

Development of Inventory Control Application for Pharmaceutical Product Using ABC-VED Cycle Counting Method to Increase Inventory Record Accuracy

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Abstract— A good inventory control system is needed in the organization to reduce costs and stay competitive. One of the inventory control strategy is stock-taking. This research aims to develop a new stock-taking policy for a pharmaceutical company using ABC-VED Cycle Counting. Proposed stock-taking policy using cycle counting result in counting 35 SKUs in group I, 21 SKUs in group II and 3 SKUs in group 3 daily. Previously, all items count only once a year. With the new policy, all items count more frequently. The first group is count 12 times a year, the second group is 6 times a year and the third group is 1.2 times a year. An inventory control application is also developed as a tool to keep track of inventory, record transaction, generate cycle counting schedule and perform the cycle counting. By using stocktaking policy of cycle counting which poured in the inventory control application, it is expected that the inventory record accuracy in the pharmaceutical company may be improved.

Keywords—*ABC-VED classification; cycle counting; inventory control; inventory control application; stock-take policy*

I. INTRODUCTION

Inventory control is one of the key management areas in organizations. This is because of the internal roles inventory control plays in the organizations such as facilitation of continuous production, smoothening of operations and enhancement of customer service [1].

There are many different inventory control strategies include stock-taking. Stock-taking is the physical verification of the quantities and condition of items held in an inventory or warehouse [2].

This research presents a case study of stock-taking in a pharmaceutical company. After several years running, this pharmaceutical company faced some difficulties caused by inaccuracy of the record. After the complete count for all SKUs is performed, it is obtained that the accuracy of overall record accuracy is 74.01%. According to the manager, the inaccuracy items causes some difficulties including difficulty in making decisions about the drugs order quantity and its time period to order.

Currently, the company try to improve accuracy by doing stock-takings using periodic physical inventory counting. This activity held once or twice a year and can last in 2 days. Pharmacy is temporarily shut-down because all places and employees are used for this activity. Also, While the pharmacy is being shut-down, it undergoes the profit loss due to the lost sales.

As for todays, most companies implement a cycle counting as the stock-taking policy to mitigate the inaccuracy of inventory records by physically counting and verifying the correctness of quantity data on a regular basis [3]. Thus, in this research, cycle counting policy will be formulated. The cycle counting is based on ABC-VED classification since in healthcare industry, considering only ABC classification which based on monetary value and rate consumption of item is not enough. Another parameter that concern with drug criticality must be considered [5]. So, it does not neglect the presence of some item with low monetary value and consumption rate that is considered vital.

This policy each year must be different depending on the item condition each year. Thus, the policy should be made annually. To do so, the inventory control application is going to be developed. The application could record both sales and purchase order transaction. It also has a database that provides information about item quantity, criticality and cost. So, the application provides updated information including inventory quantity, annual sales, item criticality that could be used to formulate a cycle counting policy. The application also designed to perform the whole cycle counting activity once the policy developed.

Some other factors to develop inventory control application is that the application is adopted for most of organizations because it is timeliness, accurate, reliable, consistent, faster, efficient and easy to use. [4]. Also, it has significant positive influence on records accuracy and procurement performance [5].

II. LITERATURE REVIEW

A. Inventory Control

Inventory is the stock of materials stored for use to facilitate production activities or quality goods, in-process goods, and finished goods [6]. In pharmacy operations, inventory is referred to the stock of pharmaceutical products retained to meet future demand. Inventory represents the largest current asset, as well as liquid asset in pharmacy practice and its value continues to rise because of the growth in variety and cost of pharmaceutical products [7]. Thus, it can be stated that inventory is one of the most expensive assets in a company, representing as much as 50% of total invested capital [8].

Inventory control is one of the key management areas in organizations. This is because of the internal roles inventory control plays in the organizations such as facilitation of continuous production, smoothening of operations and enhancement of customer service [1]. Managers are in critical need for reliable and effective inventory control system in order to reduce costs and remain competitive [9].

B. Inventory Control System

Most organizations can reduce their inventories without increasing other costs by using more efficient inventory control system. Many organizations rely on manual inventory system, but it has drawback such as time consumption, communication, difficult stock counting, difficulty in keeping track of daily inventory movements and inconsistency in ordering of materials [10]. However, advances in information technology have drastically changed the possibilities to apply efficient inventory control techniques. The recent progress in research has resulted in new and more general methods that can reduce the supply chain costs substantially [11].

Computerized inventory control system is adopted for most of organizations because it is timeliness, accurate, reliable, consistent, faster, efficient and easy to use. [4]. The system removes redundancy/duplication and irrelevance and can easily be tailored for multi-user environment with minor modifications. The system in addition is associated with enhanced efficiency, accuracy, user friendliness and conciseness [4]. Also, it has significant positive influence on records accuracy and procurement performance.

C. ABC Analysis

ABC Analysis is a concept to classify items based on their relative importance. This concept divides on-hand inventory into three classifications on the basis of cumulative value. ABC analysis is an inventory application of what is known as Pareto principle that states there are a "critical few and trivial many." The idea is to establish inventory policies that focus resources on the few critical inventory parts and not to the many trivial ones [8].

Class A items are first 5-15% of inventory items that represent 70-80% of the cumulative value (cost). Class B items are those inventory items of medium cumulative value represent about 30% of the total inventory items and 15% of the total value. Those with low annual dollar volume are Class C, which may represent only 5-15% of the cumulative value but about 50-60% of the total inventory items [8].

D. VED Analysis

VED analysis is items classification based on their criticality. The analysis classifies the items into three groups namely Vital, Essential and Desirable. Drugs which categorize in vital class are those which critical for life and patient care. Drugs classified in essential class are those critical, but some alternatives are acceptable, and drugs included in desirable class are those drugs with low critical value [12].

E. ABC-VED Analysis

This matrix is aims to evolve an inventory control system that can be used for managerial prioritization [13]. Because in healthcare industry, ABC classification is not good enough; drug criticality must be considered in the classification as well [5].

In ABC-VED matrix, each window was labeled by two alphabets. The first one indicating the ABC classification and the second one denoting VED classification. The concept of ABC-VED matrix is to divide the drugs into 9 subclasses: AV, AE, AD, BV, BE, BD, CV, CE, and CD. Later on, the subclasses were divided into 3 groups: I, II, and III. Group I consist of the drugs in subcategories AV, AE, AD, BV, and CV, group II contains the drugs in subgroups, BE, BD, and CE, group III consists of the drugs in subgroup CD [5].

F. Cycle Counting

Cycle counting is a method of performing a continuous counting of stock throughout the year [11]. This method maintains inventory record accuracy by the systematic counting of parts and the finding of discrepancies between records and actual counts and the sources of those discrepancies [14]. Some benefit obtained from using cycle counting are: fewer experienced and knowledgeable people needed to be assigned to the task, able to track and fix error in data recording, the operation doesn't required facility shut-down and there is a systematic improvement in the process that dictate inaccurate records.

The cycle counting policy based on ABC-VED classification is perform the cycle counting 12 times a year (once each month) for group I, 6 times a year (bimonthly) for group II and 1.2 times a year (every 10 months) for group III [5].

III. RESEARCH METHODOLOGY

A. Problem Solving Systematics

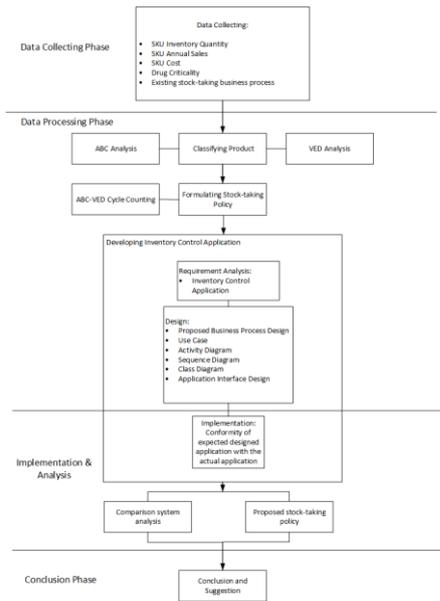


Fig. 1. Problem Solving Systematics

B. Cycle Counting Policy

The first step to develop cycle counting policy is to do ABC Classification. The ABC classification is sorted by annual sales in rupiah which is obtained from multiplying unit cost and annual unit sales.

TABLE I. ABC CLASSIFICATION

ID	Unit Cost	Annual Unit Sales	Annual Sales Rupiah	% of Total Sales	Cum. % of Total Sales	ABC
A0175	Rp115.219	916	Rp105.483.225	2.67%	2.67%	A
B0010	Rp52.145	944	Rp49.224.739	1.25%	3.92%	A
S0035	Rp99.368	472	Rp46.901.911	1.19%	5.11%	A
G0003	Rp3.015	14683	Rp44.267.917	1.12%	6.23%	A
B0129	Rp5.387	6226	Rp33.536.584	0.85%	7.08%	A
E0026	Rp6.600	193	Rp1.273.800	0.03%	80.01%	B
O0250	Rp14.300	89	Rp1.272.700	0.03%	80.04%	B
O100	Rp90.750	14	Rp1.270.500	0.03%	80.07%	B
C0135	Rp125.000	3	Rp374.999	0.01%	95.01%	C
B0001	Rp46.750	8	Rp374.000	0.01%	95.02%	C

The result of ABC classification is as follows.

TABLE II. ABC CLASSIFICATION RESULT

Class	Items	Percentage of Items	Percentage of Total Sales
A	733	22,8%	79,97%
B	818	25,5%	15,02%
C	1662	51,7%	5,00%
Total	3213	100%	100%

The following step is the VED classification. VED classification done by presenting all SKUs in the pharmacy to three clinical experts and let them categorize the drugs based on its the standard of vital, essential and desirable drugs. The final acceptable category for each SKU determined if minimum two experts agree on the same drug classification.

TABLE III. VED CLASSIFICATION RESULT

Class	Items	Percentage of Items	Percentage of Total Sales
V	487	15,2%	20,29%
E	1364	42,5%	54,08%
D	1362	42,4%	25,62%
Total	3213	100%	100%

The result is from 3213 total SKUs, 487 drugs is categorized as vital, 1364 42.5% included in essential category and the 1362 drugs 42.4% categorize as desirable drugs.

The classified items are then combine using ABC-VED matrix. For every items with subcategories AV, AE, AD, BV, and CV fall into group I, items in subgroups, BE, BD, and CE fall into group II and items in subgroup CD is in group III.

The result of ABC-VED matrix and number and percentage of each subclasses are shown below.

TABLE IV. ABC-VED TOTAL NUMBER PERCENTAGE

Classes	V	E	D
A	156 (4.86%)	407 (12.67%)	170 (5.29%)
B	146 (4.54%)	373 (11.61%)	299 (9.31%)
C	185 (5.76%)	584 (18.18%)	893 (27.79%)
Sum	487	1364	1362
Percentage	15.2%	42.5%	42.4%

The total sales percentage for each combination shown in the following table.

TABLE V. ABC-VED TOTAL SALES PERCENTAGE

Classes	V	E	D	Percentage
A	16,91%	45,09%	17,97%	80,0%
B	2,72%	7,06%	5,24%	15,0%
C	0,65%	1,93%	2,415%	5,0%
Percentage	20,3%	54,1%	25,6%	100,0%

Result of ABC-VED matrix for all SKU is shown in Table IV.

TABLE VI. ABC-VED CLASSIFICATION RESULT

Group	Items	Percentage of Items	Percentage of Total Sales
I	1064	33,1%	83,4%
II	1256	39,1%	14,2%
III	893	27,8%	2,4%
Total	3213	100%	100%

Compared to only using ABC classification, the percentage of total sales for group I is more significant than percentage of total sales in group A.

The cycle counting schedule could be formulated after classification. Cycle count schedule for group I, group II and group III should be based on the ratios of 12: 6: 1.2, which means, within a year, drugs in group I category should be counted once in a month, drugs in group II should be counted twice a month and drugs in group III should be counted once in every 10 months [5].

TABLE VII. CYCLE COUNTING POLICY

Group	Items	Frequency	Daily Count
I	1064	12	35
II	1256	6	21
III	893	1.2	3
Total	3213	19.2	63

Based on the result of cycle counting formulation, the number of SKUs that have to be counted daily is as much as 63 SKUs. The cycle counting is done during the operation of the company. In the company, there are three shifts everyday with 24 hours operation. The cycle counting is done in all 3 shifts in a day. Since everyday there are total of 6 different workers that assign with composition of 2 workers for each shift, 63 SKUs that have to be counted is divided equally. Accordingly, each worker is responsible to count 10 SKUs daily.

The daily schedule of cycle counting is already generated by the application. The first 20 items shown in the system is assign to 2 workers at the first shift, the following 20 items is for 2 workers at the second shift and last 20 items is for 2 workers at the third shift.

The schedule is based on similar or closest storage number allows the counter to check the items that is in the same location or ones that is close with one another. Thus, the operator doesn't have to move from one location to another that could save time to conduct the daily cycle counting.

C. Requirement Analysis

After cycle counting policy is formulated, the requirement analysis for the application is identified. In general, the inventory control application consists menu of:

- 1) Dashboard
The dashboard can display metrics to measure organization goal in a glance.
- 2) Cycle Counting
Cycle counting menu should be able to generate schedule for each SKU to be counted for stock-taking based on ABC-VED classification. The classification is done by the system using retrieved data from application database. Application could be platform to conduct whole cycle counting process.
- 3) Supplier Master Data
Supplier master data provide detail supplier information.
- 4) Drug Master Data
Drug master data provide detail information for each SKU include drug criticality, drug cost, drug quantity and other related data about drug information.
- 5) Purchasing management
Purchasing management consist of purchase order transaction recap of drug procurement process from supplier and feature to make purchase order.
- 6) Sales management
Sales management consist list of transaction of sales activity within pharmacy and feature to create the sales order.
- 7) Report
All transaction of purchase order and sales order could be recap in the report.

IV. IMPLEMENTATION & RESULT ANALYSIS

A. Cycle Counting Policy Analysis

Several methods that can be used to formulate the cycle counting policy include ABC classification, VED classification and ABC-VED classification.

Cycle counting policy using only ABC classification is not used in this research since the classification helps control 733 items in A category with accounted for 79.97% of total sales. However, the policy failed to pay high attention to vital items that include in B and C class which is accounted for 146 items (2.72% of total sales) and 185 items (0.65% of total sales) respectively.

Moreover, VED classification alone is also not sufficient. Although the classification covers the focus to control vital and essential items that contribute to 74,37% of total sales, it still ignores 170 items (17,97% of total items) in A class that belong to desirable category.

Therefore, ABC-VED classification as the combination matrix is chosen. This classification focus on group I that consists of 1064 items which contribute to 33,1% of total items. This group contains items that is either critical, high monetary value or both. Overall, group I contribute to 83,4% of total sales. The remaining group result is group II that controls 1256 items that has 14,2% of total sales and group III that consist of 893 items that account for 2,4% of the total sales.

B. Stock-taking Policy Analysis

Currently, the stock-taking activity the pharmacy is using periodic counting. Typically, the periodic counting conducts once a year with number of SKUs to be counted is 3213. Due to large number of SKUs, the pharmacy needs to be shut-down, and 9 workers required in every periodic counting process. Using the new method of cycle counting, the number of SKUs to be counted is only 63 SKUs per day and it will count by 6 workers that is working in the given day.

TABLE VIII. SKU NUMBER COMPARISON

Stock-Take Method	Number of SKU/ Stock-take	Number of SKU/ Stock-take/Person
Periodic	3213	319
Cycle Counting	63	12

Initially, using the periodic counting method, all SKUs is count once in a year. However, using the new method all SKUs is count more frequently. The first group is count 12 times in a year, the second group is count 6 times in a year and the third group is count 1.2 times in a year. By counting items more frequently, it is expected that the inventory record accuracy could be improved as align with the theory that the main purpose of inventory cycle counting includes; identification of causes of errors in order to correct the conditions that cause the errors, to maintain high level of inventory record accuracy and to provide the correct account of inventory [15]. In other words, cycle counting aim to reduce cost and maintain accuracy of goods [16].

TABLE IX. COUNTING FREQUENCY COMPARISON

Stock-take method	Group I	Group II	Group III
Periodic counting (Existing)	1	1	1
Cycle counting (Proposed)	12	6	1.2

C. Implementation

1) Cycle Counting

In the cycle counting menu, before getting the policy, the ABC Analysis setup should be filled. It consists of data reference years for the classification and total sales percentage for each group. Based on theory, number of 80, 15 and 5 should be inputted for each ABC class respectively. Meanwhile for the VED class, the data for each SKU is already stored in drug master data and it is classified manually when new SKU is registered.

After the setup, the system automatically classified each drug under three groups (group I, group II and group III). The category is also displayed in the drug master data.

The following step is to do the setup for the cycle counting policy. The setup is regarding the frequency in which every group wants to be counted. In this case, group I is 1 (every month), group II is 2 (every two months) and group III is 10 (every ten months). Once it is done, the schedule for cycle counting is generated by the system for all SKUs.

ID	Code	Item Name	Quantity	Unit	Category	Storage Number	Schedule	Action
123	A00342	Acetin 600 eff	1	pcs	RS	11	2018-01-05	Edit
124	A00353	Kawa Breast Pump 120 ml	1	pcs	ME	16	2018-01-09	Edit
125	A0037	Abate 1 gr	3	pcs	HE	26	2018-01-13	Edit
130	A00395	Puremed Thermometer digital	5	pcs	ME	15	2018-01-07	Edit

Fig. 2. Cycle Counting Schedule

The schedule consists of a list of drugs to be checked in a day for each category. In order to always routinely conduct the cycle counting, the date for each SKU to be counted is displayed. In addition, the storage in which the item is located is also shown to provide ease in finding the items. By clicking the edit button, adjustment for inaccurate records can be done that is automatically updates the drug quantity in master data.

Edit Data Stock

Item Name:

Initial Quantity:

Actual Quantity:

Fig. 3. Cycle Counting Adjustment

2) Dashboard

The dashboard could display data visualization of several metrics including product classification, cycle counting stock, purchase order and sales order.

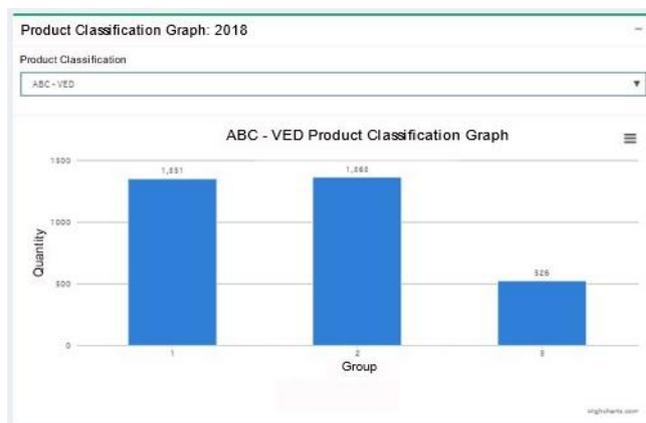


Fig. 4. Product Classification Dashboard

Product classification dashboard could show total numbers of drugs consist in each group of ABC, VED and ABC-VED.

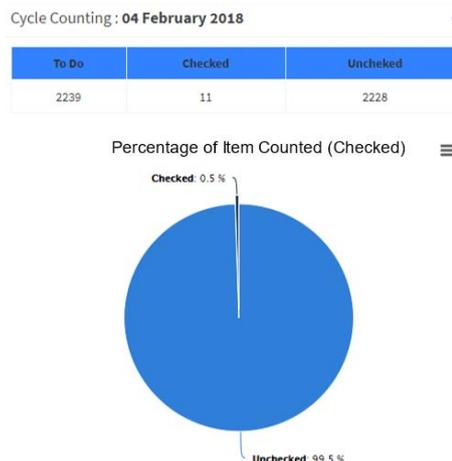


Fig. 5. Cycle Counting Stock Dashboard

Cycle counting stock dashboard could show how many items left to be checked in the day, amount of items that have been checked and items that have been checked for cycle counting activity.

3) Supplier Master Data

Supplier master data allows users to view existing supplier lists, add new supplier, edit supplier information and delete supplier.

4) Drug Master Data

Drug master data menu allows users to view existing drug lists, add new drug, edit drug information and delete drug.

5) Purchasing Management

Purchase management allows user to create purchase order for every transaction made to supplier and view list of purchase order made. It also updates the drug master data if new items are delivered by supplier.

6) Sales Management

In the sales order transaction, all items sold to the customer is recap. The initial page of sales order transaction consists of list of previous sales order. If a number of drug in storage reduce due to customer purchase, the quantity of drug in master data is also reduced.

D. Benefit of Inventory Control Application

By developing inventory control application, some benefits that can be obtained include:

- 1) The application could formulate cycle counting policy that includes how many times an item should be counted in a year to maintain its accuracy.
- 2) The application allows the company to generate different cycle counting policy annually. The policy is made based on ABC-VED classification that is formulated from annual sales, inventory quantity, cost and drug criticality data that is recorded in the application.
- 3) The application could be used to perform cycle counting. Within the application, there is cycle counting menu that not only shows item list to be counted for each group in a day but also support with edit item quantity feature to adjust if there are any discrepancy in item quantity.
- 4) Dashboard system in the application allows manager to take a glance view of metrics that relevant to the pharmacy's business objective including product classification and cycle counting stock.
- 5) The application could record sales and purchase order transaction allowing the company to have updated item stock.

The development of inventory control application is expected to increase record accuracy and reduce time and cost in conducting stock-taking.

V. CONCLUSION

Proposed stock-taking policy using cycle counting using ABC-VED classification result in counting 35 SKUs in group I, 21 SKUs in group II and 3 SKUs in group 3 daily. This is by counting all SKUs more frequently which is counting the group I 12 times in a year, counting second group 6 times in a year and counting third group 1.2 times in a year. The use of cycle counting is expected to improve inventory record accuracy.

Also, inventory control application is developed that could:

- Perform cycle counting process
- Provide schedule of drugs list that need to be count daily for cycle counting
- Show visualization of how many items has to be count for cycle counting
- Show visualization of percentage of product classification
- Create purchase order
- Create sales order
- Generate purchase order and sales order report

Using inventory control application, the inventory stock could be recorded, transactions are updates and cycle counting could be performed. The use of system is timeliness, accurate, reliable, consistent, faster, efficient and easy to use. Thus, it is expected that the inventory records accuracy could be improved.

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