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Improvement of Raw Material Inventory Management in the Flavour Industry

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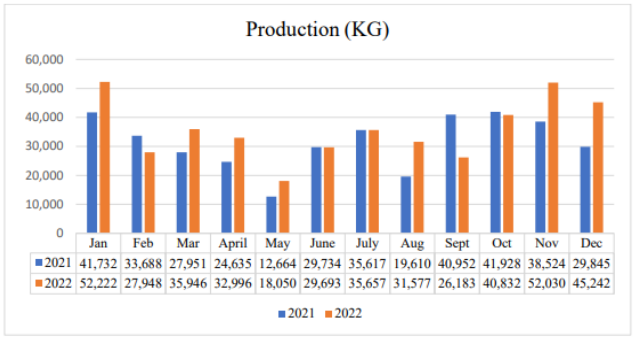
Abstract:- Flavor is an additional ingredient to enhance the taste of food and drinks. Following consumer desires by modifying flavors causes companies to use a make to order production strategy, so companies tend to accumulate inventory due to concerns about running out of stock of raw materials. The aim of this research is to determine optimum ordering and streamline raw material inventory costs. This research uses raw material data over a 12 months period. Total of 441 items were classified using the FSN-ABC method, then the category that contributed the highest inventory value was taken, fast moving A 30.37% (5 items), slow moving A 29.98% (12 items), and non moving A 18.96% (21 items). Continuous Review System (Q System or Q Model) and Periodic Review System (P System or P Model) are compared with the existing ones carried out by the company currently. The research results show that the application of the Q System can determine the minimum order quantity per order (EOQ), safety stock (SS), re-order point (ROP), and order frequency (F). The P System can determine the time between reviews (P), target inventory level (T), and safety stock (SS). Q System has differences with the existing: fast moving of 74.99%, slow moving of 69.92%, and non moving of 79.94%. P System has differences with the existing: fast moving 73.89%, slow moving 69.55%, and non moving 79.76%. Continuous Review System (Q System or Q Model) is recommended for application in the flavor industry to control raw materials.

Keywords:- *Flavor Industry, Raw Material Inventory Management, FSN-ABC, Continuous Review System, Periodic Review. System.*

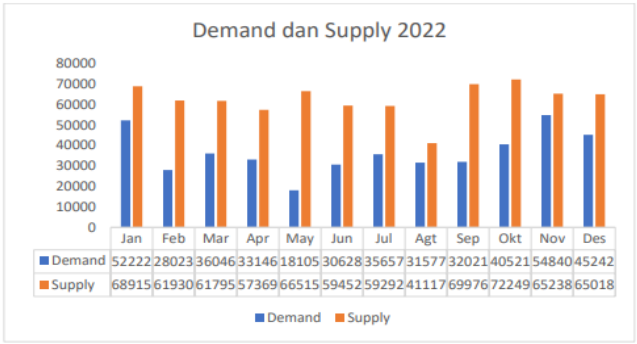
I. INTRODUCTION

Flavour, is an ingredient added to food to enhance its food profile. The sensations resulting from the integration (fusion) or interplay of the signal generated by the smell sensors' detection of chemical components are referred to as taste perception. Exciting experiences and the satisfaction of stimulants from food or beverages [9]. The flavour and fragrance modified and aligned with consumer advocacy led to the growth of this industry [14]. Picture 1. is a data chart of the increased production quantity of flavour industry in 2021-2022.



Picture 1 Total quantity produced in the flavour industry in 2021-2022

Based on the trends, the flavour company is business to business and it doesn't sell its products retailly, because it can't be consumed directly, Because it has to be re-enacted in the food and government industry. This company uses a production system strategy called make-to-order. This system is used if the product is created before, and buyers create the desired product specification. As a producer, The flavour company helps the buyer provide those specs, and then the manufacturer determines the price of the product and the time of delivery that can be changed [2].



Picture 2 Demand and Supply Flavour Raw Material in 2022

Naturally, the business must complete customer orders in the competitive environment between the food sectors and producers of extremely vibrant flavours. The main error in maintaining this is improper raw material supply management flavour Make-to-order production model makes manufacturing organizations often stockpile because they worry about stock out. Picture 2. Demand amounts and supply of flavour raw material is unbalanced, or it could be said that the supply of raw materials is much larger than its use. The difference between demand and supply of the

flavour raw material reaches 15.93 % -72.78 %. This condition causes a high cost of storing raw materials or an overcapacity warehouse. The miscalculation of many or fewer supplies is also one of the things that can cause financial currents in the company to become disturbed.

The problem of overstock and understock in a company must be minimized because it can result in loss on both the financial side of the company and periodic maintenance activities [11]. Repurchase so far done using manual estimate with monthly default materials and demand data from related departments. This led to the overcapacity of warehouses because companies tend to accumulate raw materials. The raw materials are used by food and drink companies, so it has limited shelf life. Error in the quantity of repurchase estimate can result in raw materials being stored beyond their shelf lifetime.

Based on the problem background, the author needs to conduct research with the title "Improvement of Raw Material Inventory Management in The Flavour Industry".

II. LITERATURE REVIEW

A. *Inventory*

Inventory refers to stocks or resources anything used in an organization. The inventory system is a set of policies that assess the level of control inventory and determine the extent of what has to be defended, when stock should be charged, and how much should be ordered.

Inventories can be divided into four categories based on how they are managed:

- Raw material inventories (raw material inventories) consist of goods that already exist, such as steel, wood, and other components used in the production process;
- Inventory of goods in process (work in process); This is the inventory of goods produced from each part of the production process and have been processed into finished goods, but still require additional processing to become finished goods, usually called semi-finished goods.
- Inventory of assembly components or auxiliary materials (maintenance, repair, and operational supplies); namely the inventory of goods needed for the production process, which consists of parts purchased from other companies and can be assembled directly into products.
- Finished goods inventory. In other words, inventory of products that have been processed and completed [5].

B. *Inventory Classification Methods*

In managing inventory, classification is first carried out to categorize goods. This grouping can be done using various methods, one of which is ABC classification. Apart from that, there are various other methods, namely XYZ Analysis (Use for 2-D study), HML (High, Medium, Low) Analysis, VED Analysis (Vital, Essential and Desirable), FSN Analysis (Fast, Slow and Non-Moving), SDE Analysis (Scars, Difficult and Easily available), GOLF Analysis (Govt., Ordinary, Local and Foreign), SOS Analysis (Seasonal and Off-Seasonal). All of these methods can be used based on the point of view we want to see.

➢ *FSN Analysis*

FSN analysis grouped it into three categories; fast moving., slow moving, and non. The policy and inventory model for all three categories must be different. FSN analysis is a way of grouping supplies based on the speed of movement. FSN analysis is also done based on percentage annual usage. FSN analysis steps are to collect demand data per period, and then calculate the value of consumption rate (CR). Consumption rate (CR) value obtained from total issue quantity divided by total duration period [8].

$$CR = \frac{\text{Total Issue Quantity}}{\text{Total Periode Duration}}$$

Table 1 Category FSN Analysis

Category	CR Value
F	Consumption rate 90% < 100%
S	Consumption rate 70% < 90%
N	Consumption rate < 70%

Source : (Kumar, et al., 2017)

➢ *ABC Analysis*

Multiplying costs per unit with yearly requests for each inventory item to get the annual fund volume for ABC analysis. High annual fund volume items are classified as grade A. Although they contribute only 15 % of all inventory items, these items contribute 70 % to 80 % of all funds. An inventory of the annual volume of funds is being classified as a grade B item. These products may result in between 15 % and 25 % of total values and about 30 % of inventory. Class C goods have low annual fund volumes; such items may amount to only 5 % of total inventory items, but roughly 55 % of the annual fund volume [5].

C. *Efficiency*

Efficiency is one way in use firm in terms of the management of finances, the process, material, labor, tools company, and costs effectively [13]. An activity in an organization is considered efficient or not. So, to determine the principles or requirements for efficiency, several types must be met, including:

- Efficiency must be measurable
- Efficiency refers to rational considerations
- Efficiency must not sacrificing quality

D. *Inventory Cost*

- Ordering cost is the cost of all corporate activities associated with efforts to obtain needed items. The charge depends on the frequency of the order. The higher the frequency of reservations, the bigger the ordering costs.
- Holding cost are due to a certain amount of storage in the company. Holding cost depends on the quantity of ordered goods. Holding costs are going to get bigger if the quantity of ordered goods is increasing or the average supply is getting higher.

- Shortage cost is cost incurred when demand-supply is insufficient. Shortage costs are the most difficult to estimate.

E. Inventory Method

Inventory control approach models are divided into two, namely deterministic and probablistic inventory control models [15]. In a deterministic model, all inventory parameters are known with certainty, usually the methods used are Economic Order Quantity (EOQ) and Dynamic Programming. Meanwhile, the probablistic model can be used if the demand or lead time is not known with certainty, it could be one or both [6]. Model Q inventory is characterized by a fixed order size for each order. The Continuous Review System (Q System or Q Model) is characterized by the same order quantity in one order, while the Periodic Review System (P System or P Model) is characterized by an ordering period that is always fixed.

F. Continous Review System (Q System/Q Model)

Q Model is an order system in fixed number (Q) when the supply level is below the reorder point (ROP) [7]. Formula or model for calculating Q-model :

- Order quantity (Q)

$$EOQ = \frac{\sqrt{2DS}}{H}$$

- Select the appropriate service level
- Determine the distribution of demand over the lead time

$$\sigma dLT = \sigma d\sqrt{L}$$

- Determine safety stock and reorder point

$$\text{safety stock} = z\sigma dLT$$

$$ROP = \bar{d}L + \text{safety stock}$$

- Calculation of total inventory cost (Q System)

$$TIC^{\,Q\,System} = \frac{Q}{2}(H) + \frac{D}{2}(S) + (H)(SS)$$

G. Periodic Review System (P System/P Model)

P-model is a system in which order supplies for supplies placed at the end of the period of review [7]. Formula or model for calculating P-model :

- Calculation of time between reviews (P)

$$P = \frac{EOQ}{D}(\text{days})$$

- Calculation of target inventory levels when demand varies and lead time is constant.
- Calculation of the standard deviation of demand distribution during the protection interval

$$\sigma P+L = \sigma d\sqrt{P + L}$$

Calculation of safety stock

$$\text{safety stock} = z\sigma P+L$$

Calculation of target demand level (T)

$T = \bar{d}(P + L)$ safety stock for protection interval

- Select the appropriate service level
- Determine the distribution of demand over the lead time

$$\sigma dLT = \sigma d\sqrt{L}$$

- Determine safety stock and reorder point

$$\text{safety stock} = z\sigma dLT$$

$$ROP = \bar{d}L + \text{safety stock}$$

- Calculation of total inventory cost (P System)

$$TIC^{\,P\,System} = \frac{\bar{d}\,P}{2}(H) + \frac{D}{\bar{d}\,P}(S) + (H)(SS)$$

H. Lead Time

Lead time is commonly used in the manufacturing industry, meaning it is the time required by a company to fulfill an order or the amount of time that passes between when a process starts and when it is finished. Lead time is related to company management, where companies want to reduce the amount of time needed to produce good work results.

I. Safety Stock

Safety stock is additional inventory held to protect or protect against the possibility of a shortage of materials (stock out). The possibility of stock outs can be caused by the use of raw materials that are greater than originally estimated or delays in the arrival of ordered raw materials.

J. Re-Order Point

Re-Order Point or ROP is the inventory level where when inventory has reached that level, orders must be placed immediately [5].

K. Flavour

Flavor is an additional ingredient in food. Add flavor to food to improve the taste quality of food. Flavor perception is defined as a sensation that arises from the integration (merging) or interplay of signals produced as a result of the detection of chemical components by the sense of smell, sense of taste, and the change in stimuli from food or drink [9].

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III. METHODOLOGY

The first step of this research was collected flavour raw materials. This research use purposive sampling, a sampling technique with consideration of certain criteria by the researcher. Researcher took some of criteria : 1) raw materials with their last use during 12 month period, 2) raw materials continue used over a period of 12 months. The raw materials that meet the criteria are 441 items flavour raw materials.

Before taking samples, categorize them first using the FSN classification (fast moving, slow moving, non moving) and continue with the ABC classification. After that, an analysis of the priority raw materials to be studied is carried out. The total sample to be studied was 38 items of raw materials (consisting of 5 items in the fast moving A category, 12 items in the slow moving A category, and 21 items in the non moving A category). The items above will be samples that will be analyzed using inventory control methods.The data used in this research is data taken from the manual record data and data withdrawal from the system at the flavour company.

Data collection is carried out in the following way:

➢ *Interview*

Interviewing related departments, to identify problems in the company.

➢ *Documentation*

Documenting matters related to flavor raw material supplies.

➢ *Observation*

Observe things that are related and the focus of research.

After that, here the data analysis step :

A. FSN Analysis

FSN analysis grouped it into three categories; fast moving, slow moving, and non. The policy and inventory model for all three categories must be different. FSN analysis is a way of grouping supplies based on the speed of movement. FSN analysis is also done based on percentage annual usage. FSN analysis steps are to collect demand data per period, and then calculate the value of consumption rate (CR). Consumption rate (CR) value obtained from total issue quantity divided by total duration period [8].

$$CR = \frac{\text{Total Issue Quantity}}{\text{Total Periode Duration}}$$

Consumption rate (CR) values that are less than or above 70%, they are categorized into F, consumption rates (CR) that are between 70% and 90% are categorized into S and the rest are categorized into N.

B. ABC Analysis

The ABC classification carried out in this research used Microsoft Excel with the following steps:

- Sort raw materials based on the total price of raw materials from largest to smallest.
- Calculate the cumulative percentage of raw material prices to the total consumption value.
- Classify raw materials into groups A, B, and C.

➢ *Class A:*

These are items that represent investment costs of 80% of all capital provided for inventory with a total of around 20%.

➢ *Class B:*

Consists of types of goods that represent 15% of all investment capital provided for inventory (after category A) with a total of 30% of all types of goods.

➢ *Class C:*

Types of goods that represent investment funds of 5% of all capital provided for inventory (excluding categories A and B) with a total of 50% of all goods managed.

C. Calculation of Variability Coefficient (VC)

Determining the demand inventory model is determined by calculating the variability coefficient (VC) on historical data on raw material usage. Demand data will be deterministic if the VC value is < 0.20, while demand data will be probabilistic if the VC value is > 0.20.

The step are as follows:

- Squaring the number of demands for each monthly period and adding up the results of the squared demands for each period
- Add up demand for each monthly period
- Calculate the variability coefficient (VC) value using the following formula [17].

$$VC = \frac{N \cdot \sum \binom{N}{j}=1 D^2 j}{[\sum \binom{N}{j}=1 D^2 j]^2} - 1$$

D. Continous Review System (Q System/Q Model)

Q Model is an order system in fixed number (Q) when the supply level is below the reorder point (ROP). Formula or model for calculating Q-model :

- Order quantity (Q)

$$EOQ = \frac{\sqrt{2DS}}{H}$$

- Select the appropriate service level
- Determine the distribution of demand over the lead time

$$\sigma dLT = \sigma d\sqrt{L}$$

- Determine safety stock and reorder point

$$\text{safety stock} = z\sigma dLT$$

$$ROP = \bar{d}L + \text{safety stock}$$

- Calculation of total inventory cost (Q System)

$$TIC^{Q\,System} = \frac{Q}{2}(H) + \frac{D}{2}(S) + (H)(SS)$$

E. Periodic Review System (P System/P Model)

P-model is a system in which order supplies for supplies placed at the end of the period of review. Formula or model for calculating P-model :

- Calculation of time between reviews (P)

$$P = \frac{EOQ}{D}(\text{days})$$

- Calculation of target inventory levels when demand varies and lead time is constant.
- Calculation of the standard deviation of demand distribution during the protection interval

$$\sigma P{+}L = \sigma d\sqrt{P + L}$$

Calculation of safety stock

$$\text{safety stock} = z\sigma P{+}L$$

Calculation of target demand level (T)

$T = \bar{d}(P + L)$ safety stock for protection interval

- Select the appropriate service level
- Determine the distribution of demand over the lead time

$$\sigma dLT = \sigma d\sqrt{L}$$

- Determine safety stock and reorder point

$$\text{safety stock} = z\sigma dLT$$

$$ROP = \bar{d}L + \text{safety stock}$$

- Calculation of total inventory cost (P System)

$$TIC^{P\,System} = \frac{\bar{d}\,P}{2}(H) + \frac{D}{\bar{d}\,P}(S) + (H)(SS)$$

IV. RESULT AND DISCUSSION

A. FSN and ABC Analysis

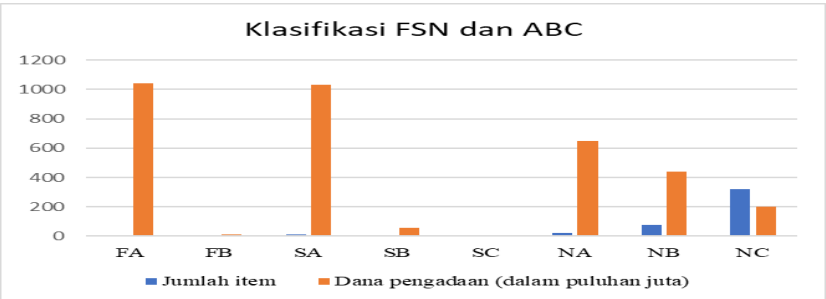
To solve the problem of raw material inventory, raw material classification is first carried out based on demand over 12 month period. The data used was obtained through historical data on demand for flavor raw materials at the company. Classification first uses the FSN method which is then followed by the ABC method. The results are as follows:

Table 2 ABC Analysis

	Total Item	Item Percentage (%)	Investment Value (Rp)	Investment Value (%)
A	39	8.84	27,477,750,119.60	80
B	82	18.59	5,135,412,636.24	14.95
C	320	72.56	1,734,548,736.47	5.05
Total	**441**	**100**	**34,347,711,492.31**	**100**

Tabel 3 FSN dan ABC Analysis

	Total Item	Item Percentage (%)	Investment Value (Rp)	Investment Value (%)
FA	5	1.13	10,432,998,592.45	30.37
FB	1	0.23	125,097,178.32	0.36
FC	0	0.00	0	0.00
SA	12	2.72	10,297,945,023.04	29.98
SB	5	1.13	548,551,232.96	1.60
SC	2	0.45	11,206,920.52	0.03
NA	21	4.76	6,511,936,524.79	18.96
NB	76	17.23	4,417,618,434.61	12.86
NC	319	72.34	2,002,357,585.62	5.83
Total	**441**	**100.00**	**34,347,711,492.31**	**100**



Picture 3 FSN and ABC Analysis

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Table 4 List Sampling Raw Material

Kategori FA	Kategori SA	Kategori NA
GMP	YGL	EMB
LIO	ILV	MAK
ETL	ICB	LML
ACT	CRY	MRJ
XDM	CCP	EMC
	ISO	ANH
	EHY	LNL
	BRZ	CRL
	COC	HBN
	JZM	GRL
	PDN	MNL
	MLN	EUG

B. Determining Inventory Methods

Table 5 VC Value of Flavour Raw Material

Item	VC Value	Inventory Model
GMP	0.0599	Deterministik
LIO	0.1187	Deterministik
ETL	2.0170	Probabilistik
ACT	0.1951	Deterministik
XDM	0.2872	Deterministik
YGL	0.2761	Probabilistik
ILV	0.1337	Deterministik
ICB	0.5780	Probabilistik
CRY	10.8277	Probabilistik
CCP	1.1307	Probabilistik
ISO	0.5169	Probabilistik
EHY	0.0793	Deterministik
BRZ	0.5890	Probabilistik
COC	0.7339	Probabilistik
JZM	0.1690	Deterministik
PDN	0.3098	Probabilistik
MLN	1.5534	Probabilistik
EMB	1.1161	Probabilistik
MAK	0.4303	Probabilistik
LML	1.0221	Probabilistik
MRJ	1.5212	Probabilistik
EMC	0.2592	Probabilistik
ANH	11.0000	Probabilistik
LNL	0.3979	Probabilistik
CRL	1.3008	Probabilistik
HBN	1.4518	Probabilistik
GRL	0.5135	Probabilistik
MNL	1.3029	Probabilistik
EUG	0.4178	Probabilistik
RCT	11.0000	Probabilistik
GRS	1.1925	Probabilistik
EXC	0.3158	Probabilistik
JVA	0.4291	Probabilistik
PIN	2.5141	Probabilistik
STZ	4.9167	Probabilistik
VCF	1.4000	Probabilistik
COL	3.9754	Probabilistik
NLC	1.5102	Probabilistik

Of the 38 items to be studied, 7 of them are deterministic, and 30 of them are probabilistic, so it can be said that the demand model is probablistic. The most appropriate inventory calculation method to be used is a probablistic inventory model, namely the Continuous Review System (Q System or Q Model) and the Periodic Review System (P System or P Model).

C. Determining Inventory Components

All calculations use 12 months demand period. The Q and P System calculation variables use the following assumptions:

- Demand data is obtained from records of the use of flavor raw materials during the 12 period in kilogram units.
- Actual ordering and arrival data for flavor raw materials is obtained from company records and systems.
- Service level 99.0%. Service rates are based on order fulfillment targets. With a service level of 99.0%, a Z value of 2.33 is obtained. The Z value is the number of standard deviations of safety stock. The Z value in this study associated with a 99 percent probability of not running out of stock is 2.33 (NORSINV Excel function).
- Storage costs are 26% of the inventory price. Storage costs are assumed to be 26% referring to [5].
- Lead times are based on historical average purchase lead times and are assumed to be constant. The waiting time for local suppliers is 3 days, while for imported suppliers it is 3 months or 90 days.
- Purchase costs for local goods are IDR 102,000.00 and for imported goods IDR 1,315,172.00. These costs were obtained from previous data, along with the results of interviews with related departments and logistics.

D. Continous Review System (Q System/Q Model)

➢ *Raw Materials Fast Moving Category A*

Table 6 Raw Material Fast Moving A with Q System

Item	EOQ	SS	ROP	TIC (Q System)
GMP	1,860kg	285.18 kg	2,488 kg	Rp 24,165,830
LIO	727 kg	27.40 kg	239 kg	Rp 5,346,377
ETL	514 kg	23.88 kg	208 kg	Rp 6,641,003
ACT	455 kg	19.82 kg	172 kg	Rp 6,219,077
XDM	608 kg	15.44 kg	134 kg	Rp 3,560,928

➢ *Raw Materials Slow Moving Category A*

Table 7 Raw Material Slow Moving A with Q System

Item	EOQ	SS	ROP	TIC (Q System)
YGL	474 kg	12.95 kg	113 kg	Rp 3,836,637
ILV	119 kg	9.00 kg	78 kg	Rp 11,126,313
ICB	252 kg	8.23 kg	72 kg	Rp 4,603,952
CRY	111 kg	7.52 kg	66 kg	Rp 9,954,104
CCP	278 kg	6.45 kg	57 kg	Rp 3,249,575
ISO	181 kg	4.45 kg	39 kg	Rp 3,449,858
EHY	65 kg	3.60 kg	32 kg	Rp 7,554,420
BRZ	324 kg	0.66 kg	833 kg	Rp 19,563,533
COC	396 kg	0.63 kg	796 kg	Rp 15,319,179
JZM	255 kg	0.53 kg	671 kg	Rp 20,052,604
PDN	141 kg	0.47 kg	604 kg	Rp 32,668,804
MLN	127 kg	0.44 kg	553 kg	Rp 33,151,263

➢ *Raw Materials Non Moving Category A*

Table 8 Raw Material Non Moving A with Q System

Item	EOQ	SS	ROP	TIC (Q System)
EMB	88 kg	2.05 kg	18 kg	Rp 3,285,466
MAK	303 kg	0.36 kg	463 kg	Rp 11,625,630
LML	62 kg	1.99 kg	17 kg	Rp 4,556,081
MRJ	163 kg	0.33 kg	422 kg	Rp 19,670,489
EMC	58 kg	1.53 kg	13 kg	Rp 3,686,132
ANH	45 kg	1.49 kg	13 kg	Rp 4,689,439
LNL	61 kg	1.46 kg	13 kg	Rp 3,370,603
CRL	36 kg	1.44 kg	13 kg	Rp 5,662,330
HBN	183 kg	0.21 kg	13 kg	Rp 11,354,047
GRL	29 kg	1.16 kg	10 kg	Rp 5,698,290
MNL	146 kg	0.20 kg	260 kg	Rp 13,530,863
EUG	40 kg	0.98 kg	9 kg	Rp 3,483,686
RCT	26 kg	0.72 kg	6 kg	Rp 3,937,961
GRS	70 kg	0.08 kg	102 kg	Rp 11,154,069
EXC	18 kg	0.08 kg	4 kg	Rp 3,383,841
JVA	28 kg	0.07 kg	84 kg	Rp 22,849,065
PIN	51 kg	0.06 kg	78 kg	Rp 11,730,415
STZ	36 kg	0.05 kg	58 kg	Rp 12,524,464
VCF	33 kg	0.05 kg	58 kg	Rp 13,352,212
COL	38 kg	0.04 kg	55 kg	Rp 11,176,079
NLC	28 kg	0.04 kg	49 kg	Rp 13,373,099

Based on the results obtained from the Q System calculations for all categories, including Fast Moving, Slow Moving and Non Moving, it was found that the minimum order quantity was smaller than what the company currently does, thereby saving on holding costs, where according to [5] the holding costs are 26%. By reducing the minimum order quantity, it will affect the efficiency of the warehouse capacity used to store raw materials. When compared with the existing one, the Q System is more efficient.

Based on the results obtained from the Q System calculations for all categories, it was found that the order frequency quantity was more frequent compared to what the company currently does, thereby saving on holding costs.

Based on the results obtained from the Q System calculations for all categories, including Fast Moving, Slow Moving and Non Moving, it was found that the time to place orders again was more measurable than what the company currently implements, because companies tend to stockpile materials due to concerns about not being able to fulfill orders that cannot be fulfilled. expected. Q System recommends ROP.

E. Periodic Review System (P System/P Model)

➢ *Raw Materials Fast Moving Category A*

Table 9 Raw Material Fast Moving A with P System

Item	P	SS	T	TIC (P System)
GMP	3 days	387.23 kg	4,449.35 kg	Rp 25,316,057
LIO	10 days	57.69 kg	995.91 kg	Rp 5,561,150
ETL	8 days	46.46 kg	744.76 kg	Rp 6,919,870
ACT	9 days	39.48 kg	646.96 kg	Rp 6,476,913
XDM	15 days	38.10 kg	764.45 kg	Rp 3,690,544

➢ *Raw Materials Slow Moving Category A*

Table 10 Raw Material Slow Moving A with P System

Item	P	SS	T	TIC (PSystem)
YGL	14 days	31.02 kg	604.86 kg	Rp 3,979,042
ILV	5 days	14.82 kg	203.29 kg	Rp 11,632,302
ICB	12 days	18.33 kg	333.96 kg	Rp 4,782,718
CRY	6 days	12.80 kg	181.19 kg	Rp 10,400,493
CCP	17 days	16.54 kg	344.00 kg	Rp 3,249,575
ISO	16 days	11.12 kg	225.99 kg	Rp 3,574,370
EHY	8 days	6.69 kg	102.92 kg	Rp 7,879,151
BRZ	35 days	0.77 kg	1156.85kg	Rp 19,570,593
COC	45 days	0.77 kg	1191.86kg	Rp 15,324,598
JZM	35 days	0.62 kg	926.04 kg	Rp 20,059,853
PDN	21 days	0.53 kg	743.93 kg	Rp 32,680,956
MLN	21 days	0.48 kg	680.35 kg	Rp 33,163,604

➢ *Raw Materials Non Moving Category A*

Table 11 Raw Material Non Moving A with P System

Item	P	SS	T	TIC (P System)
EMB	17 days	5.23 kg	108.26 kg	Rp 3,402,480
MAK	59 days	0.47 kg	766.24 kg	Rp 11,629,631
LML	12 days	4.46 kg	81.52 kg	Rp 4,732,550
MRJ	35 days	0.39 kg	584.25 kg	Rp 19,677,590
EMC	15 days	3.72 kg	73.60 kg	Rp 3,821,535
ANH	12 days	3.30 kg	59.79 kg	Rp 4,872,314
LNL	17 days	3.70 kg	75.78 kg	Rp 3,491,492
CRL	10 days	2.97 kg	50.18 kg	Rp 5,892,615
HBN	60 days	0.28 kg	455.59 kg	Rp 11,357,944
GRL	10 days	2.39 kg	40.36 kg	Rp 5,930,348
MNL	51 days	0.26 kg	405.87 kg	Rp 13,535,594
EUG	16 days	2.44 kg	49.40 kg	Rp 3,609,749
RCT	14 days	1.70 kg	32.80 kg	Rp 4,085,107
GRS	61 days	0.10 kg	170.74 kg	Rp 11,157,890
EXC	16 days	1.04 kg	21.39 kg	Rp 3,505,333
JVA	30 days	0.08 kg	110.93 kg	Rp 22,857,399
PIN	59 days	0.08 kg	128.48 kg	Rp 11,734,456
STZ	55 days	0.06 kg	93.02 kg	Rp 12,528,809
VCF	51 days	0.06 kg	90.81 kg	Rp 13,356,875
COL	61 days	0.06 kg	91.87 kg	Rp 11,179,909
NLC	51 days	0.05 kg	76.08 kg	Rp 13,377,769

Based on the results obtained, P System reviews the time between orders, so that it can be used to measure the time between orders. P System can also manage the time between orders in a more measurable manner. Because piling up raw materials is also not the right choice for flavor companies, which have a shelf life that follows that of food and beverage products. This also affects the efficiency of warehouse capacity used to store raw materials.

Based on the results obtained from the P System calculations from all categories including Fast Moving, Slow Moving and Non Moving, the target inventory level is obtained.

F. Total Inventory Cost

Table 12 Compared Total Inventory Cost

Item	TIC (Q System)	TIC (P System)	TIC Existing
Fast Moving			
GMP	Rp 24,165,830	Rp 25,316,057	Rp 60,298,923
LIO	Rp 5,346,377	Rp 5,561,150	Rp 13,754,803
ETL	Rp 6,641,003	Rp 6,919,870	Rp 81,780,928
ACT	Rp 6,219,077	Rp 6,476,913	Rp 16,619,416
XDM	Rp 3,560,928	Rp 3,690,544	Rp 10,750,260
Total	Rp 45,933,215	Rp 47,964,534	Rp 183,204,329
Slow Moving			
YGL	Rp 3,836,637	Rp 3,979,042	Rp 19,567,390
ILV	Rp 11,126,313	Rp 11,632,302	Rp 85,723,692
ICB	Rp 4,603,952	Rp 4,782,718	Rp 9,026,151
CRY	Rp 9,954,104	Rp 10,400,493	Rp 48,826,984
CCP	Rp 3,249,575	Rp 3,364,962	Rp 6,698,269
ISO	Rp 3,449,858	Rp 3,574,370	Rp 17,472,265
EHY	Rp 7,554,420	Rp 7,879,151	Rp 63,306,805
BRZ	Rp 19,563,533	Rp 19,570,593	Rp 38,562,568
COC	Rp 15,319,179	Rp 15,324,598	Rp 18,728,528
JZM	Rp 20,052,604	Rp 20,059,853	Rp 50,144,397
PDN	Rp 32,668,804	Rp 32,680,956	Rp 75,676,250
MLN	Rp 33,151,263	Rp 33,163,604	Rp 94,576,625
Total	Rp164,530,243	Rp166,412,642	Rp528,309,924
Non Moving			
EMB	Rp 3,285,466	Rp 3,402,480	Rp 3,721,280
MAK	Rp 11,625,630	Rp 11,629,631	Rp 48,858,140
LML	Rp 4,556,081	Rp 4,732,550	Rp 5,573,737
MRJ	Rp 19,670,489	Rp 19,677,590	Rp 23,492,846
EMC	Rp 3,686,132	Rp 3,821,535	Rp 24,559,368
ANH	Rp 4,689,439	Rp 4,872,314	Rp 76,955,955
LNL	Rp 3,370,603	Rp 3,491,492	Rp 12,573,190
CRL	Rp 5,662,330	Rp 5,892,615	Rp 14,285,892
HBN	Rp 11,354,047	Rp 11,357,944	Rp 63,110,575
GRL	Rp 5,698,290	Rp 5,930,348	Rp 43,114,612
MNL	Rp 13,530,863	Rp 13,535,594	Rp 20,409,407
EUG	Rp 3,483,686	Rp 3,609,749	Rp 13,622,722
RCT	Rp 3,937,961	Rp 4,085,107	Rp221,498,473
GRS	Rp 11,154,069	Rp 11,157,890	Rp 33,807,269
EXC	Rp 3,383,841	Rp 3,505,333	Rp 5,539,666
JVA	Rp 22,849,065	Rp 22,857,399	Rp 40,309,085
PIN	Rp 11,730,415	Rp 11,734,456	Rp 33,177,630
STZ	Rp 12,524,464	Rp 12,528,809	Rp 47,092,854
VCF	Rp 13,352,212	Rp 13,356,875	Rp 29,138,530
COL	Rp 11,176,079	Rp 11,179,909	Rp126,016,672
NLC	Rp 13,373,099	Rp 13,377,769	Rp 20,625,150
Total	Rp194,094,259	Rp195,737,388	Rp907,483,052

G. Discussion

After grouping with the FSN classification, ABC classification is carried out, because it is not appropriate if the analysis only focuses on fast moving goods, while other categories of goods may include goods that have a high item value. So in companies with large and varied amounts of raw materials, the use of combined FSN-ABC analysis is used in research, so that inventory control is more efficient. Inventory costs can be reduced, thereby increasing company profits, and inventory costs that have been used can be allocated to other crucial sectors. This is also in accordance with research at the spare parts company PT. Astra International Tbk. - Daihatsu Sales Operational Tegal Branch which has been carried out with the FSN-ABC classification [3]. The FSN and ABC classifications make it easier to group goods before controlling raw material inventory. In accordance with research [10]. FSN and ABC classifications make it easier to categorize goods and are useful for determining inventory levels.

The flavor industry studied has not implemented raw material inventory control methods, so far orders have been determined based on manual estimates. Based on calculations, the existing order frequency that is currently running is less frequent with a larger order quantity compared to the results suggested by the Q and P System. For example, in the fast moving type A category, namely GMP; Existing orders total 70 times a year with quantities ranging from 1,075-4,300 per order. Meanwhile, Q System recommends ordering 1,860 kg in one order and the order frequency is around 103 times a year. The result of an order quantity that is too high is high storage costs in the warehouse.

From the results of calculations using the P System, it was found that the review time between orders was 3 days for GMP items. This means that the company must review whether reordering is needed within that time period. This helps companies make more measurable purchases.

The Q and P System also measures the safety stock that must be prepared by the company to maintain the availability of raw materials. For example, for GMP items, Q System estimates the required safety stock of 285.18 kg is needed to maintain inventory. Meanwhile, in the P System, for GMP items, a safety stock of 387.23 kg is required. The safety stock on the P System is much larger than the Q System. This is in accordance with research [4] which states that safety stock is needed to deal with demand during the review period and lead time. Whichever inventory management method is used, safety stock is an important thing for the company's system to have to face reactions or possibilities that the company will face. However, storing safety stock that is too high also causes a buildup of inventory, especially if the goods produced have a shelf life, such as food and drinks.

Using the Q System produces a re-order point (ROP) or time to reorder in each fast moving, slow moving and non moving category. ROP is obtained from average daily demand multiplied by lead time and added by safety stock. For example, in the fast moving item GMP category, Q System recommends reordering when the remaining inventory is 2,488.25 kg. YGL items in the slow moving category were reordered when the remaining inventory was 113.03 kg. Meanwhile, for the non-moving category, EMB items were reordered when the remaining inventory was 17.88 kg.

The total inventory costs generated using the Q and P System are also calculated to be better than the company's actual situation. The Q and P System can minimize the costs incurred by the company. This can be observed from the difference between the total costs incurred by the flavor industry itself and the total costs incurred according to the Q and P System calculations. According to the calculation results, it can be seen that the current actual inventory costs are IDR 183,204,329 for the fast moving category, IDR 528,309,924 for the slow moving category, and IDR 907,483,052 for the slow moving category. The total cost of Q System inventory for the fast moving category is IDR 45,933,215, the slow moving category is IDR 164,530,243, and for the non moving category is IDR 194,094,259. This means that the Q System can save raw material inventory costs by as much as; IDR 13,7271,114.33 in the fast moving category, IDR 363,779,681.23 in the slow moving category, and IDR 713,388,793 in the non moving category from the actual current situation of the company. Or it can be said that by using the Q System, you can save 74.93% in the fast moving category, 68.86% in the slow moving category, and 78.61% in the non moving category. This is in accordance with research [18], that savings in total inventory costs can be done with a probabilistic Economic Order Quantity (EOQ) model compared to current company policies.

Q System is much more economical than the P System and current company methods, this is in accordance with [1]. The Continuous Review System (Q System) method can also save the main raw material for making 5 kg polypropylene gallons amounting to IDR. 5,866,905.63/year compared to the Continuous Review Periodic (P System) and the method applied by the company previously [16]. Based on previous study, system research on inventory has been done extensively. Numerous prior deterministic studies have found that comparing the EOQ method's effectiveness with company procedures, such as fabricating steel materials, has shown to be more successful and efficient than manual results, saving inventory costs [19].

The total cost of P System inventory for the fast moving category is IDR 47,964,534, the slow moving category is IDR 166,412,642, and for the non moving category is IDR 195,737,388. This means that the P System can save raw material inventory costs of IDR 135,239,794.89 in the fast moving category, IDR 361,897,282.40 in the slow moving category, and IDR 711,745,664 in the non moving category from the company's current actual situation. Or it can be said that by using the P System, you can save 73.82% in the fast moving category, 68.50% in the slow moving category, and 78.43% in the non moving category.

Based on the research results, the company's actual high inventory costs also indicate that the safety stock is too large, so that holding costs are too large. So by reducing the amount of safety stock as recommended by the Q System, total inventory costs can be reduced but can still meet customer demand with a high service level, in this case 99%. This is in accordance with [12].

The use of the P System in companies results in safety stock and a larger maximum amount of inventory, thus requiring a larger warehouse, this means higher storage costs, greater risk of depreciation and storage in large quantities when compared to the Q System. The Q System has a lower level of risk than the P System, because with this method, in storing the raw materials, the company does not need a warehouse with a large capacity because the company also does not spend a lot of money on storage costs, depreciation or depreciation of the biolith raw materials. It can also be more minimalist. The total costs incurred are also not as much as the P System, and the actual situation of the company. In the case of flavor companies, raw material inventory control will be better if they use the Q System.

V. CONCLUSION AND RECOMMENDATION

Based on the results of the research that has been carried out, the following can be concluded:

- *The optimum method for inventory control is the Q System, which produces a minimum order quantity (Q);*

Fast Moving Category A; GMP is 1,860 kg, LIO is 727 kg, ETL is 514 kg, ACT is 455 kg, and XDM is 608 kg.

Slow Moving Category A; YGL is 474 kg, ILV is 252 kg, CRY is 111 kg, CCP is 278 kg, ISO is 181 kg, EHY is 69 kg, BRZ is 324 kg, COC is 360 kg, JZM is 255 kg, PDN is 141 kg, and MLN of 128 kg.

Non Moving Category A; EMB is 88 kg, MAK is 303 kg, LML is 62 kg, MRJ is 163 kg, EMC is 58 kg, ANH is 45 kg, LNL is 61 kg, CRL is 36 kg, HBN is 183 kg, GRL is 29 kg, MNL is 146 kg, EUG is 40 kg, RCT is 26 kg, GRS is 70 kg, EXC is 18 kg, JVA is 28 kg, PIN is 51 kg, STZ is 36 kg, VCF is 31 kg, COL is 38 kg, and NLC of 28 kg.

- *The Q System inventory method can control raw material inventory more economically for cost efficiency in the flavor industry:*

The difference with existing ones in the fast moving category is 74.99%, the slow moving category is 69.92%, and the non moving category is 79.94%. Meanwhile, the P inventory method has inventory costs that are different from the existing ones as follows; Fast Moving 73.89%, Slow Moving 69.55%, and Non Moving 79.76%.

Based on this research, it was found that the use of the Q System is more efficient than the use of the P System and the methods currently used by the company.

Recommendation from researchers after conducting this research are as follows:

- Companies need to use the Q System for all raw materials, because the Q System is more efficient than the method currently used in the company.
- Future research can explore inventory management with other appropriate methods.

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