Inventory Cost Reduction and EOQ for Personal Protective Equipment: A Case Study in Oil and Gas Company

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ABSTRACT

Personal Protective Equipment (PPE) is one of materials that is urgent for oil and gas companies. Company X is an upstream oil and gas company located in Indonesia that requires its employees to wear PPE. Therefore, the PPE inventory must be controlled carefully to maintain the level of PPE inventory. This research has an objective to reduce PPE inventory cost through the application of Economic Order Quantity (EOQ) method. To achieve this objectives, a research was conducted to 22 items of PPE in Company X. The research was conducted by forecasting PPE demand, calculating optimal quantity and ordering frequency, calculating safety stock and reorder point, and finally calculating the inventory cost reduction. The result shows that the implementation of EOQ has enabled the company to reduce its inventory cost by 19.72%. Therefore, it is advisable for Company X to design and implement EOQ as the inventory control program for PPE.

A. INTRODUCTION

Globalization and technology lead oil and gas companies to win national as well as international competition. The competition among oil and gas companies forces them to run operations efficiently. One important aspect in the oil and gas companies is the requirement to conduct a high level of health and safety working environment program. This program must be implemented in oil and gas companies to protect their employees. Therefore, each employee has an obligation to wear Personal Protective Equipment (PPE). According to Occupational Safety and Health Administration (2004), PPE is an equipment used to minimize exposure to various hazards when engineering processes, work practices, and administrative controls do not provide adequate protection. PPE consist of eye and face protection, head protection equipment, foot protection, hand and arm protection equipment, and body protective equipment (Occupational Safety and Health Administration, 2004).

Company X is one of the oil and gas upstream companies engaged in the exploration, production, refining, marketing and distribution of crude oil, chemicals, power generation, and non-conventional energy in Indonesia. This company has a full day operation and implements a tight discipline in the health and safety program. The company also applies Operation Integration Management System and requires all employees and workers to wear PPE. Health and safety program is managed by the Department of Safety, Security, Health and Environment (SSHE). SSHE provides standard PPE including helmets, glasses, gloves, safety shoes, safety vests, and coveralls. SSHE has a responsibility to conduct PPE procurement procedures. Afterwards, the PPE is stored in the warehouse. Since PPE function is critical in oil and gas companies, the PPE storage handling must be managed properly to meet the needs of the employees. An excess in PPE inventory may result in the increase of holding cost, whereas a shortage of PPE inventory may result in the company's inability to meet PPE demand when it is needed. Therefore, it is necessary for the company to have an optimal inventory control program to secure the number of PPE stocks as well as the amount of inventory cost.

Inventory control is one of the managerial aspects that companies need to recognize because the physical inventory policy will be related to investment in current asset as well as customer service (Rusdiana, 2014). The purpose of inventory control is to reduce inventory cost including ordering and holding costs (Heizer, 2015). In addition, it also has a function to achieve an equilibrium between investment in the inventory and customer service since the companies are not able to reach low cost strategy without a proper inventory control program (Heizer, 2015).

Economic Order Quantity (EOQ) is one of the inventory control technique that is widely used by companies since it can be used to reduce inventory cost. There are several assumptions that must be fulfilled to apply EOQ, including: (i) demand is known and constant, (ii) ordering cost, holding cost, and unit price are constant and no discount applied, (iii) inventory system is reviewed on a continuous basis, (iv) orders are placed as soon as the inventory level reaches the reorder point (Shenoy, 2018). Wenda and Rispianda (2015) provided evidence from their research that Wilson Model of EOQ enables to reduce inventory cost for PPE including safety shoes calf and ankle size 7 and 8. The same results is also found in research conducted by Gustav, Sandora, and Arninputranto (2018), Fithri, Hasan, and Asri (2019), and Kulkarni and Rajhans (2013). They drew the same conclusion that the practice of EOQ in the companies resulted in the more efficient inventory cost that must be covered by the companies.

The process of inventory storage is commonly assumed as a non-value added activity, therefore it is necessary for the companies to reduce the inventory cost by designing and applying an effective inventory control program. Due to the importance aspect of inventory control for PPE, this research was conducted to reduce the inventory cost for PPE supplies through the implementation of EOQ.

B. RESEARCH METHODOLOGY

This research was conducted in Company X, one of oil and gas upstream companies in Indonesia. The PPE that was used as the research object consisted of 22 categories as shown in table 1.

Table 1. List of Personal Protective Equipment – PPE

No	PPE	Code
1	Dust Mask	A
2	Coverall –Size S	B
3	Coverall –Size M	C
4	Coverall –Size L	D
5	Coverall –Size XL	E
6	Coverall –Size XXL	F
7	Vest Floatation	G
8	Safety Shoes – Size 6	H
9	Safety Shoes – Size 7	I
10	Safety Shoes – Size 8	J
11	Safety Shoes – Size 9	K
12	Safety Shoes – Size 9.5	L
13	Safety Glasses – Dark	M
14	Safety Glasses – Clear	N
15	Glove Impact Resist –Size S	O
16	Glove Impact Resist –Size M	P
17	Glove Impact Resist –Size L	Q
18	Glove Impact Resist –Size XL	R
19	Safety Helmet – Reg Work	S
20	Safety Helmet – Short Serv	T
21	Ear Plug Foam	U
22	Ear Muffs	V

The first step on this research methodology was forecasting the PPE demand for each month in 2020. The PPE data used as a base for forecasting was the PPE demand from 2015 to 2019. The forecasting was conducted by Minitab software. First of all, the data was plotted and the ACF autocorrelation test and box cox test were run to determine whether they are stationer or not stationer. The data is stationer if there is no bar comes out of the confident interval line on the autocorrelation plot (Santoso, 2009) and the rounded value box-cox is 1 (Wei, 2006). In the other hand, the data is not stationer if at least 1 bar comes out of the confident interval line on the autocorrelation plot (Santoso, 2009) and the rounded value box-cox is less than 1 or higher than 1 (Wei, 2006).

Afterwards, the forecasting method was chosen for each item of PPE based on the data plot. Because all the data plot for 22 PPE were not stationer, the forecasting method used in this research were single exponential smoothing, decomposition, trend analysis, or ARIMA (Santoso, 2009). Selection of the most suitable forecasting method for each PPE item is based on the least value of Mean Absolute Deviation (MAD), Mean Squared Error (MSE), and Mean Absolute Percentage Error (MAPE) (Montgomery, 2008).

The second step was calculating optimal quantity and ordering frequency according to EOQ method. According to Heizer (2015), the formulas to calculate the optimal quantity and order frequency are shown below:

$$EOQ = \sqrt{\frac{2DS}{H}}\ ;\ Ordering\ Frequency = \frac{D}{EOQ}$$

with the following additional information:

EOQ : the optimal quantity for each order

D : yearly demand

S : ordering cost for each order

H : holding cost for each item per year

The third step was calculating safety stock and reorder point. Since the availability of PPE is really important for company X, service level that is one component to calculate safety stock must be higher than other materials in company X. The company set the service level at 0.99 which means the probability of a shortage of PPE was minimized to 0.01. According to Heizer (2015), the formulas to calculate safety stock and reorder point are shown below:

$$ss = Z\ \sigma_d\ ; ROP = (d\ x\ L) + ss$$

with the additional information:

ss : safety stock

Z : safety factor = NORMSINV(service level)

σ_d : standard deviation of demand

ROP : reorder point

d : demand per day

L : lead time

Finally, the last step was calculating the efficiency of total inventory cost after company X implementing EOQ. According to Heizer (2015), the total inventory cost calculated based on EOQ method was shown below:

$$TIC = \frac{D}{Q}S + \frac{Q}{2}H + PD$$

with this additional information:

TIC	:	total inventory cost
D	:	demand per year
S	:	ordering cost for each order
Q	:	optimal quantity based on EOQ
H	:	holding cost for each item per year
P	:	unit price

To determine the efficiency of total inventory cost, the total inventory cost calculated based on EOQ had to be compared with the total inventory cost that was usually practiced by company X. The formula to calculate total inventory cost according to company X was shown below:

$$TIC = (frequency\ of\ order\ x\ ordering\ cost) + (demand\ x\ holding\ cost) + (demand\ x\ purchasing\ cost)$$

Afterwards, the efficiency of cost reduction was calculated by using the formula below:

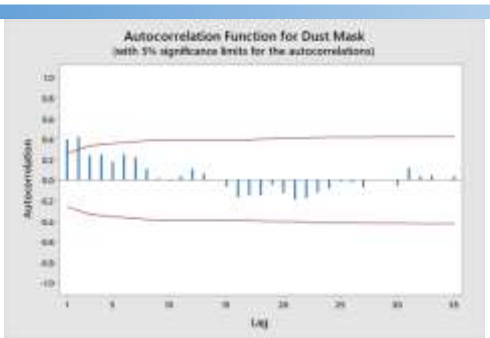
$$Cost\ Efficiency = \frac{TIC_{company} - TIC_{EOQ}}{TIC_{company}}$$

C. . RESULTS AND DISCUSSION

1. Forecasting the PPE Demand for Each Month in 2020

The first step of demand forecasting was data plotting to determine whether the data is stationer or not stationer. Figure 1 shows the data plotting. Figure 1 provides information that there is at least one bar comes out from the confident interval and rounded value box-cox plot is not equal one. This means that all the data for 22 items of PPE are not stationer.

Jurnal Logistik Indonesia Vol. 5 , No. 2, Oktober 2021, pp 86-103



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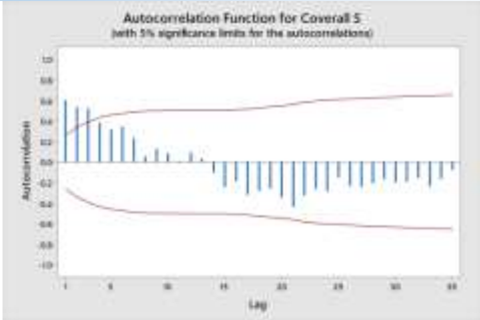

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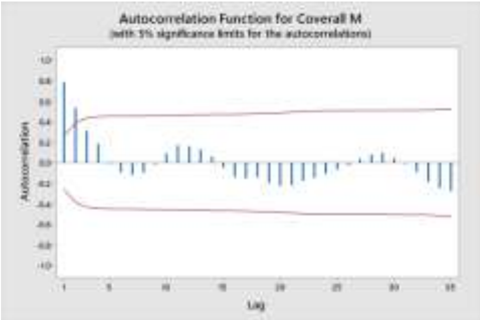

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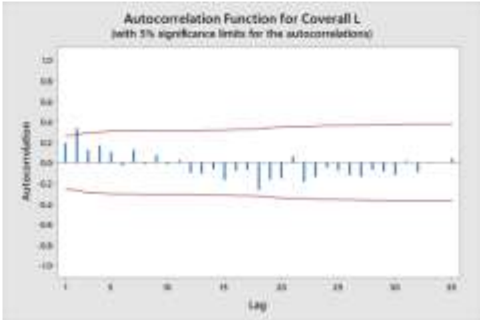

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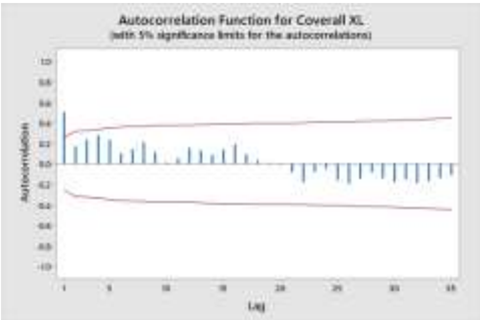

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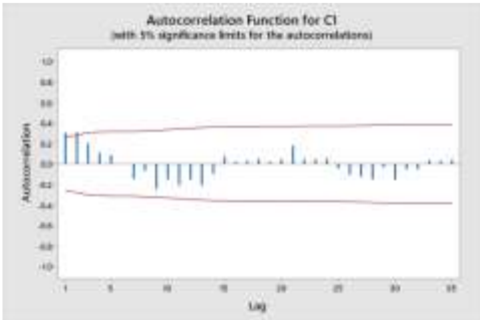

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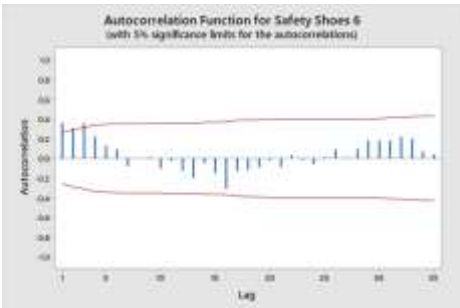

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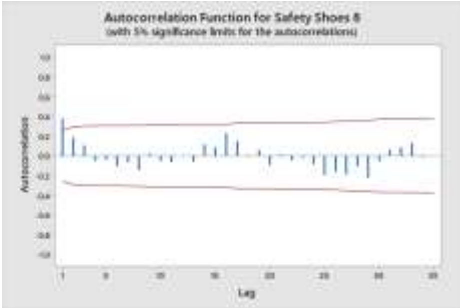

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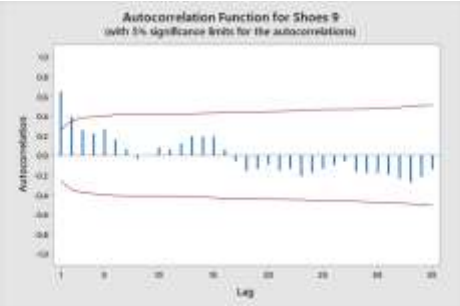

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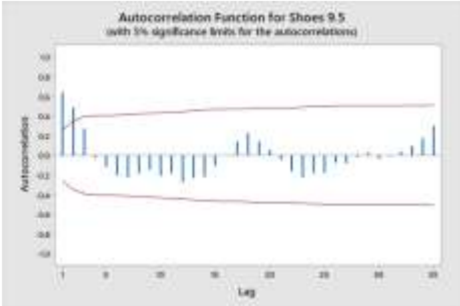

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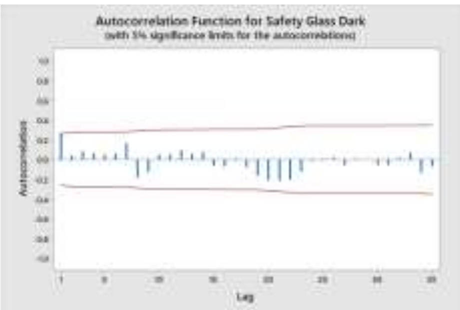

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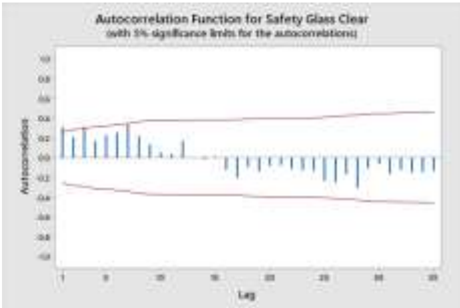

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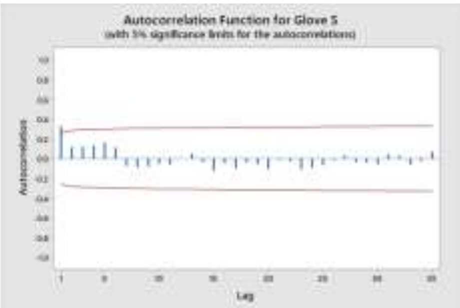

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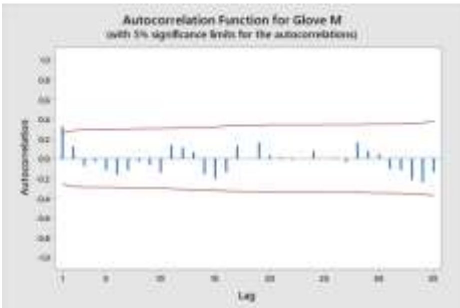

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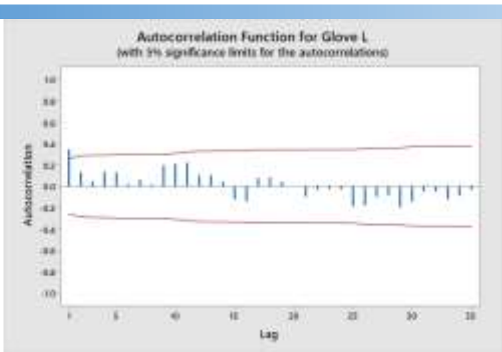
 Jurnal Logistik Indonesia Vol. 5 , No. 2, Oktober 2021, pp 86-103



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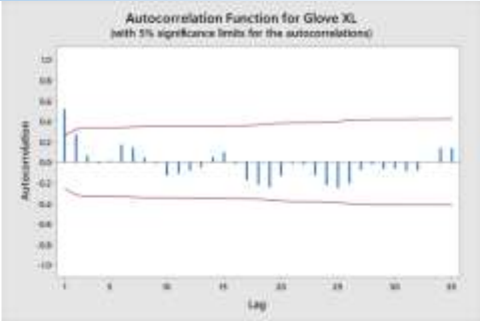

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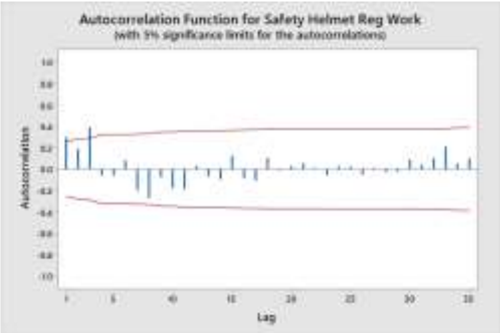

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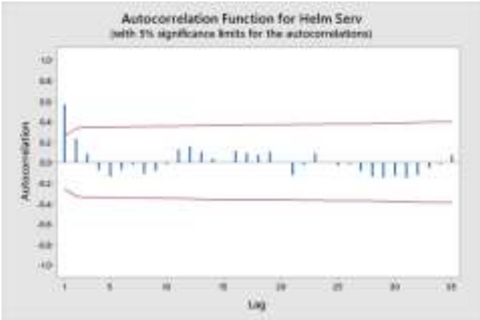

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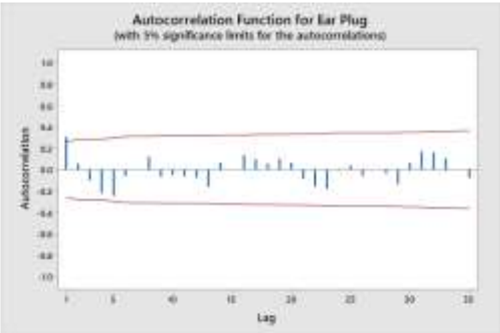

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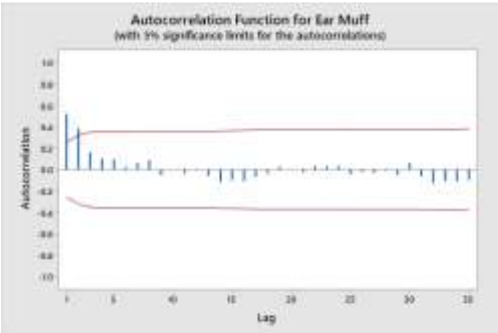

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Figure 1. Data Plotting of PPE

Since all the data are not stationer, the forecast methods used in this research are the choice among exponential smoothing, decomposition data, and trend analysis. Selection of the most suitable method for each item of PEE based on the smallest value of MAPE, MAD, and MSE. Table 2 shows the forecast method chosen for each item of PPE in company X.

Table 2. Forecasting Method for PPE

PPE	Forecasting Method	MAPE	MAD	MSE	Forecasting Equation
A	Decomposition – Multiplicative	29.3337	2.3592	8.6468	Yt = 6.260 + 0.1116×t
B	Winter – Additive	14.1946	1.1385	2.2171	α 0.2 β 0.2 δ 0.2
C	Double Exponential Smooth	13.4361	1.6263	5.0328	α1.66652 β0.01854
D	Trend Analysis – Quadratic	18.0250	2.7649	13.3865	Yt = 18.85 - 0.250×t + 0.00411×t^2
E	Decomposition – Multiplicative	16.5740	3.0306	17.9837	Yt = 15.67 + 0.1244×t
F	Decomposition – Multiplicative	12.0030	1.2840	2.7776	Yt = 10.200 + 0.0342×t
G	Decomposition – Multiplicative	11.5063	0.9130	1.4429	Yt = 7.386 + 0.027673×t
H	Decomposition – Additive	22.7259	1.1800	2.2697	Yt = 4.661 + 0.0379×t
I	Decomposition – Additive	19.3934	1.2273	2.9034	Yt = 6.152 + 0.0185×t
J	Decomposition – Additive	16.3006	1.1690	2.2639	Yt = 6.908 + 0.0200×t
K	Double Exponential Smooth	8.38636	0.58427	0.65442	α1.16658 β0.01000
L	Double Exponential Smooth	14.3380	1.0905	1.8878	α0.801669 β0.031173
M	Decomposition – Additive	4.69568	1.62867	4.22996	Yt = 35.356 - 0.0253×t
N	Winter – Additive	20.565	8.502	121.827	α 0.2 β 0.2 δ 0.2
O	Trend Analysis – Quadratic	29.8220	1.8066	5.2287	Yt = 9.826 - 0.1967×t + 0.00280×t^2
P	Decomposition – Additive	13.2436	2.0767	7.2950	Yt = 17.221 - 0.0313×t
Q	Decomposition – Additive	15.3500	3.1811	17.7025	Yt = 18.05 + 0.0958×t
R	Double Exponential Smooth	18.5806	3.1273	15.9935	α0.922735 β0.042445
S	Trend Analysis – Quadratic	25.0204	5.5758	42.6324	Yt = 18.56 + 0.446×t - 0.00602×t^2
T	Decomposition – Additive	6.21581	0.98182	1.77267	Yt = 14.742+ 0.0385×t
U	Decomposition – Additive	11.36	63.55	6709.95	Yt = 559.5 + 0.367×t

Jurnal Logistik Indonesia Vol. 5 , No. 2, Oktober 2021, pp 86-103

PPE	Forecasting Method	MAPE	MAD	MSE	Forecasting Equation
V	Trend Analysis – Quadratic	11.6561	3.3673	17.8792	Yt = 23.08 + 0.588×t - 0.00836×t^2

The forecasting methods as shown in table 1 are used to forecast the number of PPE demand for each month in 2020. Table 3 shows the demand of PPE in 2020.

Table 3. The Demand for PPE in 2020

PPE	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
A	14	11	16	12	12	14	17	19	15	11	13	9	164
B	10	8	7	7	6	7	7	7	7	6	7	8	87
C	12	12	12	11	11	11	11	11	11	10	10	10	132
D	19	19	19	20	20	20	21	21	21	22	22	22	246
E	20	19	27	28	25	24	21	28	25	23	26	22	287
F	11	13	12	15	13	14	13	11	12	13	12	11	150
G	8	8	8	8	10	11	11	10	10	9	9	8	111
H	7	8	7	6	7	6	7	8	6	7	8	7	86
I	6	7	7	8	8	9	9	7	7	7	7	7	89
J	9	8	7	8	8	9	9	10	8	8	9	7	99
K	8	8	8	8	8	8	8	8	8	8	8	8	98
L	7	7	7	7	7	7	6	6	6	6	6	6	78
M	34	32	34	34	35	33	35	34	33	34	35	32	404
N	37	47	37	35	49	32	37	27	29	35	36	29	431
O	8	8	9	9	9	9	9	9	10	10	10	10	110
P	18	18	15	14	14	17	14	16	16	13	13	14	182
Q	27	27	25	20	22	21	24	25	23	24	26	30	293
R	19	19	19	19	19	19	19	19	19	19	19	19	232
S	23	23	23	22	22	22	21	21	21	20	20	19	258
T	17	16	17	18	20	19	17	16	17	17	17	17	208
U	629	608	541	645	563	570	556	593	611	621	495	575	7007
V	28	28	27	27	26	26	25	24	24	23	23	22	302

2. Optimal Quantity and Order Frequency – EOQ Based

The forecasted demands shown in table 3 are used as inputs in calculating the optimal quantity and order frequency based on EOQ method. Calculating the order quantity using EOQ needs information regarding ordering cost, holding cost, and unit price of PPE item. All these data were collected from the company X's documentation as shown in table 4. The ordering cost consisted of transportation cost, assurance and document cost, unloading cost, export import cost, and labor cost. Company X has a policy that its ordering cost is 13.38% from unit price. In addition, the holding cost of Company X included housing cost, material handling cost, labor cost, investment cost, and pilferage/scrap/obsolescence. Company X set a policy that its holding cost is 26% from unit price.

Table 4. Unit Price, Ordering Cost, and Holding Cost of PPE

PPE	Unit Price	Ordering Cost	Holding Cost
A	$23.27	$3.11	$6.05
B	$73.26	$9.80	$19.05
C	$76.00	$10.17	$19.76
D	$74.19	$9.93	$19.29
E	$77.32	$10.35	$20.10
F	$84.42	$11.29	$21.95
G	$92.91	$12.43	$24.16
H	$119.08	$15.93	$30.96
I	$112.41	$15.04	$29.23
J	$106.71	$14.28	$27.74
K	$114.03	$15.26	$29.65
L	$115.72	$15.48	$30.09
M	$5.74	$0.77	$1.49
N	$4.95	$0.66	$1.29
O	$35.65	$4.77	$9.27
P	$40.12	$5.37	$10.43
Q	$36.07	$4.83	$9.38
R	$34.31	$4.59	$8.92
S	$16.63	$2.23	$4.32
T	$16.23	$2.17	$4.22
U	$2.55	$0.34	$0.66
V	$52.19	$6.98	$13.57

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After getting the unit price, ordering cost and holding cost, the ordering quantity and ordering frequency are calculated. The result of calculation is shown in table 5.

Table 5. The Ordering Quantity and The Ordering Frequency – EOQ Method

PPE	EOQ	Unit	Ordering Frequency
A	13	Box	13
B	9	EA	9
C	12	EA	11
D	16	EA	15
E	17	EA	17
F	12	EA	12
G	11	EA	10
H	9	PAA	9
I	10	PAA	9
J	10	PAA	10
K	10	PAA	10
L	9	PAA	9
M	20	EA	20
N	21	EA	20
O	11	PAA	10
P	14	PAA	13
Q	17	PAA	17
R	15	PAA	15
S	16	EA	16
T	15	EA	14
U	85	PAA	83
V	18	PAA	17

3. Safety Stock and Reorder Point

Safety stock is extra stocks that are allowed by the company due to the abnormal demand (Heizher, 2015). Safety stock is usually applied when the demand is unknown, but it can be determined through distribution probability (Heizher, 2015). Therefore, safety stock is a better model for the companies since the number or demand and the properly time to order are sometimes not always known. Reorder point is the point at which the company places an order for supplies (Heizher, 2015). The company has to place the order for supplies when the number of supplies closes to safety stock.

It is also necessary for Company X to calculate its safety stock and reorder point since PPE material in oil and gas companies cannot be zero. Therefore, Company X should place its order when the number of PPE closes to its safety stock. The safety stock and reorder point for Company X are shown in table 6.

Table 6. Safety Stock and Reorder Point

PPE	Deviation Standard	Service Level	Service Factor	Lead time	Daily Demand	Safety Stock	Reorder Point
A	2.8397	99%	2.32635	84	0.4491	7	44
B	1.88268	99%	2.32635	42	0.23892	3	12
C	0.5447	99%	2.32635	42	0.3610	2	16
D	1.0718	99%	2.32635	42	0.6727	3	30
E	3.1671	99%	2.32635	42	0.7872	8	40
F	1.2946	99%	2.32635	42	0.4099	4	20
G	1.2777	99%	2.32635	42	0.3034	3	15
H	0.74442	99%	2.32635	124	0.23607	2	31
I	1.01814	99%	2.32635	124	0.24272	3	32
J	0.91468	99%	2.32635	124	0.27074	3	35
K	0.08594	99%	2.32635	124	0.26797	1	33
L	0.30102	99%	2.32635	124	0.21321	1	27
M	1.0112	99%	2.32635	124	1.1070	3	139
N	6.6229	99%	2.32635	124	1.1799	16	161
O	0.6325	99%	2.32635	120	0.3007	2	37
P	1.7640	99%	2.32635	120	0.4978	5	63
Q	2.5900	99%	2.32635	120	0.8027	7	102
R	0.0140	99%	2.32635	120	0.6344	1	76
S	1.2829	99%	2.32635	124	0.7069	3	90
T	1.1480	99%	2.32635	124	0.5689	3	73
U	42.307	99%	2.32635	124	19.196	99	2,378
V	1.8892	99%	2.32635	124	0.8269	5	106

E-ISSN 2621-6442

4. Total Inventory Cost

Inventory cost includes ordering cost and holding cost. According to Shenoy (2018), ordering cost is the cost relates to the activities of inventory ordering and its receiving in the warehouse. This cost includes administration cost (such as managers salary and record keeping cost), transportation cost (such as fuel cost and loading/discharged cost), inspection cost (such as traveling cost to vendor workplace and salary of inspectors), and other costs (Shenoy, 2018). In another side, the holding cost is the cost relates to the activity of putting away and storage the inventory in the warehouse, and picking away the inventory from the warehouse to be delivered to users (Shenoy, 2018). It consists of capital or investment cost, storage cost (such as warehouse rent cost and handling equipment rent cost), inventory risk cost (such as damage cost, obsolescence cost, and shrinkage cost), and inventory servicing cost (such as insurance cost, taxes, and physical handling cost).

Table 7 shows the inventory cost calculated through EOQ method; whereas table 8 shows the inventory cost calculated through the method had been already used by Company X. Its comparison is shown in table 9 to achieve the cost reduction at $52,569.90 and its efficiency at 19.72%.

Table 7. Total Inventory Cost – EOQ Method

PPE	Demand	Q Optimal – EOQ	Ordering Cost	Holding Cost	Unit Price	Total Inventory Cost
A	164	13	$3.11	$6.05	$23.27	$3,892.59
B	87	9	$9.80	$19.05	$73.26	$6,569.02
C	132	12	$10.17	$19.76	$76.00	$10,243.16
D	246	16	$9.93	$19.29	$74.19	$18,523.16
E	287	17	$10.35	$20.10	$77.32	$22,563.88
F	150	12	$11.29	$21.95	$84.42	$12,903.59
G	111	11	$12.43	$24.16	$92.91	$10,546.22
H	86	9	$15.93	$30.96	$119.08	$10,551.74
I	89	10	$15.04	$29.23	$112.41	$10,237.44
J	99	10	$14.28	$27.74	$106.71	$10,824.57
K	98	10	$15.26	$29.65	$114.03	$11.450,27
L	78	9	$15.48	$30.09	$115.72	$9,274.64
M	404	20	$0.77	$1.49	$5.74	$2,349.49
N	431	21	$0.66	$1.29	$4.95	$2,157.13
O	110	11	$4.77	$9.27	35.65	$4,011.20
P	182	14	$5.37	$10.43	$40.12	$7,432.41

PPE	Demand	Q Optimal – EOQ	Ordering Cost	Holding Cost	Unit Price	Total Inventory Cost
Q	293	17	$4.83	$9.38	$36.07	$10,728.89
R	232	15	$4.59	$8.92	$34.31	$8,082.51
S	258	16	$2.23	$4.32	$16.63	$4,361.86
T	208	15	$2.17	$4.22	$16.23	$3,430.79
U	7007	85	$0.34	$0.66	$2.55	$17,897.67
V	302	18	$6.98	$13.57	$52.19	$15,992.09
					Total	$214,024.34

Table 8. Total Inventory Cost – Existing Method in Company X

PPE	Demand	Ordering Frequency	Ordering Cost	Holding Cost	Unit Price	Total Inventory Cost
A	164	12	$3.11	$6.05	$23.27	$4,843.02
B	87	12	$9.80	$19.05	$73.26	$8,167.22
C	132	12	$10.17	$19.76	$76.00	$12,738.48
D	246	12	$9.93	$19.29	$74.19	$23,071.92
E	287	12	$10.35	$20.10	$77.32	$28,119.02
F	150	12	$11.29	$21.95	$84.42	$16,050.87
G	111	12	$12.43	$24.16	$92.91	$13,112.48
H	86	12	$15.93	$30.96	$119.08	$13,119.03
I	89	12	$15.04	$29.23	$112.41	$12,728.02
J	99	12	$14.28	$27.74	$106.71	$13,457.74
K	98	12	$15.26	$29.65	$114.03	$14,235.63
L	78	12	$15.48	$30.09	$115.72	$11,532.57
M	404	12	$0.77	$1.49	$5.74	$2,931.23
N	431	12	$0.66	$1.29	$4.95	$2,691.81
O	110	12	$4.77	$9.27	$35.65	$4,987.22
P	182	12	$5.37	$10.43	$40.12	$9,249.51
Q	293	12	$4.83	$9.38	$36.07	$13,371.15
R	232	12	$4.59	$8.92	$34.31	$10,065.53

E-ISSN 2621-6442

PPE	Demand	Ordering Frequency	Ordering Cost	Holding Cost	Unit Price	Total Inventory Cost
S	258	12	$2.23	$4.32	$16.63	$5,433.85
T	208	12	$2.17	$4.22	$16.23	$4,271.15
U	7007	12	$0.34	$0.66	$2.55	$22,484.31
V	302	12	$6.98	$13.57	$52.19	$19,932.48
					Total	$266,594.23

Table 9. Inventory Cost Reduction

PPE	Total Inventory Cost – Company	Total Inventory Cost – EOQ	Inventory Cost Reduction	Inventory Cost Efficiency
A	$4,843.02	$3,892.59	$950.43	19.62%
B	$8,167.22	$6,569.02	$1,598.20	19.57%
C	$ 12,738.48	$10,243.16	$2,495.32	19.59%
D	$23,071.92	$18,523.16	$4,548.76	19.72%
E	$28,119.02	$22,563.88	$5,555.14	19.76%
F	$16,050.87	$12,903.59	$3,147.28	19.61%
G	$13,112.48	$10,546.22	$2,566.25	19.57%
H	$13,119.03	$10,551.74	$2,567.28	19.57%
I	$12,728.02	$10,237.44	$2,490.58	19.57%
J	$13,457.74	$10,824.57	$2,633.17	19.57%
K	$14,235.63	$11.450,27	$2,785.36	19.57%
L	$11,532.57	$9,274.64	$2,257.93	19.58%
M	$2,931.23	$2,349.49	$581.74	19.85%
N	$2,691.81	$2,157.13	$534.68	19.86%
O	$4,987.22	$4,011.20	$976.02	19.57%
P	$9,249.51	$7,432.41	$1,817.10	19.65%
Q	$13,371.15	$10,728.89	$2,642.25	19.76%
R	$10,065.53	$8,082.51	$1,983.02	19.70%
S	$5,433.85	$4,361.86	$1,072.00	19.73%
T	$4,271.15	$3,430.79	$840.35	19.68%
U	$22,484.31	$17,897.67	$4,586.64	20.40%

PPE	Total Inventory Cost – Company	Total Inventory Cost – EOQ	Inventory Cost Reduction	Inventory Cost Efficiency
V	$19,932.48	$15,992.09	$3,940.38	19.77%
Total	$266,594.23	$214,024.34	$52,569.90	19.72%

5. Discussions

The result shows that EOQ method enables Company X to reduce inventory cost by 19.72%. This reduction is achieved because EOQ method supports the company to order inventory at the optimal level and to reduce the number of orders per year. As a result, there is a saving in the ordering cost. In addition, the optimal level of inventory also supports the company to reduce its holding cost.

This research supports the research conducted by Fitriana, Moengin, and Riana (2016). The research found that EOQ method applied to spare parts enhanced an inventory cost saving per week at 56.67% for cable tie 15”, 3.86% for wire las RB 26-32MM, 3,92% for ring plat 5/8”, 5.02% for grinding stone cut 4”, 3.6% for ring plat ½”. This research also supports the research conducted by Panday et al (2020) in a fashion company. Panday et al (2020) indicated a problem in their research that ordering cost became higher due to the ordering frequency is higher than 100 times a year. By applying EOQ method, Panday et al found that the ordering frequency decreased to 15 times a year and it results in the more efficient ordering cost. The decrease of ordering cost had a significant impact of the saving of total inventory cost tin which there was a saving of 94.75%.

Similar research is also found in the research conducted by Sunhal and Mangal (2017). They simulated the inventory control with EOQ method in the medical factory that produces IV sets and sutures, right heart catheters, and chip products. They provided evidence in their research that EOQ method is an effective method to reduce annual inventory cost. By applying EOQ, inventory cost was reduced by 5.83%. The reduction of inventory cost was achieved due to the decrease of ordering cost for 0.91% as well as the decrease of holding cost for 15.57%. All those cost savings were resulted from the decrease of number of ordering by 6.25% and the reduction of average inventory per year by 8.63%.

D. CONCLUSION

The research withdraws the conclusion that EOQ method is proper to be applied for controlling PPE inventory in company X because this method is able to optimize the number of orders. Optimizing the number of orders leads a reduction in the annual inventory cost up to 19.72%. Therefore, it is advisable for company X to design and implement EOQ as the inventory control method for its PPE.

However, this research does not take into account the capital cost as an important aspect in calculating inventory cost. The capital cost can be in the form of the amount of interests that must be paid by the company due to the use of loans in purchasing inventory. It also includes the opportunity cost of not investing the money to other places. The cost of capital in the newest EOQ model is calculated separately from ordering cost and holding cost. Therefore, it is advisable for the next research to apply EOQ method that emphasizes the capital cost as the part of annual inventory cost.

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