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Abstract. Raw materials and production outcome play important role in supporting warehouse capacity. The performance of company's production process will not be bothered if the company can control raw materials inventory and production capacity so that this is important to control logistics in warehouse. The activities in company's warehouse are very important because they will affect the response level to goods collecting. Risk management is required to respond actions that affect problem in raw materials capacity and production stocks in warehouse. This study aims to determine the amount of raw material inventory and warehouse stock capacity in PG XYZ and to determine the schedule of sugarcane raw materials so that the raw materials intensity and stocks can be equally distributed during the milling season. This study obtained total inventory cost from inventory management analysis of Rp. 663.945.589,8 resulted in an efficiency of Rp 36.054.410,02 and there are 2 risks that are categorized into high risk category, namely the previous milled sugar is still available and refined sugar is circulating exceed capacity.

Keyword : Warehouse Capacity, Overstock, Risk Management.

1. Introduction

Sugar mills are part of leading sector in plantation-based industries so that they contribute to economic growth and increase employment. Sugar mills are downstream plantation industries. The growth of sugar mills allows for an increase in employment both forward and backward linkages so as to increase level of community welfare [1]. The importance of sugar factories are part of economic assets and also social assets. The production of sugar factories are generally in the form of white crystal sugar. Sugar is one of the consumption needs for society. The per capita need for sugar to Indonesian population reaches 14,5 kg per capita per year [2]. National sugar production in 2018 ranges from 2,70-2,80 million tons, increase 800 thousand tons from 2017 target [3]. Increased production is influenced by the expansion of plantation areas and the successful implementation of farming patterns.

Fulfillment of sugar needs must be accompanied by the amount of sugar cane as raw material during sugar production process. Control sugarcane needs by sugar mills is required to meet needs during production process. The production planning needs parallel with company's strategy. Production planning aims to make decisions based on the resources owned by company to fulfill products demand. Good production planning can avoid extra costs in production process [4]. Overstock and stockout due to poor planning [5]. Lack of raw material inventory due to poor planning can be detrimental to company because it will interrupt the continuity of company's production and distribution activities [6].

Good planning in business units at PTPN XI is a solution to problem of overstock and stockout. Sugar mills in Indonesia is better known as PG. PG XYZ is part of business unit at PTPN XI which is engaged in agro-industry to produce sugar and drops. The need for raw materials cultivation in production process because sugarcane is a seasonal crop that is harvested once a year. Therefore, XYZ Mill conducts continuous production activities so that production machines can operate efficiently [7]. Warehouse capacity control during production process is needed to overcome overstock risk due to sugar is piling up from the previous inventory that has not been sold. Control in supply of raw materials and production results affect the inventory cost and will affect the profits that will be received by company. Forecasting analysis is also needed in determining future production plans for product periods and capacity so as provide an overview the needs of sugarcane and sugar [8]. During production cycle, the control of raw material and warehouse capacity are providing raw materials and warehouse capacity control so that the production process can run continuously and does not occur overstock and obtain minimal inventory cost [9]. The overstock problem can be minimized through risk management so that it does not affect production targets every year [10]. The risk management process is carried out through identification, measurement and risks handling so that losses from risks can be minimized.

This research is expected to be a reference to reduce the impact on overstock and stockout problems starting from the fulfillment of factory raw materials to finished products in warehouse. This is because both problems often occur during sugar production process at PT XYZ. The process of risk management due to overstock and stockout is important so that policies will not harm factory and reduce profit at PT. XYZ. The need for integration of SAP (System Application and Product) in data processing to warehouse management which is implemented by PT. XYZ can be a further research study.

2. Literatur Review

2.1 Inventory Management

Inventory management plays an important role in flow of goods in company. Inventory management plays a role in business activities towards fulfillment of goods which used in processing products to be sold [11]. Inventory management plays a role in fulfilling consumer demand in a certain period [12]. Inventory management is declared successful if it has criteria for availability, capability and quality [13]. Poor inventory management control can result in a shortage of supplies so that the production process stops. This condition shows that inventory management plays an important role in operational activities in a company. Excess of inventory due to poor inventory management results in overstocking, which makes high operational costs in the existing warehouse in company [14].

The important target of inventory management expects not only to reduce or increase inventory but also to increase profits in Sugar Mill which is a business unit of PT Perkebunan Nusantara. The condition of the sugar mill in East Java amounts to 31, equivalent to 50% of total amount in Indonesia [15]. As a sugar production hub in East Java, it is expected that PG XYZ can contribute to increase sugar production with good inventory management control. This condition is supported by the highest sugar consumption in Indonesia in Asia reaching 6% per year [16]. The influence of imported refined sugar that exceeds the industry's needs interrupt stock supply in sugar mills in East Java [17]. The effect allows the previous year's sugar stock to not be released due to no market demand. It is expected that PG XYZ can manage inventory in warehouse so that there will be no additional storage and reprocess costs due to melting sugar. Inventory management in this study was measured based on a problem study in PG XYZ which are determining Economic Order Quantity (EOQ), determining safety stock, calculating reorder points, calculating maximum inventory and calculating total inventory cost.

2.2 Risk Management

Risk management is the manage uncertainty through a structured approach or methodology that deals with threats to a range of human activities includes assessing risk, developing risk and mitigating risks through empowerment and resource management [18]. Risk management relates to comprehensive handling through an action in preventing loss [19]. Risk management is part of the general application

of branch of management science with the stages of identification, measurement and handling uncertainty from a company [20]. Risk management seeks to open a loss through logical steps [21].

Risk management in designing warehouse inventory capacity during production is indispensable, because risk management seeks to recognize, measure and minimize risk impact [22]. Handling inventory risk in inventory warehouse includes raw materials, auxiliary materials / supplies, spare parts, semi-finished goods and finished goods [23]. General risk management measures for excess inventory capacity include prevention and repair. Risk prevention includes avoiding, minimizing or transferring risks while improvement includes actions to reduce the effects of risk or take risks [24]. Risk handling measures are carried out based on response development and impact prediction [25]. Risk management in PG XYZ is expected to maximize production targets every year.

3. Research Methodology

The initial stages of this research are field studies to understand the problems that occur. Literature study activities are needed to learn from theoretical studies to solve problems. The results of data collection are divided into two, namely primary data and secondary data. Data collection stages are carried out through observation, interviews and literature studies. The entire data obtained is carried out data processing.

Data processing begins with an inventory management analysis. Inventory management analysis includes calculating Economic Order Quantity (EOQ), determining safety stock, calculating reorder points, determining maximum inventory, calculating total inventory cost and determining cost efficiency. Risk management analysis is carried out by stages of identifying the overstock cause risk in warehouse, conducting risk assessments and developing risk responses. The expectation with this research can contribute to overstock problem in storage warehouses in PG XYZ.

4. Case Study

PG XYZ was established in 1894 by NV. Cooy Coostern Van Voor Hout. PG XYZ is one of the five business units of PTPN XI located in western region of East Java. PG XYZ has a sugarcane planting area of 4.997.0 ha with PG XYZ sugarcane area of 1.880.0 ha and a community-owned sugarcane area of 3.117.0 ha. The result from planting area is estimated that PG XYZ can produce 375.131.6 tons of sugarcane. PG XYZ has a capacity of 3.200.0 tth (excluding stop hours) or 2.821.9 tth including stop hours. PG XYZ has two production periods, namely inside milling period and outside milling period. PG XYZ always strives to optimize the planting time. The ideal composition for arranging varieties, preparing quality agro input, improving cultivation yields and improving transport management. PG XYZ is actively accelerating technology in conducting experiments.

The current condition at PG XYZ has the problem of stacking sugar production in warehouses because of there are unsold sugar due to refined sugar emerge in the local market. This problem makes PG XYZ to optimize production targets according to market capacity so as does not increase inventory costs and increase profits. This risk cannot be avoided as long as the regulation of Trade Ministry No. 117/M-DAG/PER /12/2015 concerning the provisions on sugar import provisions is still applied.

4.1 Data Collection

In this research, data collection was carried out in three stages namely observation, interview and literature study. Observation activities are carried out through direct observation of activities in PG XYZ. Interview activities are carried out in divisions related to activities of sugarcane raw materials and sugar finished product. Literature study activities are activities to record data from documents related to research problem studies.

Data obtained from data collection are divided into two, namely primary data and secondary data. Primary data includes data number of warehouse employees, warehouse capacity, sugar production reports and number of sugarcane raw materials. Secondary data includes statistics on Indonesian plantations and Madiun District in figures in 2014-2018.

4.2 Inventory Management Analysis

The inventory management analysis was carried out by calculating the problems studied using formulas according to the overstock topics. The initial stage of inventory management analysis is to calculate the Economic Order Quantity (EOQ). EOQ is the optimal purchase amount obtained through a minimal cost of goods quantity [26]. Calculation can be determined by following formula.

$$EOQ = \sqrt{\frac{2 \times R \times S}{P \times I}} \quad (1)$$

where

R = Number of raw material requirements in a certain period (tons)
S = Ordering cost in one period (Rp)
P = Unit cost (Rp)
I = Warehouse storage and maintenance costs in %

Calculation of Economic Order Quantity (EOQ) in 2018 requires some data including data on raw material quantities / year, raw material cost, ordering cost and holding cost. Data for EOQ calculation as follows.

1. Total amount of sugar cane is 24.4539,8 ton (R)
2. Price of sugarcane per ton is Rp 650.000 (P)
3. Ordering cost per order / year is Rp. 13.866.666.67 (S)
4. Maintenance and storage cost is 10% (I)

Obtained data from historical data of PG XYZ, the number of EOQ for sugarcane raw materials is calculated using the following formula :

$$EOQ = \sqrt{\frac{2 \times R \times S}{P \times I}}$$

$$EOQ = \sqrt{\frac{2 \times 244539{,}8 \times 13866666{,}67}{650.000 \times 0{,}1}}$$

$$EOQ = \sqrt{104336981{,}3}$$

$$EOQ = 10214{,}55 \text{ ton}$$

During milling period the frequencies number (5 months or 150 days) $= \frac{244539{,}8}{10214{,}55} = 23$ kali times or equivalent $\frac{150}{23} \times 1$ day = once every 7 days. The company only needs to make efficient purchases 23 times in one year with a total capacity of 234.934,65 tons / year. But PG XYZ purchases raw materials 76 times during milling period. Based on the estimation calculation, then one purchase by considering the total sugarcane inventory of 24.4539,8 tons / year is obtained a savings of 9.605,15 tons / year or equivalent to 3,93%.

The second stage of inventory management is calculating safety stock. Calculation of Safety Stock (SS) is used to determine the amount of inventory that must available at PG XYZ. The result of the safety stock calculation is used as a basis to prevent inventory shortages. Calculation of safety stock is calculated using the formula below:

SS = Average delay in raw materials per day × raw material requirements per day (2)

Calculation of safety stock in PG XYZ requires some historical data of company through library study activities in division that handles the inventory activities problem at PG XYZ. Calculation of safety stock in PG XYZ using the following formula.

1. The average delay in sugarcane is 1,5 days.
2. Milling time is 150 days.
3. Maximum milling capacity of PG XYZ is 3.200 ton / day.
4. Requirements of sugarcane per day $= \frac{244539{,}8}{150} = 1630{,}26$ tons / day

From the above data, the results of sugarcane safety stock are as follows

SS = Average delay in raw materials per day × raw material requirements per day
= 1.630,26 tons / day × 1,5 days
= 2.445,39 tons

PG XYZ has a minimum supply of 2.821,9 tons per day, while the analysis result of efficient sugarcane raw materials should be 2445,39 tons. Safety stock at PG XYZ can save 376,51 tons per day or equivalent to 13,35%.

The third stage of inventory management analysis is reorder points calculation. The reorder point calculation at PG XYZ is used to know when to re-order so that sugarcane order can arrive on time. Calculation of reorder point can be calculated in the following formula:

Reorder Point = safety stock + raw material requirements during lead time (3)

In reorder point calculation, PG XYZ requires some other data.

1. Waiting time for sugarcane starts when make order until order arrive at PG XYZ is 0,3 day.
2. Assuming demand until raw materials arrive / Forecast Demand Through the Lead Time (DLT).
   DLT = KTH × waiting time = 1630,26 ton/day × 0,3 day
   = 1630,26 ton

ROP calculation in the following formula

ROP = DLT + SS
= 489,08 ton + 2445,39 ton
= 2934,47 tons

PG XYZ makes reorder 3200 tons in one order process. Based on calculation analysis in ROP, it is known the reorder is 2.934,47 tons, gets saving result is 265,53 tons or gets saving of 8,30%.

The fourth analysis of inventory management is the maximum inventory. Maximum inventory calculation is used to find the maximum available inventory total achieved by PG XYZ. Information on maximum inventory is expected PG XYZ can give a decision on warehouse condition whether it is full or not so as can minimize storage costs due to overstock of sugar production. Calculations is obtained in the following formula.

$$\text{Maximum Inventory (MI)} = SS + EOQ \quad (4)$$

From the previous data, the maximum inventory calculation = SS + EOQ
= 2445,39 + 10214,55
= 12659,94 tons / 2 days

PG XYZ has maximum inventory 14.000 tons, based on the maximum inventory calculation, it is known that the maximum inventory amount is 12.659,94 tons every 2 days. This can be information for PG XYZ does not procure sugarcane raw materials. The advantage for PG XYZ is storage costs can be allocated to other needs.

The last step of inventory management analysis is to calculate inventory cost amount. The purpose of inventory cost calculation is to compare real conditions in the field with mathematical calculation so that information is obtained whether the cost is efficient or not. The calculation of total inventory cost in the following formula.

$$TIC = \frac{c \times q \times T}{2} + \frac{R \times o}{q} \quad (5)$$

Where:

TIC	=	Total Inventory Cost
R	=	Raw material requirements during milling season (ton)
O	=	Cost in every order (Rp)
c	=	Storage cost per unit (Rp)
T	=	Storage time (day)
q	=	Number of weights in every order (ton)

Based on 2018 data can obtain some informations as follows.

1. The number of sugarcane needs during the production process is 244.539,8 ton.
2. The number of economic orders is 10.214,55 ton.
3. The cost of ordering sugarcane in a single order is Rp. 13.866.666,67
4. The cost of storing sugarcane is Rp. 65.000
5. The storage period for raw material is 1 day.

From classified data above, can be calculated the efficient total cost. The calculation efficient total cost in the following formula.

$$TIC = \frac{c \times q \times T}{2} + \frac{R \times o}{q}$$

$$TIC = \frac{65000 \times 10214{,}55 \times 1}{2} + \frac{244539{,}8 \times 13866666{,}67}{10214{,}55}$$

$$TIC = \text{Rp } 331972875 + \text{Rp } 331972714{,}8$$

$$TIC = \text{Rp. } 663945589{,}8$$

Based on calculation of total inventory cost, it is known that the effective cost of sugarcane milling is Rp. 663.945.589,8. PG XYZ during the milling process in 2018 spend Rp. 700,000,000. Based on the efficiency principle, there was a decrease in inventory costs number to Rp 36.054.410,02 or a decrease in the percentage is 5,15%.

4.3 Risk Management Analysis

Risk management analysis aims to evaluate the risks that might occur when an overstock occurs in a storage warehouse. Looking at the total raw materials number 244.539,8 ton with a yield rate of 10,72%, the sugar produced is 26.214,67 ton. This condition resulted overstock in warehouse because the warehouse capacity at PG XYZ only reached a capacity of 22.400 ton. Therefore, a risk management process is needed to reduce adverse effects of excess capacity in storage warehouse.

The risk management process is carried out in three stages: risk identification, risk assessment and risk control. The risk identification process is used to examine the reasons behind the occurrence of overstock based on potential of risk sources in storage warehouse at PG XYZ. The second stage is risk assessment. Risk assessment is carried out qualitatively with the risk matrix method. Risk matrix is used in classifying risks based on sequences through an identification process so as to give solutions [27]. The final stage is risk control. Risk control is used for decision making on overstock problems in PG XYZ warehouse.

The results of risk management analysis at PG XYZ are related to risk management as follows.

1. Risk Identification

Risk identification in this study was carried out through observation, looking at historical data of company and interviews with related parties. This step aims to map out what causes the risk event that occur. The results of risk identification are listed in Table 1. The results of risk identification contained 9 risk causes that resulted in sugar stacking at PG XYZ.

Table 1 Results of Overstock Risk Identification at PG XYZ

No	Overstock Risk Variable
1	Selling price of sugar is too low.
2	Sugar distribution by Badan Urusan Logistik (Bulog) is not good.
3	Relations between retailers are less harmonious.
4	There is no sugar packaging in 1 kg.
5	The previous milled sugar period was still available.
6	Regulation of trade ministry regarding imported sugar.
7	Refined sugar in circulation exceeds capacity.
8	The cost of storing sugar owned by the sugarcane farmers is still relatively low.
9	Less stable prices for sugar as raw material for food and beverage industry.

2. Risk assessment.

The risk assessment using risk matrix was carried out by questionnaire. The questionnaire distribution stage was carried out in two phases, namely the preliminary questionnaire to find out whether the risk variable was relevant or not. After finding out the relevant risk variables, the main questionnaire was distributed to determine the probability and overstock risk impact at PG XYZ. Table 2 shows the relevant risk variables for overstock risk at PG XYZ. The calculation example from risk variables is selling prices are too low from respondents number 24, for example 17 people answered relevant and 7 people answered irrelevant. The results of people answered relevant = 17 x 2 = 34 and 7 people answered irrelevant = 7 x 1 = 7 so that the calculation score = 41, while the score was relevant for all risk variables if answering all relevant = 24 x 2 = 48 and if all respondents answer irrelevant = 24 x 1 = 24. So the risk variable in the variable is still considered relevant because it is still within the relevant criteria limit. The results of the preliminary questionnaire measurements recapitulated in Table 2 indicated that all risk variables show relevant results.

Table 2 Preliminary Questionnaire Recapitulation

No	Risk Sub Variable	Relevant	Irrelevant	Total	Information
1	Selling price of sugar is too low.	16	9	41	Relevant
2	Sugar distribution by Badan Urusan Logistik (Bulog) is not good.	17	8	42	Relevant
3	Relations between retailers are less harmonious.	18	7	43	Relevant
4	There is no sugar packaging in 1 kg.	19	6	44	Relevant
5	The previous milled sugar period was still available.	18	7	43	Relevant
6	Regulation of trade ministry regarding imported sugar.	20	5	45	Relevant
7	Refined sugar in circulation exceeds capacity.	17	8	42	Relevant
8	The cost of storing sugar owned by the sugarcane farmers is still relatively low.	21	4	46	Relevant
9	Less stable prices for sugar as raw material for food and beverage industry.	17	8	42	Relevant

The probability and impact calculations of main questionnaire data are shown in Table 3. The risk level in Table 3 is obtained from multiplication of opportunities and impacts that occur when the main questionnaire was filled by respondents. The determination of the rating scale is based on position of opportunities and impact on risk matrix. The highest risk level in risk variable is previous milled period sugar is still available and refined sugar that is circulating exceeds capacity.

Table 3 Risk Level

No	Risk Sub Variable	Nilai		Risk Level	Scoring Scale
		Opportunity	Impact		
1	Selling price of sugar is too low.	2	3	6	Low
2	Sugar distribution by Badan Urusan Logistik (Bulog) is not good.	3	2	6	Medium
3	Relations between retailers are less harmonious.	4	2	8	Medium
4	There is no sugar packaging in 1 kg.	2	4	8	Medium
5	The previous milled sugar period was still available.	5	3	15	High
6	Regulation of trade ministry regarding imported sugar.	3	3	9	Medium
7	Refined sugar in circulation exceeds capacity.	4	4	16	High
8	The cost of storing sugar owned by the sugarcane farmers is still relatively low.	2	3	6	Low
9	Less stable prices for sugar as raw material for food and beverage industry.	3	3	9	Medium

Figure 1 is the result of probability and impact plots so that risk variables can be identified as high risk, moderate risk and low risk criteria. The aspect of impact assessment within the risk matrix is divided into 5 criteria, which are Very Often (VO) the value is 5, Often (O) the value is 4, Medium (M) the value is 3, Rare (R) the value is 2 and Very Rare (VR) the value is 1. Opportunity assesment aspect in risk matrix is divided into 5 criteria, namely Very Big (VB) the value is 5, Big (B) the value is 4, Medium (M) the value is 3, Small (S) the value is 2 and Very Small (VS) the value is 1 . The results of the risk variable plot on risk matrix were found that 56% of risk variables were in medium category, 22% of risk variables were in low category and 22% of risk variables were in high category.

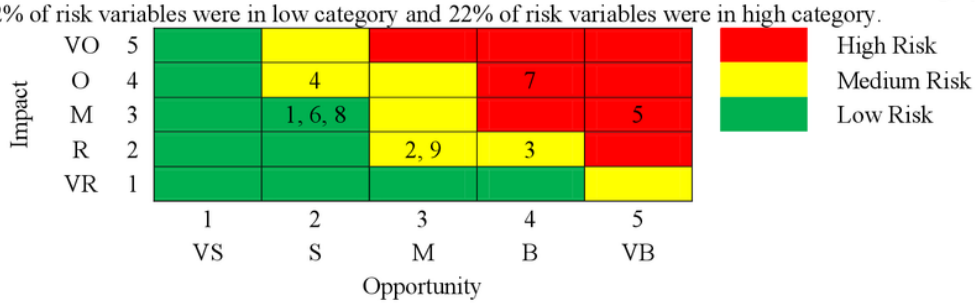

Figure 1 Risk Matrix of Overstock Risk at PG XYZ

3. Risk Control

Based on recommendations from PG XYZ, risk control is only on risk variables that produce high impact, namely that the previous milled period sugar is still available and refined sugar is circulating excess capacity. Risk control aims as an action in making decisions about overstock risk that occurs in storage warehouse. The risk management process is also carried out by contingency planning to make alternative actions that can reduce negative impact of risk events. Risk management stages are based on observations and considerations from PT XYZ. The results of manage these risks below.

a. The previous period of sugar was still available.

Possibilities	:	1) Restrain the risk Give limitation for sugarcane farmer to immediately take sugar through profit sharing. 2) Transfer the risk Reprocess to renew sugar quality.
Causes	:	1) Inventory cost in warehouse is affordable. 2) The price of sugar in market does not match with production cost.
Contingency Plan	:	1) Transfer sugar to other mills in subsidiary at PTPN XI. 2) Maximize good planning during the milling process.

b. Refined sugar in circulation exceeds capacity.

Possibilities	:	1) Share the risks Conducting distribution cooperation with Badan Urusan Logistik (Bulog). 2) Restrain the risks Strengthen retail sales through wholesale and retail sales.
Causes	:	1) Regulation of Trade Ministry concerning imported sugar. 2) Government supervision is not sustainable. 3) The price of local sugar cannot compete with refined sugar.
Contingency Plan	:	1) The government closes the sugar import policy. 2) Revitalization of sugar mills to improve local sugar quality. 3) Improve the quality of sugarcane seeds to produce high yields.

5. Findings and Discussion

Inventory management analysis is needed in business cycle by expecting that PG XYZ can meet the planned target. Based on the calculations that have been made, it is found some informations on performance of raw materials and sugar supply. The calculation result of the Economic Order Quantity (EOQ) from inventory management analysis shows that the optimal purchase number is 10.214,55 tons with purchase frequency is 23 times. Calculation estimation of safety stock produced is 2.445,39 tons so that it can saves 376,51 tons per day. The results of the reorder point calculation at PT XYZ obtained 2.934,7 tons so that it can saves 265,53 tons where the reorder point which is usually done by PG XYZ is 3200 tons in one order process. Total Inventory Cost from inventory management analysis is Rp. 663.945.589,8 resulted in an efficiency is Rp. 36.054.410,02. The overstock problem at PT XYZ cannot be avoided.

The results of risk management are necessary in strengthening decision making if there is still a risk outside the mathematical calculation of PESI management analysis. There are 9 risk variables from the identification activities carried out. Risk assesment obtained 56% of risk variables included in medium category, 22% in low category and 22% in high category. Based on recommendation of PG XYZ, the variables that require improvement are only the risks in high risk classification. When manage risks, contingency plans are also needed to provide logical solutions to decision making by stakeholders.

6. Conclusion

The conclusion obtained after data calculation, processing and analysis. Firstly, total inventory cost obtained from inventory management analysis of Rp. 663.945.589,8 obtained an efficiency of Rp. 36.054.410,02. PG XYZ can allocate these funds to other needs. Secondly, there are 2 risks that are categorized as high risk, namely the previous milled sugar is still available and refined sugar is circulating exceed capacity. The need for contingency planning for these risk variables is to make alternative actions that can reduce negative impact of risk events.

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