bhat, 2013).

Therefore, enterprise must follow some technique so as to categorise each inventory at distinct level. There are various techniques which categorise inventory according to different criteria. This study focusses on 3D selective inventory control model. This study deals with the inventory analysis of a medical store ‘A2Z PHARMACY’. The medical store is situated in an urban city of Sitamarhi district in Bihar.

II. RESEARCH OBJECTIVE

The objective of this research is: -

1) To identify the key factors which affects the inventory management in medical store.
2) To classify inventory into ABC and FSN categories.
3) To analyse the inventory with selective inventory control technique, ABC and FSN analysis.
4) To carry out combined analysis using ABC - FSN matrix and to find improved technique for improved inventory management in medical stores.

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III. LITERATURE REVIEW

(Thomas & Sanjeevy, 2014) had implemented an improved inventory management and control system in a chemical processing industry. The research work is concentrated on the inventory management problem of a chlor-alkali industry. ABC and VED analysis have been done and their combination along with lead time, reorder level and reorder quantity used to analyse problem. The research work is done keeping the main objective to select appropriate inventory control tool and to use three-dimensional multi-unit selective inventory control (MUSIC-3D) approach and suggested optimum reorder level and reorder quantity using simulation and concluded that after 3D analysis, that high consumption value item whether critical or non-critical 16% of item with annual consumption value of 87% and remaining 84% item accounts for annual consumption value of 13% only. For low consumption value item cost reduction technique are not used as cost of cost reduction method is more that the cost of item itself. Result of simulation model is that for selected value of reorder level and reorder quantity, the programme iteratively calculated the total cost for various demand and lead time to give total cost. Recommended that class A item should be tightly controlled to reduce total cost, class B item should be moderately stocked and liberal policy should be adopted for class C item. Vital spares should be in stock to avoid production breakdown.

(Sengottuvelu, 2021) worked on application of selective inventory control model that is ABC, FSN and SDE and MUSIC-3D analysis in warehouse of traded parts. MUSIC-3D approach is used by combining all three ABC, FSN and SDE analysis. The study was conducted in an auto connection system company of Kerala, India. Total 720 traded parts were considered for study. Primary data were collected from companies' ERP-SAP system. ABC, FSN and SDE analysis have been done individually and then MUSIC-3D approach is applied on data. The result shows that class A item is 18% by quantity and 80% by annual usage value, class B item is 24% by quantity consumes 15% of total annual usage value, and class C item which occupy 58% of total quantity consumes only 5% of total annual usage value. Also, fast moving item which is 82% by volume covers 80% of total annual usage value, slow moving item which is 8% by volume covers only 3.74% of annual usage value, and non-moving item is 10% by volume covers only 0.16% of total annual usage value. Similarly scars item is 1% by volume covers 1% of annual usage value, deficient item is 33% by volume covers 35% of annual usage value, and essential item is 66% by volume covers 64% of annual usage value. Result of MUSIC-3D analysis shows that category of item like ANS, ANE, AND, ASS, BNS, BND, BNE and BSS are zero (0). Category of item like AFD, AFE, BFD, BFE, CND, CNE, CSE, CFD and CFE a greater number of items are reported. The research paper suggests the warehouse manager to give high priority to ANS item, moderate priority to BSD item, and less priority to CFE item.

(Kant & Kapoor, 2015) approximately 35% of total annual budget of hospital is spent on buying materials and supplies including medicines. In this research paper selective inventory control techniques are used for the drugs used in intensive care unit (ICU) of a tertiary care hospital. ABC and VED analysis and combination of ABC-VED matrix analysis is carried out. In this analysis total 30 medicines are analysed out of which 13 (43.33%) medicines were classified in category 1 (AV, AE, AD, BV, CV) for strict control. The conclusion of research work is that the scientific inventory control management has to be applied for efficient management of medical stores.

(Devnani et al., 2015) has analysed the pharmacy store of post graduate institute of medical education and research (PGIMER), Chandigarh, India. ABC and VED analysis and combine ABC-VED matrix analysis is done to identify the category of medical item that is needed stringent management control. Total 421 items were considered for research study. Analysis of ABC- VED matrix shows that category I, II and III acquires 22.09%, 54.63% and 23.28% of total items respectively, accounts for 74.21%, 22.23% and 3.56% of ADE of the pharmacy. Paper concluded that ABC and VED techniques need to be adopted as routine practice for optimal use of resources and elimination out-of-stock situation in hospital pharmacy.

(Palanisamy & Ranganathan, 2017) research work Is done to identify the problems in the existing supply chain of private hospital pharmacy. Qualitative and quantitative analysis is done through SPSS, and normal distribution and correlation analysis is don on the sample data. Correlation analysis shows that variable collected through questionnaire is normally distributed. ABC-FSN matrix analysis is also done which concluded that implementation of prioritised ABC-FSN matrix in pharmacy will help to provide highly efficient services to customer.

(Se & Udy, 2008) has investigated the reason behind inventory management inefficiency in HEM-SOL. The study has been done at a company involved in gym sports equipment wholesale. This is qualitative single case study using primary and secondary data about 20 items using a purposive sampling approach. It concluded that small business has limited resources and bargaining power. Big demand fluctuation, long distance suppliers and lack of selective inventory control techniques leads to HEM-SOL bad performance on inventory management.

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(Girija & Bhat, 2013) has applied three-dimensional multi-unit selective control technique in a hospital pharmacy. ABC, VED and SDE analysis is done at two multispeciality hospital in Hyderabad. Data used is collected through informal interviews and from hospital record room. Further MUSIC 3D techniques are applied. The conclusions are that conventional ABC analysis is not an effective selective inventory control technique, as there are other influencing factors like criticality and availability which influences greatly on material control. Thus MUSIC-3D approach is helpful in classifying all item into eight category and for material controls on all aspects and achieve cost reduction and in order to facilitate the material department the centre of profit.

(Akcesme, 2014) presents analysis and comparison of multiple approaches as they relate to navy's weapon support system (WSS) command's large national item identifiers number (NIIN) inventory. Of all explored ABC analysis method, the multi-criteria weighted non-linear optimisation technique is best option for WSS's NIIN prioritisation goal.

(Riadi et al., 2020) is a case study of a company involved in oil and gas exploration that experience a situation of deadstock and surplus material for maintenance, repaired and operation occurred in the company. Study is conducted on deadstock and surplus data from material maintenance, repair and operation for the period of 2017 – 2019. ABC and FSN analysis followed by ABC-FSN matrix analysis is done. Forecasting is also done after which it concluded that forecasting related to maintain ace, repaired and operational material by referring request pattern data can be done in details using the Croston, Syntetos-Boylan approximation (SBA) method and single smoothing.

(Devarajan & Jayamohan, 2016) In this research work, the combined analysis of FSN and XYZ is done. The study is conducted in a chemical firm, which has no specific inventory material management techniques due to which stock accumulation occurs. It concludes that combined analysis of FSN and XYZ helped in identifying the spares should be salvaged. The two-dimensional classification results in the identification if NX category item and are decided to disposal, of the N item by selling them off.

(Sharda & Gorana, 2016) presents an approach for cost reduction techniques by using MUSIC technique for stock control management of spare parts. It includes FSN, VED and ABC analysis followed by implementing MUSIC-2D and MUSIC-3D. the conclusions are that the ABC-FSN analysis reveals that with MUSIC, vital among category A, consumption and annual consumption cost is drastically reduced.

(Keerthana & Rao, 2018) has set-up a bench mark or minimum safety stock for the in-house pharmacy of a 139 bedded multispeciality hospital. Analysis have been done using ABC, FSN and material requirement planning (MRP) for the past six-month data (march 2018 – august 2018) from the record of the in-house pharmacy. The conclusion is that regular review of past six-month data will help to lead order set change in the hospitals computerised order entry system for frequently intervened drug. The minimum safety stock level is given as 'ALET LEVEL' and 'ALERT CODS' for the enhancement and betterment using track care software.

(Ghewari, 2020) has studied the inventory control system of wheel manufacturing industry using ABC and FSN analysis. It finds that there is a relation between annual demand and total cost of material and FSN techniques significantly reduces the unnecessary movement while issuing material if they are arranged accordingly.

(Soto et al., 2020) has used data mining technique called Logical analysis of data (LAD), which is based on Boolean theory used for pattern recognition. LAD model is used to support AB classification based on multiple criteria. Two applications for two different datasets are presented. The average accuracy prediction is 96% for 20 observation at training set. That means phenomena characterisation generated by LAD is efficient and effective for new item classification and have good consistency in pattern generation. Also recommended that for faultless data classification no lot of information is needed for good prediction accuracy.

(Pandya & Thakkar, 2016) is a reviewed paper on inventory management control techniques of various article in different field of application. Concluded that ABC analysis provides means for identifying the items that have largest impacts on organisations overall inventory cost. XYZ analysis is preferred for high demand fluctuation and for very high consumption of item.

(Plinta, 2012) describes methodology for inventory analysis and reduction. ABC and XYZ analysis have been done followed by statistical inventory analysis. Adopted actions to improve inventory level and inventory control system.

(Kumar & Anas, 2013) is a qualitative single case study of Scooters India Limited. ABC analysis is used for multiple products of Scooters India Limited which shows that company follows ABC analysis for multiple- products and observed that there is no relation between annual demand and total cost of the products. It concluded, there is a problem in procurements and handlings go the raw material used for finished products and develops an approach (Stock level review, Cycle counting, identify items for potential consignments) to adopt which will results more efficient utilisation of financial resources.

(Khobragade et al., 2018) eliminates paper work, human faults, manual delay and speeds up process. Focuses on management system as a window developed application for window operating system, in the area of inventory control and generates the various required reports.

Presents the awareness about the information section in the bill which in the view of desktop application. It's a straight forward desktop application in which the network to the immediate distributor centre with goal that information ought to be refreshed in store for the confirmation. Concluded that as a secure application in which no information spillage from the stock room.

IV. DATA COLLECTION

The data used in this research work is primary as well as secondary. The primary data is collected through the questionnaire from the medical store manager and relevant staffs.

The secondary data is collected from the database of the medical store. The medical store is situated in an urban city of Sitamarhi, Bihar, India. The population of the city is around 2,00,000 (2 lakhs). The medical store is divided in whole sale and retail counter. Each counter has separate manager.

V. RESEARCH METHODOLOGY

In this research study selective inventory control techniques are used for better improvement of inventory management of a medical store named 'A2Z PHARMACY' in an urban city of Sitamarhi, Bihar, India. ABC (Always better control) and FSN (fast moving, slow moving, non-moving) analysis are carried out using primary data collected from the database of medical store. In this research study total 190 types of medicine are analysed for the time of 90 days from January 2022 to March 2022. ABC analysis is done on the basis of annual consumption value, which is based on Pareto's law of 80/20 rule (Engineering, n.d.), which describes as in class A, 10% of the inventory accounts for 70% of annual consumption value, in class B, 20% of the inventory accounts for 20% of annual consumption value, in class C, 70% of the inventory accounts for only 10% of annual consumption value. FSN (fast moving, slow moving, non-moving) analysis is done on the basis of consumption rate, which is calculated by dividing total consumed quantity by total number of days. The inventory which have been consumed at the rate greater than 4 item per day is considered as fast moving item, the inventory which have been consumed at the rate greater than 1 item per day but smaller than 4 item per day is considered as slow moving item and the inventory which have been consumed at the rate smaller than 1 item per day is considered as non-moving item. Further combined analysis of ABC and FSN by plotting ABC-FSN matrix is done.

VI. RESULT AND ANALYSIS

A. ABC Analysis

The output of ABC analysis is shown in the Table 1.

TABLE 1: ABC analysis of medicines

CLASS	Consumption value (Rs.)	No. of item	% of item	Usage value (Rs.)	% usage value
A	Above: 19660	54	28.42	2883394	70.05
B	9500 - 19660	58	30.52	82475.7	20.03
C	Below: 9500	78	41.05	408003.5	9.91

The ABC analysis is done on the basis of consumption value for the 90 days. The consumption value is calculated by multiplying total used quantity with cost of item. The percentage consumption usage value is calculated followed by calculating percentage cumulative consumption usage value. The above table depicts that the class A item which is 54 out of 190 as 28.42% by volume accounts for 70.05% of total usage value, the class B item which is 58 out of 190 as 30.52% by volume accounts for 20.03% of total usage value, and the class C item which is 78 out of 190 as 41.05% by volume accounts for 9.91% of total usage value. The pie chart of ABC inventory analysis is plotted in Figure 1.

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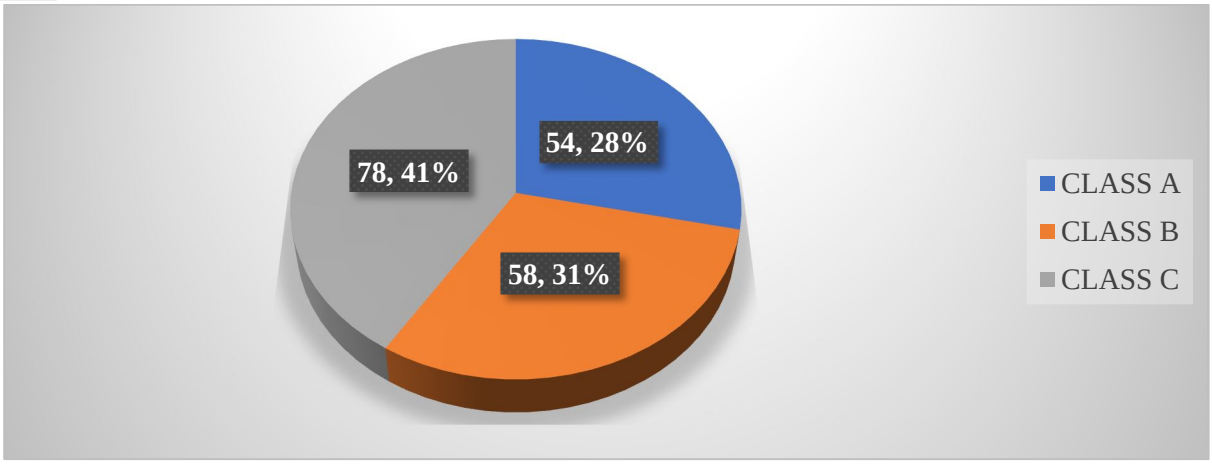


FIGURE 1: ABC analysis Pie chart

B. FSN Analysis

The outputs of FSN analysis is shown in Table 2.

TABLE 2: FSN analysis of medicines

CLASS	Consumption rate (Qty/day)	No. of item	% of item	Usage value (Rs.)	% usage value
F	Above: 4	22	11.58	1584075	38.49
S	1-4	130	68.42	2253583	54.74
N	Below: 1	38	20	278491	6.77

The FSN analysis is done on the basis of consumption rate. The consumption rate is calculated for 90 days. The inventory having consumption rate greater than 4 item per day is considered as Fast moving inventory, the inventory having consumption rate greater than 1 item per day but smaller than 4 item per day is considered as slow moving inventory, and the inventory having consumption rate smaller than 1 item per day is considered as non-moving inventory. The above table depicts that out of 190 sample only 22 as 11.58% of total inventory is fast moving inventory and covers 38.49% of total usage value. 130 out of 190 sample as 68.42% of total inventory is slow moving and covers 54.74% of total usage value, and 38 out of 190 sample as 20% of total inventory is non-moving and covers only 6.77% of usage value. The pie chart of FSN analysis is plotted in figure 2.

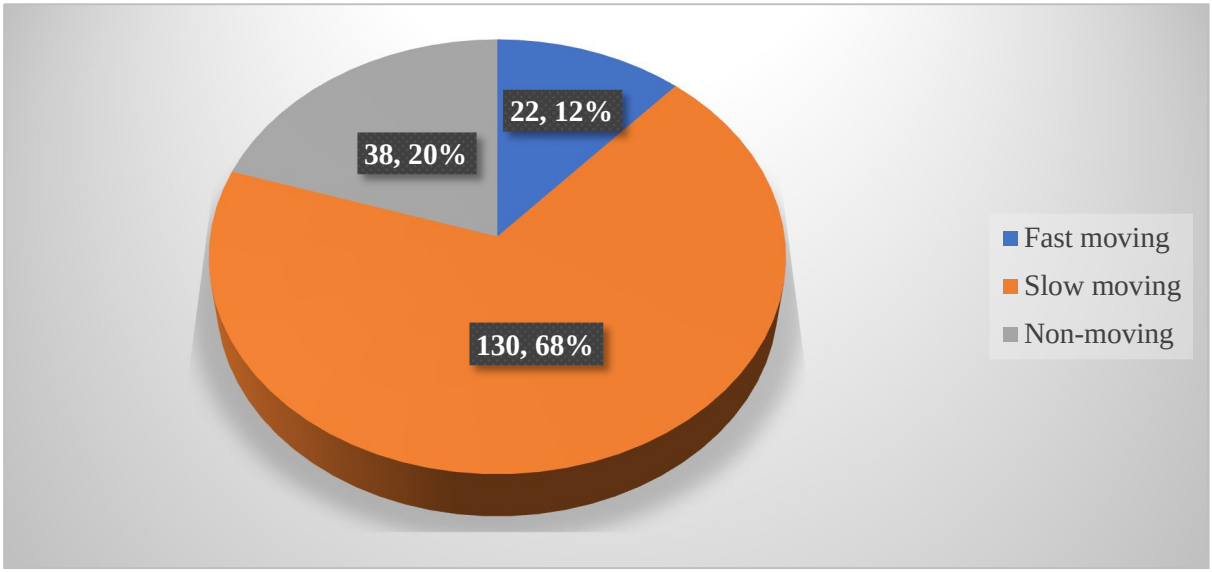


FIGURE 2: FSN analysis Pie chart

C. ABC-FSN (Combined) Matrix Analysis

The combined analysis of ABC and FSN is done using three-dimensional selective inventory control model. The ABC – FSN matrix is tabulated in Table 3.

TABLE 3: ABC-FSN matrix analysis

CLASS	A	B	C	TOTAL
F	15	6	1	22
S	36	45	49	130
N	3	7	28	38
TOTAL	54	58	78	190

Also, a column chart of ABC- FSN matrix analysis is plotted in the figure 3, in which the composition of fast moving, slow moving and non-moving inventory in class A, class B and class C is indicated accordingly in figure 4.

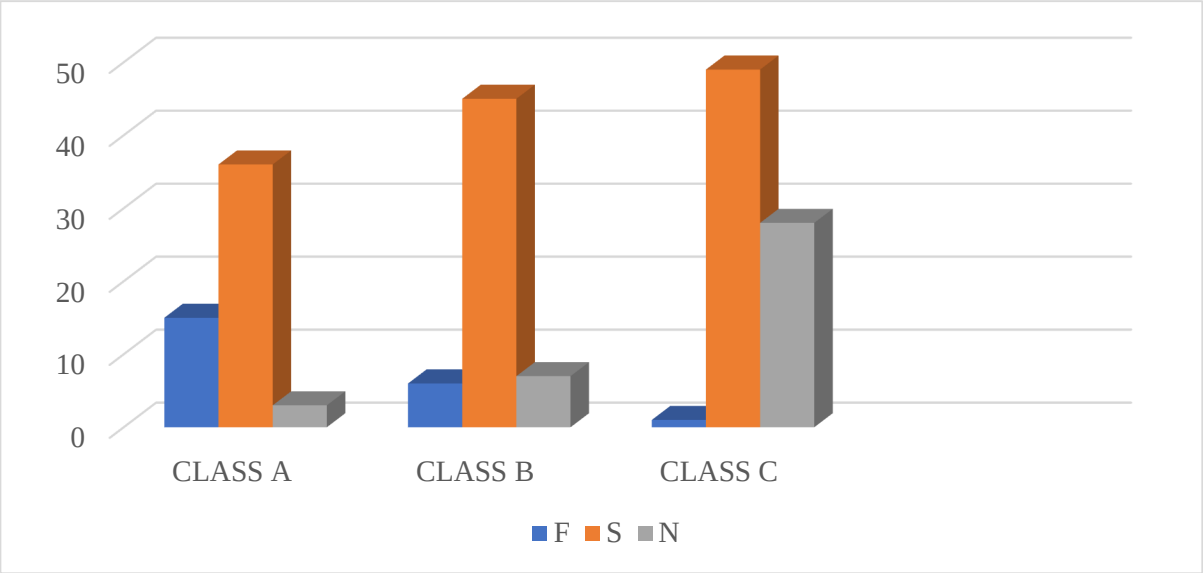


FIGURE 4: ABC-FSN matrix chart

The ABC- FSN matric table shows that there are **3x3=9** elements indicates nine different class as **AF, AS, AN, BF, BS, BN, CF, CS, and CN**. All nine class has its own priorities. So, based on the priorities all nine class are categorised in only three categories say category I, category II, and category III. The three sub-category is formed on basis of priority matrix of ABC and FSN analysis. In the priority matrix, priority is given to various element **as (9,9), (9,5), (9,1), (5,5), (1,5), (5,1), (1,9), (5,9), (1,1)**. The digit **'9'** represents most important category, digit **'5'** represents medium importance category and digit **'1'** represents the least important category. The priority matrix in which every element of ABC- FSN matrix have been given priority that is represented in Table 4.

TABLE 4: priority matrix

Class	A	B	C
F	(9,9)	(9,5)	(9,1)
S	(5,9)	(5,5)	(5,1)
N	(1,9)	(1,5)	(1,1)

Based on the priority matrix, element of ABC-FSN matrix **AF(9,9), AS(5,9), AN(1,9), BF(9,5)** and **CF(9,1)** being the most important inventory are grouped together into **sub-category I, BS(5,5), BN(1,5)** and **CS(5,1)** having medium importance are grouped together into **sub-category II** and only **CN(1,1)** being least important or have no important at all are grouped into **sub-category III**. All three categories are shown in Table 5.

TABLE 5: Sub-category of ABC-FSN matrix element

Sub-Category	No. of item	% of item	Usage value	% usage value
I	61	32.10	2973004	72.22
II	101	53.16	1016043	24.69
III	28	14.73	127101.8	3.09

Also, the pie chart for the **sub-categories I, II** and **III** for the element of ABC-FSN matrix is plotted in figure 5.

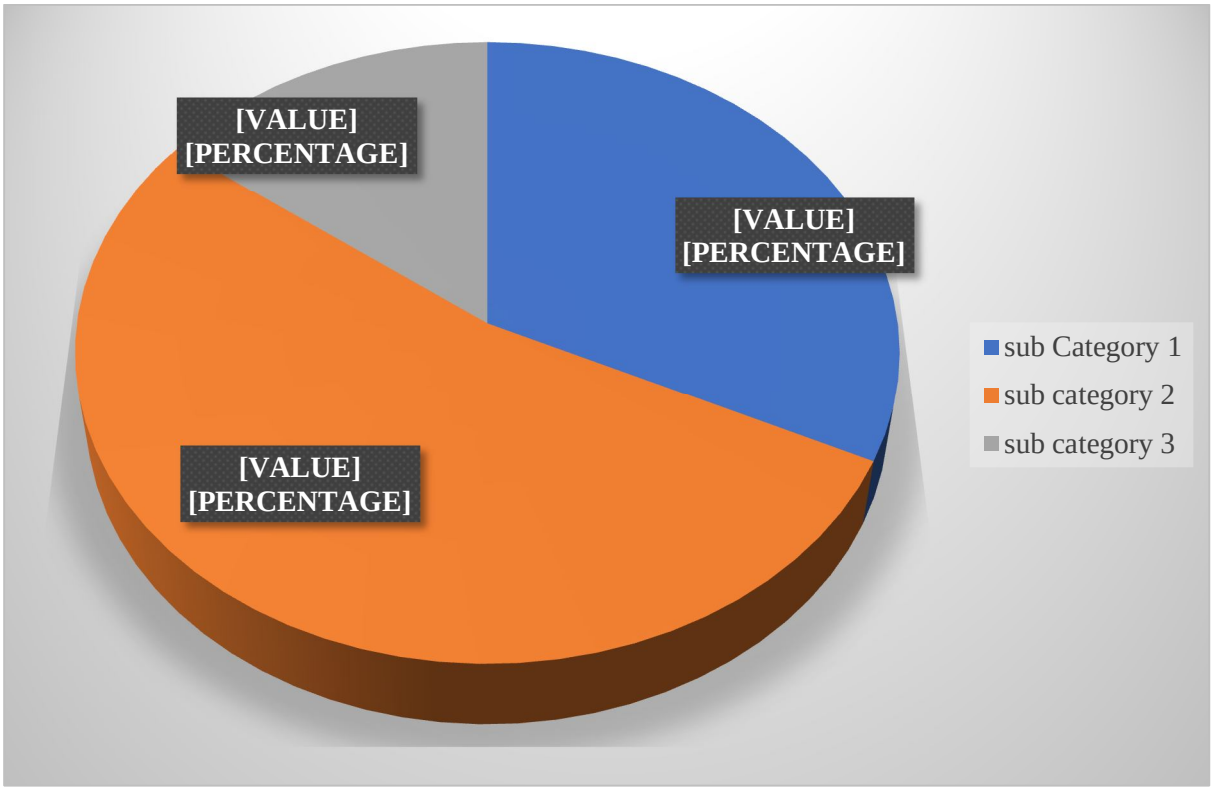


FIGURE 5: Sub-category pie chart

As the table 5 represents the all the inventory according to their importance. All items of the sub category I is having most importance among three sub-categories that is 61 (32.10%) item out of 190 items have occupied 72.22% of total usage. So, this sub-category must have strict control over inventory and superior supervision is required. Sub-category I consist an inventory element AF (9,9) which is extremely important and consists 15(7.89%) of total inventory for which no compromise will be considered. Sub-category II consists 101(53.16%) of total inventory is having medium importance, for which periodic review is required. Sub-category III consists only one matrix element CN (1,1) which is least important among all inventory items for which periodic review is not needed at all, only keep safety stock.

VII. CONCLUSIONS

From the ABC analysis, FSN analysis and the combined ABC-FSN matrix analysis it is depicted that, there are 3x3=9 elements of ABC-FSN matrix (ABC and FSN combined analysis). Among all the inventory element of ABC- FSN matrix irregular pattern of ABC criteria is observed, as fast-moving inventory is following reverse ABC criteria, but slow moving and non-moving inventory follows ABC criteria accordingly.

Class A inventory follows FSN criteria at some extent, but class B and class C inventory do not follow FSN criteria. For the improved and betterment of inventory control system the class A, class B, class C and fast-moving, slow moving and non-moving inventory should be ordered and stocked as to follow ABC and FSN criteria which will further optimise overall inventory cost and ordering cost. Following the recommended criteria holding cost and maintenance cost will reduce.

VIII. RECOMMENDATIONS

From the analysis and results followed by the conclusions it is extremely important that the recommended criteria must be followed by medical store manager so as to optimisation of inventory control system. The criteria to be followed is recommended in the form of recommendation matrix in Table 6.

TABLE 6: Recommendation matrix

ABC-FSN matrix element	SUB-CATEGORY	% by volume	CONTROL	REVIEW	STOCKING REMARKS	PLACE IN STORE
AF	I	7.89	Strict	Superior	Maximize	Counter
AS	I	18.94	Strict	Superior	Maintain	Rack
AN	I	1.57	Strict	Superior	Elimination needed	Back store room
BF	I	3.15	Strict	Superior	Maintain	Rack
CF	I	0.52	Strict	Superior	Keep safety stock only	Counter
BS	II	23.68	Moderate	Periodic	moderate	Rack
BN	II	3.68	Moderate	Periodic	Keep safety stock only	Back store room
CS	II	25.78	Moderate	Periodic	Minimize up to safety stock	Rack
CN	III	14.73	Less	Not needed	Minimize	Back store room

IX. FUTURE SCOPES

1) The data collected is of the duration of covid-19 pandemic (i.e. January 2022 to March2022). During pandemic situation medical store were to be opened for limited time about four to six hours a day. Therefore, this data can also be used for sales forecasting in future pandemic situation.

2) In addition to this research paper analysis HML analysis can also be done followed by combined analysis of ABC-FSN-HML using three-dimensional multi-unit selective inventory control techniques, which can be beneficial for inventory budget optimisation.

X. LIMITATIONS

1) The collected data has no procurement date, due to which average stay days (average inventory holding days) cannot be calculated. Therefore, FSN analysis is done on the basis of consumption rate only.

2) Opening stock is not provided, due to which it is difficult to determine inventory turnover ratio.

3) The analysis is only done for three months (90 days). Therefore, results and conclusion can be improved more better way.

4) As the data is analysed during covid-19 pandemic, it is optimised for similar situation. For normal situation there may be some fluctuation on results, conclusions and recommendations.

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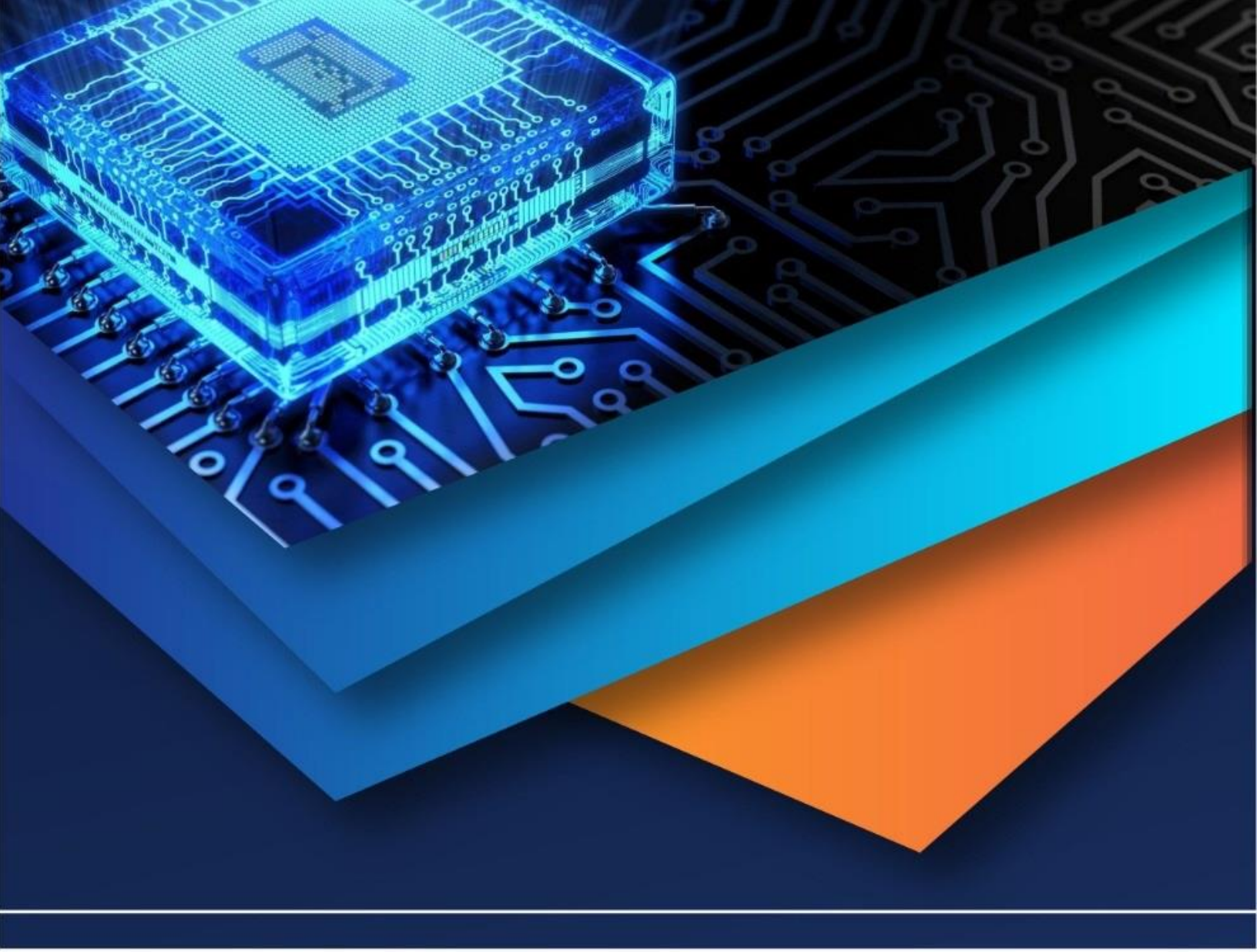
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