ISSN : 1978-774X

DETERMINING THE INVENTORY POLICY FOR V-BELT USING PROBABILISTIC METHOD

Sukanta[1], Dene Herwanto[2]

University Singaperbangsa of Karawang, Indonesia
[1]sukanta.tsm@gmail.com, [2]Deneherwanto@yahoo.com

ABSTRACT

The Company is one department that has an important role namely the material department. Material department is responsible to analyzing all kinds of materials needs related to the process of production. In the production process that in the production NPK fertilizer Granular, there is a mechanical material that has a critical function as transmission components supporting the production process, it is the v-belt mechanical material routine. The problems being faced by the company is to determine optimal material inventory policy to ensure a smooth production process. In accordance with the existing problems, the aim is to determine the optimal inventory policy, there will be use a probabilistic inventory method, which consists of two models Q Model and P Model of inventory control. At the time of the research, it is known that the company implement inventory control with P Model (back order) with order time is made every four months (T0 = 1/3 or 0.333). After processing the data, found that the total cost of inventory for Q Model as IDR 47,442,745 and P Model as IDR 63,916,823. The total expenses of the inventory cost Q Model resulted in smaller total expenses of inventory cost.

Key words: Inventory control probabilictic

1. INTRODUCTION

The Company is a state-owned company in the Departemen Perindustrian that has the task to build an urea fertilizer plant in the village of Karawang, West Java. The Company producing various types of fertilizers one of them is the NPK Granular fertilizer. In the production process in the company, in the production NPK fertilizer Granular, there is a mechanical material that has a critical function as transmission components supporting the production process, it is the v-belt mechanical material routine.

As one of the mechanical material routine that is very important in supporting a smooth production process, certainly v-belt inventory system also has a very close relationship with smooth production process. The object of observation in this study are 10 types of the v-belt mechanical material routine as transmission components supporting the production process for the manufacture of NPK Granular fertilizer.

The problems that arise in the v-belt mechanical material routine inventory control in the company is to determine optimal inventory policies to support the smooth production process. Determination of inventory policy is influenced by several factors in this case every kind of v-belt usage rate has uneven or fluctuating and frequent inaccuracy of supplier delivery time.

In accordance with the existing problems, the author proposes to use a probabilistic inventory method to be applied to the company. The use of probabilistic inventory methods because the company's need of the v-belt mechanical material routine is probabilistic, so the company does not know the exact material needs for the v-belt mechanical material routine in the future.

2. THEORETICAL BASIS

2.1. Inventory

Stock (inventory) is idle resources (idle resources) whose existence is awaiting further processes. What is meant by a further process here can be found in the production activities such as manufacturing systems. (Bahagia, 2006)

2.2. Probabilistic Inventory System

In probabilistic inventory system the average requirement or demand is uncertain and fluctuating but have a specific pattern that can be characterized by the distribution patterns. The central value and the actual value. In probabilistic inventory control, inventory policy determination is relatively difficult, the information that is known is the pattern of demand is in the form of average price parameter, standard deviation, and demand distribution. Probabilistic inventory models can be viewed as a model by adding a static deterministic inventory of safety stock.

2.3. Probabilitstic Inventory of Q Model

Q models characterized by two fundamental things, there are a constant lot size order and order is done when the goods have reached the reorder point (Bahagia, 2006). Probabilistic demand is the demand that not fixed or variable, while the lot size order always remains so time interval between the time of the booking is changeable. In the Q models, inventory shortages may occur during squares off time (lead time), therefore the backup safety (safety stock) used to dampen fluctuations in the need for the lead time period.

2.4. Probabilistic Inventory of P Model

P model is characterized by the two main points, there are ordering made by the fixed interval (T) of the lot size, varies depends on maximum inventory and inventory at the time the order is made.

3. RESEARCH METHOD

The research methodology can be seen in Figure 1.

3.1. Data Collection Method

Data used in this study are classified into two, namely general data and specific data. These data are needed to find answers to the problems and simplify inventory policy in its processing.

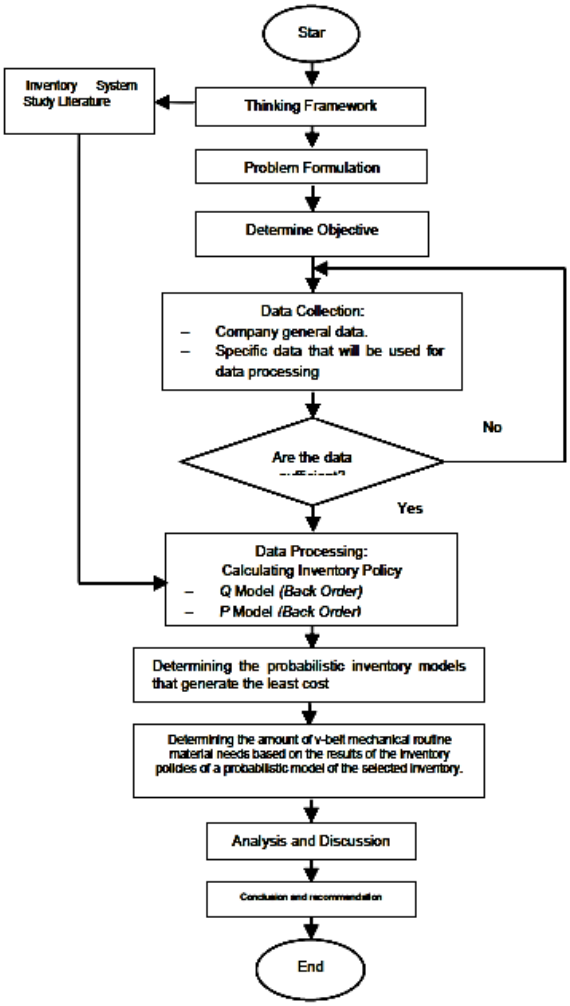

Figure 1. Research Methodology Flow Chart

a. Company General Data
   General data required is the general data about the object of this study which took place at The Company, general data that will be discussed are as follows:
   - A brief history of the company
   - The company's activities
   - Vision and mission of the company
   - The organizational structure and others.

b. Specific Data
   Specific data is data that has a very important link with the theme of material inventory control of v-belt routine mechanical being studied. These data are:
   - Data regarding v-belt mechanical material routine: Item or the material type routine mechanical v-belt, Price per pcs, and lead time.

- Data routine use of v-belt mechanical materials from the 2010 until 2014.

3.2. Data Processing Method

Processing steps of this research data as follows:

3.2.1. Hadley-Within Q Model (Back Order)

Conditions in the company when there is a shortage of inventory is, by way of a back order, in this case the user wants to wait until a requested item is available in the warehouse. To determine the lot size order q_0* and reorder point r* can be found iteratively using the Hadley-Within method where the lot size order q_0* and reorder point r* derived as follows :

1. Calculate the value of initial q_{01}* equal to the value of q_{0w}* using Wilson formula.
   $$q_{01} = q_{0w} = \sqrt{\frac{2AD}{h}} \quad (1)$$
2. Based on the value of q_{01}* determined, calculate the value of α using this equation:

$\alpha = \frac{hq_{01}}{C_u D} \rightarrow z_\alpha$ value can be found from standard normaly distribution.

Reoder point with formula as below:

$r_1^* = D_L + z_\alpha S\sqrt{L}$ (2)

3. Based on value of r_1* determined, calculate the value of q_{02}* using this equation:
   $$q_{02}^* = \sqrt{\frac{2D\left[A + C_u \int_r^\infty (x-r) f(x) dx = 0\right]}{h}} \quad (3)$$
   Where back order per cycle can be seen back order probabilistic and formula as below:
   $N = \int_n^\infty (x - r_1) f(x) dx = S_L[f(z_\alpha) - z_\alpha \Psi(z_\alpha)]$ or $N = S_L[f(z_\alpha) - z_\alpha \Psi(z_\alpha)]$ (4)
4. Recalculate the value of $\alpha = \frac{hq_{02}}{C_u D}$ and r_2* using equation, $r_2^* = D_L + z_\alpha S\sqrt{L}$
5. Compare r_1* and r_2*. If r_2* relatively similar to r_1*, so iteration is completed by the r_1* = r_2* and q_{01}* = q_{02}*. If not then go back to step 3 using the value r_1* = r_2* and q_{01}* = q_{02}*.
   a. Safety Stock Value, $ss = z_\alpha S\sqrt{L}$
   b. Service Level $\eta = 1 - \frac{N}{D_L} x100\%$
   c. Total Cost Expectation per year
   $$O_T = D_P + \frac{AD}{q_0} + h\left(\frac{1}{2}q_0 + r - D_L\right) + C_u \frac{D}{q_0} \int_r^\infty (x - r) f(x) dx \quad (5)$$

3.2.2. Hadley-Within P Model (Back Order)

At the time of the research, it is known that the company implement inventory control with P Model (back order) with order time is made every four months (T_0 = 1/3 or 0.333). In determining the lot size q_0* and reorder point r* can be found iteratively using the Hadley-Within method where the lot size order q_0* and reorder point r* derived as follows:

1. Calculate the value of T_0
   In determining the inventory policies using a P model, value of T_0 expected by the company is 4 months.
   T_0 = 1/3 year = 0,333
2. Calculate the value of α and R :
   $$\alpha = \frac{Th}{C_u} \quad (6)$$
   z_α value can be found from standard normaly distribution.
   $$R = DT + D_L + z_\alpha S\sqrt{T + L} \quad (7)$$
3. Calculate the value of safety stock
   $ss = z_\alpha S\sqrt{T + L}$
4. Calculate inventory total cost $(OT)_0$ using this equation:
   $$O_T = D_P + \frac{A}{T} + h\left(R - D_L + \frac{DT}{2}\right) + \frac{C_u}{T} \int_R^\infty (z - R) f(z) dz \quad (8)$$
   $N = S\sqrt{T + L}[f(z_\alpha) - z_\alpha \Psi(z_\alpha)]$
   Value of $f(z_\alpha)$ and $\Psi(z_\alpha)$ can be found from back order probabilistic.
5. Repeat step 2 by changing $T_0 = T_0 + \Delta T_0$
   - If the result of new $(OT)_0$ bigger than initiate $(OT)_0$, additional iteration of T_0 can be stopped. Then try using iteration $(T_0 = T_0 + \Delta T_0)$ up to the value found T* = T_0 that gives the value of minimum total costs $(OT)_0$*.
   - If the result of new $(OT)_0$ smaller than initiate $(OT)_0$, additional iteration of $(T_0 = T_0 + \Delta T_0)$ continued and only stopped if new $(OT)_0$ bigger than $(OT)_0$ that previously calculated. T_0

price that gives minimum total cost (OT)* is the optimal lead time (T*).

4. RESULT AND DISCUSSION

Here below is the result of calculations inventory policy with the total cost of inventory generated from each probabilistic inventory model:

a. The calculation result of inventory policy v-belt mechanical routine material using Q model can be seen table 1.

Table 1. Calculation recapitulation of inventory policy using Q model

No	Nama Material Rutin Mekanik V-Belt	Inventory policy (pcs)			ή	Inventory cost (IDR)
		qo	ss	r		
1	V-Belt B-92	89	37	51	75,24%	4.405.496
2	V-Belt B-95	28	7	12	87,88%	2.419.188
3	V-Belt B-98	45	8	17	94,69%	2.966.926
4	V-Belt C-82	32	12	16	81,82%	3.289.864
5	V-Belt C-83	32	10	16	86,08%	2.859.069
6	V-Belt C-98	25	8	11	71,69%	1.705.265
7	V-Belt C-139	19	11	15	84,85%	5.956.955
8	V-Belt C-161	64	29	53	95,69%	19.712.012
9	V-Belt B-2390	39	3	5	67,20%	493.583
10	V-Belt SPB 3550	17	6	9	86,92%	3.634.387
Total						47.442.745

Overall, v-belt inventory control using Q Model inventory policy (Back Order), obtain that total inventory cost is IDR 47.442.745.

b. The calculation result of inventory policy v-belt mechanical routine material using P model can be seen table 2.

Table 2. Calculation recapitulation of inventory policy using P model (Back Order)

No	Material Mechanic V-Belt	Inventory policy (pcs)		Inventory cost (IDR)
		R	ss	
1	V-Belt B-92	117	90	6.316.997
2	V-Belt B-95	27	17	3.652.008
3	V-Belt B-98	36	17	4.028.606
4	V-Belt C-82	39	29	4.889.017
5	V-Belt C-83	35	24	4.252.519
6	V-Belt C-98	29	23	3.135.869
7	V-Belt C-139	32	24	8.443.819
8	V-Belt C-161	99	52	22.438.042
9	V-Belt B-2390	18	13	1.592.992
10	V-Belt SPB 3550	20	14	5.166.955
Total				63.916.824

In the P Model (Back Order) the determination of value q_0 based on the quantity in time to make an order (R-r). So that the values are not necessarily dependent on the last stock (r) at the time of order. The ordering period is fixed at ordering every four months. Overall, v-belt inventory control using P Model inventory policy (Back Order), spend quite big total inventory cost, this occur because of v-belt order is made every four months, so that in a year there are 3 times ordering. Total inventory cost is IDR 63.916.823,- (Sixty Three Million Nine Hundred Sixteen Thousand Eight Hundred Twenty-Three Indonesian Rupiah).

c. Probabilistic inventory models that generate the most minimum total inventory cost

In determining inventory control model should be used for each type of v-belt mechanical routine material, The author will vote based on the comparative total inventory costs incurred for each v-belt. Here the authors present a comparative total cost of inventory in tabular form below can be seen table 3.

Table 3. Comparison of the total cost of inventory

No	Parts Mechanic V-Belt	Inventory cost Model Q (IDR)	Inventory cost Model P (IDR)
1	V-Belt B-92	4.405.496	6.316.997
2	V-Belt B-95	2.419.188	3.652.008
3	V-Belt B-98	2.966.926	4.028.606
4	V-Belt C-82	3.289.864	4.889.017
5	V-Belt C-83	2.859.069	4.252.519
6	V-Belt C-98	1.705.265	3.135.869
7	V-Belt C-139	5.956.955	8.443.819
8	V-Belt C-161	19.712.012	22.438.042
9	V-Belt B-2390	493.583	1.592.992
10	V-Belt SPB 3550	3.634.387	5.166.955
Total		47.442.745	63.916.824

From the table above shows that the Q Model (backorder) that has the minimum total inventory cost is shown in bold and colour. Thus, the Q Model (Back Order) can be used by company as a consideration to determine the company's inventory policy.

5. CONCLUSION

a. In determining the form of the inventory control system to determine optimal inventory policy, each probabilistic inventory models have different result. Wheter it is the order lot size, the reorder point and safety stocks.
b. The inventory control system model that fits with the problems being faced by the company best use the Q Model (back order). Because it can be concluded after the processing of the data, it was found that the total cost of inventory that should be spent annually for Model Q (back order) as IDR 47,442,745 and Model P (back order) as IDR 63,916,823. Based on the calculation results of total inventory costs, Q Model (back order) resulted in smaller total inventory costs making it more efficient when used by a company to determine inventory policies.
c. Based on the results, the research model of the inventory control system that has the smallest total inventory cost is the Q Model (back order). Therefore, the amount of material needs routine for 10 different types of vbelt mechanical routine material are based on the calculation of inventory policy Q model (back order).

6. REFERENCES

(a) Bahagia, Senator N. (2006) *Sistem Inventori*, Penerbit ITB, Bandung.
(b) Bella Suciana Istiqomah, Iveline Anne Marie, (2015). “Perbaikan Kebijakan Pengendalian Persediaan Just in Time produk Main floor side LH pada PT. Gaya Motor”, *Jurnal Ilmiah Teknik Industri*, Vol. 14, No. 1.
(c) Yamit, Zulian. (1999). *Manajemen Persediaan,* Penerbit Ekonisia Fakultas Ekonomi UII, Yogyakarta.

AUTHOR BIOGRAPHIES

Sukanta is both Dean Faculty of Engineering and a lecturer in Department of Industrial Engineering, Faculty of Engineering, University Singaperbangsa of Karawang. He received bachelor Industrial and management Engineering from University Langlangbuana Bandung 1992; and master of Mechanical engineering from Institute Technology Bandung 2003. His research interests are in the area of production planning and control, system production or system manufacturing. He is a member of the BKSTI, ISTMI, management BKTI-PII, Direction PII Karawang Branch, *Karawang Engineering SME’s Association* (APEK) Karawang. His email address is sukanta.tsm@gmail.com

Dene Herwanto is a lecturer in Department of Industrial Engineering, Faculty of Engineering, University of Singaperbangsa Karawang. He received his Master of Industrial Engineering from University of Mercu Buana Jakarta in 2013. His research interests are in the area of Ergonomics and Biomechanics, Quality Management, and Productivity. His email address is deneherwanto@yahoo.com