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Evaluating the Performance of Inventory Management The Production Division of PT. Tiga Serangkai Surakarta as a Case Study

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Abstract

This research aims to understand the process of production and to analyze the performance of inventory system on production division of PT. Tiga Serangkai. The data has been gathered from direct observation of the process production and warehouse and the interview with the production employee, the employee of warehouse division, supervisor of purchasing and finance manager. This research demonstrates that inventory system performance of PT. Tiga Serangkai Surakarta can be optimized through the determination of inventory policy, applying a model minimum and maximum inventory that considers the safety stock in accordance with service level plan, implementing model Reorder Point (ROP) which can be used as guidelines in charging supply back, and applying the model economic ordering quantity. In doing so, they can save the cost of inventory.

Keywords

inventory management, economic order quantity (EOQ), PT. Tiga Serangkai

All companies will attempt to achieve its purpose with performance maximizing of its departments, production is one of them. Production department is vital for a company. Production activities will need raw material. Raw material is very important and need thorough thought (Dian, 2008). Inventory management relates to raw material in production process is badly needed.

The purpose of inventory management is managing material in correct quantity, correct location, correct time, and minimum cost. It is due to direct relation of material inventory with customer desire fulfillment. Company will encounter customer not-fulfillment desire risk due to lack of inventory (Gandhi and Amithya, 2008). According to Henmaidi and Hidayati (2006), inventory management and procurement is vital in fulfilling customer desire on needed time and funding resource with appropriate economic management. The main problem of raw material planning and control is providing correct materials therefore the production activities is undisturbed and the invested fund on material inventory is not excesses.

PT. Tiga Serangkai Surakarta is a manufacture company in book printing and publishing such as the Qur'an, general books, and also education and learning books for TK, SD/MI, SMP/ MTs, SMA/MA. The research purpose is finding out the production process at PT. Tiga Serangkai Surakarta started with raw material procurement into book (finished goods), and also find out and analyze inventory management performance of PT. Tiga Serangkai Surakarta production department.

The interview on administration staff of PT. Tiga Serangkai Surakarta production department shows that there are the problems relate to raw materials for production process. The problems of production department is relating to lack of raw material in production process due to late supplies of needed material shipping. In addition, the problem is due incorrect safety stock quantities of minimum stock of materials in the warehouse before the reordering material. It also dues to not on time deal with supplier. Late material supply will cause late material procurement process.

PT. Tiga Serangkai Surakarta production department's inventory management performance evaluation is needed to avoid the problem

aforementioned, and also as consideration in material inventory's decision making. This evaluation is also used to enhance the inventory system performance, to decide the company's efforts to enhance inventory system performance enhancement, and to calculate the company inventory's cost to manage its inventory. The inventory studied in this research is related to paper as production process' raw material for finished goods, namely book. The method in use to evaluate inventory management performance for this research is raw materials inventory control policies.

Processing Idle Resources

Inventory according to Nasution (1997, p. 1) is an idle resources waiting for further process. The further process means manufacture system production activities, system distribution marketing activities or household system food consumption activities. According to Assauri (1978, p. 176) inventory definition is an active consists of company owning goods, or inventory's good to be sold at normal business period, or goods in production processing, or raw material inventory waiting for production process.

According to Prawirosentono (1997, p. 61) inventory is flowing wealth of a company in raw material inventory, work in process goods, and finished goods. Inventory according to Handoko (2000, p. 333) is a general terminology of everything or saving organization resources to anticipate demand fulfillment. Pardede (2005, p. 412) argues that inventory is quantity of materials or available materials to use in future time. Inventory is occurred whether procurement goods quantity (bought or made) is higher than used materials quantity (bought or made).

According to Ahyari (1999, pp. 4-7) there are several affected factors of raw materials inventory. Those factors are inter-related; therefore they will affect the raw materials inventory at the same time. Those factors

are (1) Estimation use; estimation on raw materials quantities for the company to use in production process in the future time. Raw material need estimation is found on the production planning, mentioned on company sales planning with finished goods inventory level required by the management. Furthermore, (2) material cost; raw material cost is the basic of calculation on total cost of company fund for this raw material inventory investment. The next factor, (3) inventory costs; the cost of raw materials inventory establishment should be calculated in raw material inventory amount decision. There are two cost types in inventory cost calculation, namely the cost increasing dues to increasing inventory rates, and the lower cost dues to dues to higher inventory rates.

The further factors discuss on (4) Expenditure policy; the cost from the company for raw material inventory depends on the company expenditure policy. Is the provided fund sufficient to pay all the company needed materials or only some of them? (5) Real utilization; the amount of raw material absorption by the company production process and its relation with arranged utilization estimation should be analyzed all the time. Therefore the raw material estimation could be arranged close to real condition. (6) Lead period; lead time is needed frame time (occurred) in raw material ordering time to the raw material arrival. The known correct time will make the company to but at the right time, therefore inventory commutation risk or inventory lack will be put in minimum as possible.

Inventory system is the inputs related inventory management mechanism and made them into output. It will need feedback to be an output with certain standard. The purpose of this system is determine and guarantee finished product availability, in process goods, components, and optimum raw materials in optimum quantities and time (Baroto, 2002, p. 54). Handoko (2000, p. 334) writes inventory system definition is a series of policies and controls to monitor and determine should be

maintained inventory level, the time the inventory should be filled, and the total amount of orders to be done. Tampubolon (2004, p. 190) further argues inventory management is operational management function and should establish a permanent system with various tests, such as inventory classification method, how inventory should be written, and maintain accurately.

Inventory System Performance Measurement

According to Rangkuti (2002, p. 88) the related concept used by the management to monitor inventory level is Inventory Turn Over. It is an annual requirement ratio divided with inventory rates, the formula is:

$$\text{ITO} = \frac{\text{annual demand}}{\text{inventory average}}$$

Whether the company inventory turnover is lower than its competitor, in turn so the inventory level is higher and need to be reduced. The difficulty of this measurement is it only focuses on one cost type, inventory holding cost.

This calculation is considering ordering cost and shortage cost, and also quantity discount. The company can use quantity discount with selecting higher inventory rates at the certain condition. Therefore the turnover and cost will be lower and will create higher profit. According to Henmaidi and Hidayati (2006) inventory system performance is measured base on two measurements, namely Turn Over ration (TOR) and Inventory Turn-Over (ITO). Turn Over ration (TOR) used as inventory system performance measurement dues to its ability to show inventory circulation at certain period.

Inventory Turn Over (ITO) is another format of TOR showing the duration of inventory ability to fulfill utilization. The formula is:

$$\text{ITO} = \frac{\text{total inventory}}{\text{inventory average}}$$

Raw Material Inventory Control's Policy

Inventory control is vital management function because physical inventory of most companies involving the biggest rupiah investment in fluent active post (Handoko, 2000, p. 333). Material planning and control according to Prawirosentono (1997, p. 79) is estimation activities material inventory in qualitative and quantities, therefore the company will operate as planned. Assauri (1978, p. 190) states that materials orders need to determine the orders, the total amount of orders to be economics, and the time of orders. The need of inventory is the safety stock of inventory, minimum inventory; the amount of minimum inventory, the amount of inventory at the reordering; and the amount of maximum inventory.

Economic Order Quantity **(EOQ).** According to Teguh Baroto (2002, p. 5) to get minimum cost on every order (EOQ) formula EOQ could be used as below:

$$\text{EOQ} = \sqrt{\frac{2AD}{IC}}$$

With   A = order cost

D = requirement per period/ annually

C = cost per unit

I = annual saving cost percentage

Safety Stock. According to Assauri (1978, p. 200) to determine the amount of safety inventory the company will need, should be based on measured rational considerations. It will create correct and effective policy determination. There are several approaches such as probability of stock out and level of service approach. First, probability of stock out; this approach utilization is used by lead time assumption and is constant; all ordered materials are accepted from suppliers at the same time. This assumption will create a stock out, does not cause by lead time's fluctuation or entrusted ordered good not at the same time. Stock out is due to requirement or utilization enhancement.

Second, level of service approach; According to this approach safety inventory amount which is owned/ established by the company will me more rational or correct. However it will need the relation of service level and safety inventory level in the level of service. A measurement is needed to watch this relation of expected absorbed/ fulfilled of inventory requirement fluctuation. The measurement in use is:

$$Variance = \frac{\Sigma_1^N (D_i - \bar{D})^2}{N - 1}$$

With $\bar{D}$ is a requirement rate

$$Deviasi\ Standar = \sqrt{Variance}$$

The relation of safety inventory and deviation standard is shows on the formula below:

$$SS = Zr\sqrt{L}$$

With   Z   = safety factor

r = standard deviation

L = lead time

ROP (Reorder Point). According to Heizer and Render (2010: 99-100) Reorder point (ROP) is inventory level (point) in with an action should be taken to refill goods inventory. ROP formula is:

$$ROP = d \times L$$

The ROP equation assumes requirement at lead time and the lead time is constant. Whether the case is different, inventory addition or usually called safety stock should be added. The equation will be:

$$ROP = d \times L + SS$$

With   d   = daily requirement
         L   = ordering lead time
        SS   = safety stock

Daily requirement (d) is calculated by dividing annual requirement (D) with work days in a year.

$$d = \frac{D}{\text{total amount of annual work hours}}$$

Total Inventory Cost (TIC). Heizer and Render (2010, pp. 93-94) defines that the purpose of inventory model in general is minimizing total cost. It is assumed the most significant cost is matching set (ordering) and saving cost. Other costs are constant. The minimizing matching set (saving) cost will minimize total cost. The increasing ordered quantities will decrease annual ordering amount. The increasing ordering quantities will increase saving cost due to increasing amount inventory rates.

Nasution (1997, pp. 18-19) discusses that inventory total cost is gained with this formula:

$$TIC = \sqrt{2Dkh}$$

> With   D = Periodical/ annual requirement
>
> k = order cost
>
> h = saving cost

Doing Research and Its Findings

    This research is using primary and secondary data. Primary data are collected data of PT. Tiga Serangkai Surakarta Production and Purchasing Division. These data is collected with direct observation on production process and warehouse; and also from direct interview to related parties such as production staff, warehouse staff, purchasing supervisor and financial manager. Secondary data is arranged data in written documents. These data are gained of company management reports and documents, especially of production, literature, previous research, bibliography, internet, and related institution data. The data resources used in this research is internal data resources, namely data of organization or PT. Tiga Serangkai Surakarta. In turn, primary data are company organization structure, buying process and goods acceptance data, and others.

    PT. Tiga Serangkai Surakarta is producing goods in the form of book, with several production process steps: a). the script is accepted by publishing division in pdf. b). Then the script will be setting at pre-press division of production department. At pre-press division the script will be imposition. It is a process of pages, writing, pictures, chapter and verse switching's layout. c). The imposition script will be on plate process. d). The finished plate will be taken to printing machine at printing division to be printed. The machine in use is web machine printing to print content and sheet printing machine to print cover. e). After printing the script will be brought to finishing division to process gluing, cutting, and packing.

f). The packed books then send to finished good warehouse ready for shipping or selling.

Determine Inventory Rate Values

Determine Safety Stock. Determine safety stock with customer satisfaction level of 95%, therefore the normal curve table result is z = 1.65.

$$SS = zr\sqrt{L} \quad SS = zr\sqrt{L}$$

$$Deviasi\ Standar\ (r) = \sqrt{Variance}$$

$$Variance = \frac{\sum_1^N (D_i - \bar{D})^2}{N - 1}$$

Material Requirement for one period (1 year)

Month	D (Kg)	$\bar{D}$	$(D - \bar{D})$	$(D - \bar{D})^2$
January	234.675	438.317,4	-203.642,4	41.470.227.077,76
February	728.901	438.317,4	290.583,6	84.438.828.588,96
March	533.022	438.317,4	94.704,6	8.968.961.261,16
April	602.111	438.317,4	163.793,6	26.828.343.400,96
May	1.006.491	438.317,4	568.173,6	322.821.239.736,96
June	820.786	438.317,4	382.468,6	146.282.229.985,96
July	372.545	438.317,4	-65.772,4	4.326.008.601,76
August	54.160	438.317,4	-384.157,4	147.576.907.974,76
October	26.932	438.317,4	-411.385,4	169.237.947.333,16
November	3.551	438.317,4	-434.766,4	189.021.822.568,96
Total	4.383.174			1.140.972.516.530,4
Rates	438.317,4			

Source: Processed secondary data, 2014

$$Variance = \frac{\sum_1^N (D_i - \bar{D})^2}{N-1} = \frac{1.140.972.516.530,40}{10-1}$$

$$= \frac{1.140.972.516.530,40}{9}$$

$$= 126.774.724.058,93$$

$$r = \sqrt{Variance} = \sqrt{126.774.724.058,93}$$

$$= 356.054,38$$

$$SS = zr\sqrt{L} = 1,65 \times 356.054,38\sqrt{0,23}$$

$$= 587.489,73 \times 0,48$$

$$= 281.995,07 \text{ round down into } 281.995$$

The safety stock is 281.995 kg.

Determine Minimum Inventory Amount.

$$Min = d \times L + SS$$

$$d = \frac{4.383.174}{298} = 14.709$$

$$Min = 14.709 \times 7 + 281.995$$

$$= 102.963 + 281.995$$

$$= 384.958$$

The minimum inventory is 384.958 kg.

Determine Maximum Inventory Amount

$$Maks = 2dL + SSMaks = 2dL + SS$$
$$= 2 \times 14.709 \times 7 + 281.995$$

$$= 205.926 + 281.995$$

$$= 487.921 = 487.921$$

The maximum inventory is 487.921 kg.

Determine Inventory Rate Value

Inventory Rate $\quad = \dfrac{\text{minimum}+\text{maksimum}}{2} \dfrac{\text{minimum}+\text{maksimum}}{2}$

$$= \dfrac{384.958 + 487.921}{2} = \dfrac{872.879}{2}$$

$$= 436.439,57 \text{ round up into } 436.440$$

The inventory rate of 436.440 kg, for inventory rate value of 436.440 X cost per unit is 436.440 x Rp. 348.170 = Rp. 151.955.314.800,00

Determine Inventory Circulation Ratio

Inventory system performance is measured base on two measurements, namely Inventory Turn Over (ITO) and Turn Over Ratio (TOR).

$$= \dfrac{4.383.174}{436.440}$$

$$\text{ITO} \dfrac{\text{permintaan per tahun}}{\text{rata}-\text{rata persediaan}}$$

$$= 10,04 \text{ round down into } 10$$

The Inventory Turn Over value is 10

The Turn Over Ratio calculation formula is:

$$= \dfrac{1.906.263.033}{28.033.279,90}$$

TOR $\quad = 67,9$
Turn Over Ratio (TOR) value is 67,9

Determine Reorder Point Value (ROP)

$$\text{ROP} = \text{Min} = d \times L + SS$$

$$= 14.709 \times 7 + 281.995$$

$$= 102.963 + 281.995$$
$$= 384.958$$

Reorder Point (ROP) value is 384.958 kg.

Determine Economic Order Quantity Value (EOQ)

$$EOQ/Q^* = \sqrt{\frac{2AD}{IC}}$$

$$I = \frac{H}{P \times banyaknya\ jenis\ bahan} = \frac{1.135.023,67}{348.170 \times 68}$$

$$= \frac{1.135.023,67}{23.675.560} = 0,05$$

$$EOQ = \sqrt{\frac{2 \times 851.317.520 \times 4.383.174}{348.170 \times 0,05}}$$

$$= \sqrt{428.695.501.554,81}$$

$$= 654.748,43 \text{ Round down into } 654.748$$

The Economic Order Quantity (EOQ) is 654.748 kg.

Determine Inventory Total Cost

$$TIC = \sqrt{2Dkh}$$

$$= \sqrt{2 \times 4.383.174 \times 1.558.790 \times 1.135.023,67}$$

$$= \sqrt{15.509.979.952.853.000.000}$$

$$= 3.938.271.188,33$$

The inventory total cost value is Rp 3.938.271.188,33 annually.

The data analysis result discussion will discuss the result of safety stock calculation, minimum inventory, maximum inventory, inventory rate value, inventory system performance, Reorder Point (ROP), Economic Order Quantity (EOQ), and its total cost.

Inventory Rate Value Analysis

Data processing to determine inventory rate value is done after safety stock calculation. Safety stock analysis is used to determine safety stock amount, should own by a company. Therefore it will create correct and effective policy. Safety stock is gained from multiplying wanted service level (z) with standard deviation (r) and lead time root (L), the lead time for 7 days = 0.23 of month. Safety stock calculation result for paper raw material at PT. Tiga Serangkai Surakarta should have safety stock at raw material warehouse of 281.995 kg. It will prevent material lacking. PT. Tiga Serangkai Surakarta able to apply inventory policy with safety stock inventory model application or safety inventory of 281.995 kg with the service level plan.

Minimum and maximum inventory analysis is carried out to find out the minimum and maximum limit of material at inventory warehouse. The minimum inventory is gained of multiplying daily requirement (d) with lead time (L) and adds the result with safety stock value (ss). The maximum inventory is gained from multiplying 2 of daily requirement (d) and leads time (L) and adds it with safety stock value (ss). Minimum inventory calculation for paper raw material at PT Tiga Serangkai Surakarta is 384.958 kg, and the maximum inventory is 487.921 kg.

It means PT Tiga Serangkai Surakarta inventory policy is applied with minimum inventory model of 384.958 kg with consideration of on safety stock as mentioned in the service level plan. The minimum inventory is the smallest inventory amount limit, should be available at the company for every material. PT Tiga Serangkai Surakarta also able to applied maximum inventory of 487.921 kg with consideration of safety stock mentioned in the service level plan. This maximum inventory policy is needed to avoid exceeding inventory at the warehouse and increasing cost of inventory saving.

The minimum and maximum inventory calculation above show the inventory rate is 434.440 kg of paper. This is rate is equal to Rp. 151.955.314.800,00. It means inventory rate should be available at PT Tiga Serangkai Surakarta warehouse is 434.440 kg with inventory rate value of Rp. 151.955.314.800,00.

Inventory System Performance Analysis

The inventory system performance is measured base on two measurements, namely Turn Over Ratio (TOR) and Inventory Turn Over (ITO). Turn Over Ration (TOR) uses as inventory system performance measurement due to its ability to show inventory goods circulation at certain period. The higher Turn Over Ratio value the faster inventory circulation, means higher or more efficient investment utilization.

Inventory Torn Over (ITO) is another form of TOR, shows the period of inventory ability to fulfill utilization. Daily general consumption goods usually have high Inventory Turn Over, and expensive goods usually have low Inventory Turn Over. Turn Over Ratio (TOR) value at PT Tiga Serangkai Surakarta is 67.9, means the fulfillied inventory is 67.9%. PT Tiga Serangkai Surakarta Inventory Turn Over (ITO) value is 10. It means inventory period ability to fulfill its user is 10% each month.

The inventory circulation value calculation's result shows the fulfilled PT Tiga Serangkai Surakarta inventory performance is about 67.9% and inventory circulation level is 10% each month. This company should enhance its inventory utility and management with applying inventory policies. It needs to be done to fulfill inventory and enhance inventory circulation. It dues to the higher a company inventory circulation value the faster inventory circulation, means the higher and more efficient investment utilization.

Reorder Point (ROP) Analysis

Reorder Point (ROP) is an inventory level (Point) to act to refill inventory. ROP equation is similar to minimum inventory equation. It assumes the requirement at lead point and the lead time is constant. Whether the case is different, the addition stock or usually called safety stock should be added. PT Tiga Serangkai Surakarta Reorder Point (ROP) is 348.958 kg. It means the company able to refill its inventory when the raw material amount is 348.958 kg. PT Tiga Serangkai Surakarta inventory policy can be carried out with applying Reorder Point (ROP) inventory model. It can be guidance for the company to take an action in inventory refill.

Economic Order Quantity (EOQ) Analysis

Economic Order Quantity (EOQ) method is permanent order method. It uses demand assumption and constant lead time at planning horizon, in fact there is no constant demand and lead time. This method is determining method with two cost variables as parameter namely ordering cost and saving cost. EOQ model explains more often orders will make the saving cost lower and ordering cost higher. Therefore more seldom orders will make the saving cost higher and ordering cost smaller.

Economic Order Quantity (EOQ) calculation result or economic ordering quantity at PT. Tiga Serangkai Surakarta is 654.748 kg. It means PT. Tiga Serangkai Surakarta inventory policy can be carried out with applying Economic Order Quantity (EOQ) model namely the economic material order of 654.748 kg, therefore the company able to cut the inventory cost.

Inventory Total Cost Analysis

Inventory model general purpose is minimizing total cost. The new providing assumption is ordering cost and saving cost. All other costs

are constant. The saving cost minimization will decrease the total cost. The increasing orders quantity will decrease annual orders. The increasing orders quantity will increase saving cost, due to higher inventory amount rate. The TIC calculation on PT. Tiga Serangkai Surakarta total cost is Rp 3.938.271.188,33. It means inventory cost of PT. Tiga Serangkai Surakarta in 2013 is Rp. 3.938.271.188,33. The company able to reduce inventory cost with more effective and efficient inventory management.

Conclusion

PT. Tiga Serangkai Surakarta goods production of books has several production process steps: the script is accepted by publishing division in pdf; Then the script will be setting at pre-press division of production department. At pre-press division the script will be imposition. It is a process of pages, writing, pictures, chapter and verse switching's layout; The imposition script will be on plate process; The finished plate will be taken to printing machine at printing division to be printed. The machine in use is web machine printing to print content and sheet printing machine to print cover; After printing the script will be brought to finishing division to process gluing, cutting, and packing; The packed books then send to finished good warehouse ready for shipping or selling.

PT. Tiga Serangkai Surakarta inventory performance able to fulfill about 67.9% and inventory circulation level is 10% each month. The company should enhance its inventory management and utilization with applying inventory policies, therefore the inventory is fulfilled and the inventory circulation level is increasing. The increasing inventory circulation value will make the inventory circulation faster, means higher or more efficient investment utilization. PT. Tiga Serangkai Surakarta inventory system performance enhancement can be carried out with optimal inventory policy decision, namely:

a. Inventory policy can be carried out with applying minimum maximum inventory model and consideration on safety stock mentioned on service level plan.

b. Inventory policy can be carried out with applying Reorder Point inventory model, could be company guidance to act in inventory refill.

c. Inventory policy can be carried out with applying economic ordering quantity model to reduce the inventory cost. Total cost calculation shows annual inventory cost is Rp. 3.938.271.188,33.

The research limits are the research analysis uses inventory system with traditional method or determined inventory system and the research data uses data of all paper raw materials; non-specific discusses one type of raw material. Base on the conclusions mentioned above the writer suggests to the related parties: for the next researchers, the research could be carried out on different object with different method and for the company, to pay more attention on the inventory system performance.

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