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Proposed Inventory Strategy of NSR Material in Cikarang-Indonesia Oil and Gas Services Company

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Abstract

The main purpose of this article is to present the inventory control model to determine the most reasonable amount of stock. The amount of stock exceeding or less than the requirement gives adverse impact to the company. With the current inventory system Oil and Gas Services, companies often experience the amount of NSR (Neutron Source Radioactive) supplies that exceed their needs. This is due to the number of orders provided to the supplier set based on various things such as anticipated safety stock, improper accuracy in the estimated needs, and projected lead time of arrival of goods. If the amount of inventory is too large, the amount of funds that must be spent by the company will also increase, in addition to increased storage costs, and an increased risk of damage to goods. However, if too little causing cessation of production processes, delays in profits can happen, or even loss of customers. The most reasonable inventory level improvement is done through stock optimization methods such as EOQ (Economic Order Quantity) model, Newsvendor Model, Lot-Sized Reorder Point System, and Service Level in Q and R System. With these inventory modes, the most reasonable inventory level can be found.

Keywords: NSR Material, Overstock, Inventory Cost, Inventory Strategy, Stock Optimization;

1. Introduction

The main purpose of inventory control is that the company can always have an inventory for the right amount of goods, the right type, the right time, and in the specified specification or quality [2,25]. So, the result is that the cost incurred to hold inventory is the most reasonable. If the amount of inventory is too large, the amount of funds to be spent by the company, the cost of storage (such as personnel costs, operational costs, building costs, etc.) as well as the risk of damage to goods can all increase. However, too little inventory leads to a risk of stock running out as often inventory items cannot be brought in unexpectedly which may result in cessation of production processes, delays in profits, and even loss of customers. This is certainly not expected by the company because the loss of customers is the worst situation for any company.

The same problem is also experienced by an oil and gas service company in Cikarang which is a leading company in the field of oil and gas services industry. Oil and gas services companies play an important role in exploration and exploitation activities. Petroleum exploration or search is a long study involving several fields of study of earth and exact science. For basic study, research is done by geologists, those who master earth science. They are the ones who are responsible for the search for the hydrocarbons. While exploitation means actively and efficiently utilizing oil and gas wells maximally so it can be made as the most reasonable [1].

To do the drilling and logging, sophisticated technological equipment is required. Each company has its own technology that will continue to compete, and thus it reflects on its reliability as to provide drilling and logging services. This tech logging equipment uses NSR material which is then incorporated into a drilling tool that is useful for reading the structure of rocks in the soil. Therefore, the NSR material plays an important role in the well logging process to obtain data from the soil tested which is then used to plan the next drier process.

In 2014, based on the Brent Crude Oil price, there was a decrease of world oil price per barrel, it also caused the decrease of oil and gas exploration activity in the world, and in Indonesia in particular. Based on data obtained from monthly demand reports of NSR materials to a drilling site by a Cikarang Oil and Gas Services Company, in 2014 the company experienced a decrease in demand for NSR materials to 21-units on average each month. This number continues to decline by 2015, the average demand for NSR material decreases to 14 units per month. And in December 2016 the demand for the number of NSR materials to the drilling sites was only 5-unit only, as shown in Figure 1.

The company's inventory management system currently uses a traditional approach by assuming that the uncertainty of consumer demand leads to production and purchase uncertainties so that the firm must have a large

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supply. Management seeks to overcome these uncertainties through the best possible dosage planning. In this approach the assumption that production problems can be overcome by managing inventories. There are several reasons that encourage companies to use traditional approaches as they need inventories to balance storage and ordering costs, satisfy customer demand, take advantage of rebates, keep watch in case of price increases, and maintain the smoothness of the production process. Under current conditions, the company has an excess stock for existing NSR materials in storage bunkers.

With the current inventory system, the company accumulates 30 units of NSR material, assuming as a safety stock and assuming that the demand for materials or products is not known for certain, the likelihood of a supply shortage arises. According to Hansen and Maryanne [5,19], safety stock is an extra supply that is kept as collateral in the face of a demand that keeps fluctuating. Excess inventory on the company will result in increased cost of inventory management. Conversely, if there is a shortage of inventory, it will increase the risk of delay in operations that resulted in the company lost. Radioactive Neutron Source Material (NSR) is a material that serves to read the formation of the borehole using high-energy epithermal neutrons which then decreases its energy due to elastic scattering to the thermal level moments before being absorbed by the formation nucleus. With neutron logging technology itself can capture gamma rays, thermal neutron scattering, and high energy epithermal neutrons can be detected [4]. Note that neutron porosity is usually sensitive to the quantity of hydrogen atoms in certain formations, which are generally associated with rock porosity.

Nahmias [3,20] states that there are several factors affecting inventory levels, namely: estimates of raw material usage, raw material prices, inventory costs, spending policies, materials usage, waiting times, material purchase models, safety stocks and repurchases. Furthermore, there are two types of inventory controls that are used to be used on the basis of demand. For example, inventory control for known requests and inventory controls for changing demand. Nahmias [3,6,7] also states that there are some inventory strategies that can be used among them EOQ (Economic Order Quantity) is one of the inventory management models, EOQ (Economic Order Quantity) model is used to determine the quantity of inventory orders that can minimize storage costs and inventory ordering costs. Then Newsvendor Model, is a mathematical model in operations management used to determine the most reasonable order quantity of goods. This is usually characterized by fixed price and uncertain product demand. Another is Lot-Sized Reorder Point System, which is a system that uses inventory levels as a trigger for ordering supplies. The company must set the minimum number of items held in the warehouse, so that when the inventory reaches the minimum, the item must be ordered again. And other strategies such as Q and R Service Level System is a system by determining the amount of optimum inventory in one order cycle to avoid stock-out cost.

From some of the above-mentioned inventory concepts seem to be able to solve inventory problems faced by the company. But not yet known which model is the most reasonable. The most reasonable model in question is an inventory model that can provide the highest level of availability and the lowest cost of inventory. This study will combine the four concepts of inventory to obtain the most reasonable inventory model.

2. Material and Method

Inventory or inventory within a company is the stock of goods used to meet customer demand and to facilitate the production process. Inventory can be divided into several types, such as raw materials, work in process, finished goods, and maintenance goods (repair, repair and operating supplies). Inventory is calculated as one type of corporate wealth so it requires a large capital (capital) to procure / purchase. On the one hand inventory is a burden to the company's finances, but on the other hand inventory availability is a must for the operation / production process to run smoothly and consumer / customer demand can be fulfilled [23-25].

Ben-Daya and Hariga [9,21] states that in general the types of inventory contained in manufacturing companies are divided into three groups, namely: Inventory of raw materials, Work in process inventory, and finished goods. Kogan and Lou [10] define inventory management as inventory management including planning, coordinating, and controlling activities related to the flow of incoming supplies, though, and out of an organization. Based on the above definition it can be concluded that inventory management is concerned with decisions about how much quantity of goods to be ordered (how much to order) and when reservations will be made (when to order). The pressure of inventory management is that there is a reduction in inventory while maintaining customer service and production levels. There are two objectives for the inventory management system; to provide the level of customer service, and to minimize the cost of providing the service. Based on some opinions above, it can be concluded that the purpose of inventory management is to provide good service to customers (customers) with a minimum total cost. Some definitions of existing inventory management terms are as follows: ordering cost, setup cost, capital cost, and stock out cost.

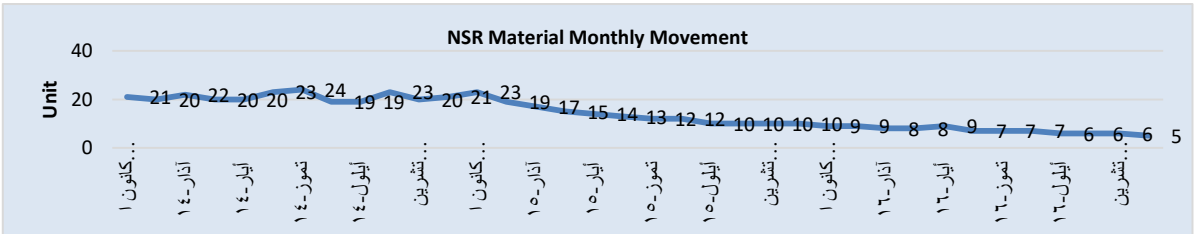

Figure 1. Graph of Delivery of NSR materials to Drilling Site 2014-2016
(Source: Internal Data Collection)

2.1. Economic Order Quantity (EOQ)

Economic Order Quantity (EOQ) is an inventory system by providing a quantity of inventory material in a single purchase period with the least inventory cost. EOQ methods can be used for both purchased and self-produced goods. EOQ is widely used today because it is easy to use, however, one should pay attention to the assumptions used when applying it. The basic assumptions for using EOQ methods are as follows: (1) Demand can be determined with certainty and constancy so that the cost of stock out and associated with its capacity does not exist. (2) Items ordered independently with other items. (3) Booking is received promptly and surely. (4) The price of the item is constant [11-12].

The usual formula used to calculate the EOQ is as follows [3,10]:

$$EOQ = \sqrt{\frac{2DS}{H}} \quad (1)$$

$$T = \frac{EOQ}{D} \quad (2)$$

$$Holding\ Cost = H\frac{EOQ}{2} \quad (3)$$

The Economic Order Quantity (EOQ) method is used to determine how much ordering is economical for each order with the predetermined order frequency as well as when the order is re-done. EOQ can answer the questions about the conditions that often occur in the company, which determines the amount of inventory in accordance with the needs of the company that is not too high nor too low as to reduce losses that occur in the company due to improper company processing inventory [17].

2.2. Newsvendor Model

The Model Newsvendor or Model Newsboy is a stochastic model that considers the uncertainty factor in the number of requests per production period. The Newsboy model is a model developed by Federgruen [8] where the mean is a profit whereas deviations from averages (variance) are made at risk. Generally, the Newsboy Model has a production period that is not too long, because the goods produced have a time limit that is not too long (short live). Although that the expiration of goods can be observed, the age of goods can also be seen from the sale of goods. If the goods concerned can be sold at normal prices, then the goods are still within the time limit (age of goods has not been exhausted) [8]. The basic purpose of the Newsboy model is to determine the most reasonable amount of production that provides the maximum profit and predicts the magnitude of risk or deviation from the profit to be obtained [18].

In a stochastic production model, any product that exceeds demand will result in the cost of overstock cost of Co and any goods in production that are less than the need will cause the cost of the lack of goods (understock cost) Cu. When s the sale price of goods per item, c purchasing goods per item and v residual value of unsold inventory. In the Newsboy model it is assumed that v <c <s. The calculation of excess goods (Co) can be calculated using the following formula:

$$Co = c - v \quad (4)$$

Calculation of shortage of goods (Cu) can be calculated using the following formula:

$$Cu = s - c \quad (5)$$

So we get the equation to calculate the critical ratio. Since the Co and Cu values are positive, the critical ratio is in the range of 0 to 1. This equation applies to continuous demand distribution and always solves the problem.

$$F(Q*) = \frac{Cu}{(Co+Cu)} \quad (6)$$

The equation F (Q *) is defined as the probability that the demand will not exceed the supply Q *. Critical ratios are defined as the probability of satisfaction over all requests over the period if unit Q * is provided at the beginning of the period. It should be noted and understood that this is not the same as the proportion to demand fulfilment. When the cost of shortages and excess inventory is the same, the critical ratio value is half. If on the issue where Q * is the median (middle value) of the demand distribution. When a symmetric demand density (such as normal density), the mean and middle values are equal.

$$Q = \sigma z + \mu \quad (7)$$

Dengan $\sigma = \sqrt{\frac{\sum_{i=1}^{n} x_i{}^2 - (\sum_{i=1}^{n} X_1)^2}{n}}$ (8)

2.3. Lot-Sized Reorder Point System

Reorder point is the point where the order must be held again in such a way that the arrival or acceptance of goods ordered is right when needed. This re-ordering needs to be done by the company at each period to prevent the occurrence of shortage of goods, so that company activity is not disturbed. Reorder Point is also defined as the time reorder of goods that will be required. Reorder point of each item of goods need to be known for the availability of goods is guaranteed, so ordering goods done at the right time when the stock of goods is not excessive and not empty. The calculation of reorder point is determined by the length of lead time, the average use of goods and safety stock [13-14].

Reorder point system model occurs when the amount of inventory contained in the stock decreases steadily, so we must determine how much the minimum level of inventory should be considered to re-order so that there is no shortage of inventory. The expected amount is calculated during the grace period, may also be added to the safety stock which usually refers to the probability or likelihood of stock shortages during the grace period. Here is an overview of reorder point and lead time [16]. Reorder point is also defined as a system that uses the inventory level to trigger a reordering of the inventory. In this case, the company must establish the minimum quantity of goods that must be available in the warehouse, so that when the inventory reaches the minimum, the goods must be reordered. This system is usually calculated as a forecast of goods demand during the lead time plus safety stock. In the EOQ (Economic Order Quantity) model, it is assumed that there is no time lag between ordering and procurement of materials. Therefore, the ordering point for inventory replenishment occurs at a prescribed minimum

level. When the inventory level drops to zero and due to an instant delivery by the supplier, the inventory level will return. Sometimes the rate of re-ordering is greater than the maximum inventory, this is due to the lead time that is too long or due to the uncertain levels of demand and lead time [3,15].

Furthermore, by defining G (Q, R) as an estimate of the average annual cost for storage, setup, and lack of inventory. The combination of these costs into equations.

$$G(Q, R) = h(Q/2 + R - \lambda\tau) + K\lambda / Q + p\lambda n(R) / Q \quad (9)$$

The goal is to determine Q and R to minimize G (Q, R). The most reasonable results can be found by equations.

$$Q_1 = \sqrt{\frac{2\lambda\,[K+pn(R)]}{h}} \quad (10)$$

$$1 - F(R) = Q_0 h / p\lambda \quad (11)$$

$$R = \sigma z + \mu \quad (12)$$

$$s = R - \mu \quad (13)$$

2.4. Service Level in (Q, R) Systems

This system helps management to determine the amount of costs due to out of inventory. On various issues, stock out costs include intangible components such as loss of product value and potential delays in other systems on the system. A common replacement for the term stock out cost is service level. Although there are many different meanings of the word service, it is generally interpreted as the probability of achieving customer satisfaction. Level services can be applied to both periodic review systems (Q, R). There are two service level types, Type 1 Service and Type 2 Service.

In the case of type 1 service, specifically to calculate the probability level against the absence of stock out cost at lead time. The α symbol is used to indicate the probability level. As the specification of the probability is determined from the value of R, the calculation of the R and Q values can be separated. The calculation of the most reasonable value (Q, R) aimed at the type 1 service is very easy.

a. Calculate the value of R with the equation F (R) = α.
b. Value of Q = EOQ (Economic Order Quantity).

On the Type 2 service, measure the proportion of the demand specified from the inventory. The β symbol is used to indicate the proportion of this type. The value of n (R) / Q is the average fraction of the demand for the stock out cost in the cycle. Therefore, the value of β can be searched by the equation n (R) / Q = 1 - β. This equation is very complex compared to type 1, because it includes both Q and R values. This proves that EOQ is not lean in this case, only usually gives a pretty good result. If EOQ is used as a lot size, then its value can be calculated by the equation n (R) = EOQ (1- β) [3,22].

3. Result

As explained in the methodology, this study will present a comparison of 5 different inventory strategies for NSR materials, by comparing the most reasonable amount of inventory, material ordering time and the most reasonable inventory cost of the five strategies. The five strategies are the Traditional Inventory Strategy that the company is currently implementing, EOQ (Economic Order Quantity), Newsvendor Model, Lot-Sized Reorder Point System, and Q and R Service Level System. Table 1 is a summary of the average number of inventories, planning and actual use of NSR materials.

Table 1. Summary of the average number of inventories, planning and actual use of NSR materials

No	Description	Amount
1	Average NSR Material Storage	39,50
2	Average NSR Material Use Planning	2,67
3	Average NSR Material Usage	2,33

Source: Company Data Processed

3.1. Economic Order Quantity (EOQ)

With EOQ strategy, to calculate the most reasonable order quantity of materials, equation (1) can be used, in this paper based on data from internal company, the number of materials needs NSR 2017 is as many as 32 units. The cost of ordering each order is USD 10,000 and material deposit per unit is USD 1,000.

$$EOQ = \sqrt{\frac{2DS}{H}} \quad (1)$$

$$EOQ = \sqrt{\frac{2\ x\ \text{annual needs x ordering cost per order}}{storage\ cost\ per\ unit}}$$

$$EOQ = \sqrt{\frac{2\ x\ 32\ \text{x}\ 10{,}000}{1{,}000}}$$

$$EOQ = \sqrt{640}\ = 25.3\ \approx\ 25\ \text{unit}$$

Furthermore, the most reasonable time to place an order can be calculated by the equation (2).

$$T\ = \frac{EOQ}{D} \quad (2)$$

$$T\ = \frac{25}{32}$$

$$T\ =\ 0.78\ \text{year} = 9.375\ \text{months} \approx 9\ \text{months}$$

Then can be calculated holding cost per order period with equation (3):

$$Holding\ Cost\ =\ H\frac{EOQ}{2} \quad (3)$$

$$Holding\ Cost\ =\ 1{,}000\frac{25}{2}$$

$$Holding\ Cost\ = \text{USD } 12{,}500$$

$$Holding\ Cost\ = \text{USD } 1{,}388 \text{ per month}$$

3.2. Newsvendor Model

With the Newsvendor Model, to calculate the most reasonable order quantity of materials, equations (4-8) can be used. In this case, based on data obtained from the internal company for the number of annual needs 2017 is

32 units. With a production cost of USD 20,000 and a product selling price of USD 40,000 and the remaining selling price of USD 10,000.

First calculate the cost of excess inventory (Co) and the cost of inventory shortage (Cu) by using equations (4-5).

Co = c – v (4)

Co = Cost of Production – Remaining Selling Price

Co = USD 20,000 – USD 10,000 = USD 10,000

Cu = s – c (5)

Cu = Product Selling Price – Cost of Production

Cu = USD 4,0000 – USD 2,000 = USD 2,000

Next calculate the critical ratio with equation (6).

$$F(Q*) = \frac{Cu}{(Co+Cu)}$$

$$(6) F(Q*) = \frac{USD\ 20{,}000}{USD\ (20{,}000+10{,}000)}$$

$$F(Q*) = \frac{USD\ 20{,}000}{USD\ 30{,}000}$$

$$F(Q*) = 0.667$$

By using table z, we get z value for 0.667 is 0.42. So that the most reasonable number of orders for one period of material ordering can be calculated by equation (7). By calculating the standard deviation (σ) first using equation (8).

$$\sigma = \sqrt{\frac{\sum_{i=1}^{n} x_i{}^2 - (\sum_{i=1}^{n} X_1)^2}{n}} \quad (8)$$

$$\sigma = \sqrt{\frac{(12)(100) - 1024}{(12)(11)}}$$

$$\sigma = \sqrt{1.33} = 1.15$$

Q = σz + μ (7)

Q = (Standard Deviation x z Value) + (Mean)

Q = (1.15) (0.42) + (2.67) = 3.153 Unit ≈ 3 Unit per Month

Table 2. Number and Time of Order and Material Storage Costs by Using EOQ Inventory Strategy

No	Product Code	Material	Month	Number of Needs (unit)	Number of Order	Average of Storage Cost (USD)
1	RA 01US	NSR	Jan-17	1		1,388
2	RA 01US	NSR	Feb-17	3		1,388
3	RA 01US	NSR	Mar-17	3		1,388
4	RA 01US	NSR	Apr-17	3		1,388
5	RA 01US	NSR	May-17	2		1,388
6	RA 01US	NSR	Jun-17	2	25 Unit	1,388
7	RA 01US	NSR	Jul-17	3	for 9 Month	1,388
8	RA 01US	NSR	Aug-17	4		1,388
9	RA 01US	NSR	Sep-17	2		1,388
10	RA 01US	NSR	Oct-17	1		1,388
11	RA 01US	NSR	Nov-17	3		1,388
12	RA 01US	NSR	Dec-17	5		1,388
Total				32		16,666

Source: Company Inventory Data 2017 Processed

Table 3. Quantity, Order Time and Material Storage Cost by Using Newsvendor Model

Material	Month	Number of Needs (unit) (x)	(x^2)	Mean (μ)	Number of Monthly Storage (unit)	Average of Storage Cost (USD)
NSR	Jan-17	1	1		3,00	4,166
NSR	Feb-17	3	9		3,00	4,166
NSR	Mar-17	3	9		3,00	4,166
NSR	Apr-17	3	9		3,00	4,166
NSR	May-17	2	4		3,00	4,166
NSR	Jun-17	2	4		3,00	4,166
NSR	Jul-17	3	9		3,00	4,166
NSR	Aug-17	4	16	2,67	3,00	4,166
NSR	Sep-17	2	4		3,00	4,166
NSR	Oct-17	1	1		3,00	4,166
NSR	Nov-17	3	9		3,00	4,166
NSR	Dec-17	5	25		3,00	4,166
Total		32	100		36	49,999

Source: Company Inventory Data 2017 Processed

3.3. Lot-Sized Reorder Point System

To determine the Lot Size Reorder Point System, first we need to know the value of EOQ by using equation (1). With EOQ strategy, to calculate the most reasonable order quantity of materials can use Equation (1), in this paper based on data from internal company, the number of materials needs NSR 2017 is as many as 32 units. The cost of ordering each order is USD 10,000 and material deposit per unit is USD 1,000.

$$EOQ = \sqrt{\frac{2DS}{H}} \quad (1)$$

$$EOQ = \sqrt{\frac{2\ x\ \text{annual needs x ordering cost per order}}{storage\ cost\ per\ unit}}$$

$$EOQ = \sqrt{\frac{2\ x\ 32\ \text{x}\ 10{,}000}{1{,}000}}$$

$$EOQ = \sqrt{640} = 25.3 \approx 25 \text{ unit}$$

Next use equation (11) to calculate the loss function, with the cost of the order shortage of USD 6,500.

$$1 - F(R) = Q_0 h / p\lambda \quad (11)$$

$$1 - F(R) = \left(\frac{25\ x\ 10.000.000}{100.000.000\ x\ 32}\right)$$

$$1 - F(R) = \left(\frac{25}{320}\right)$$

$$1 - F(R) = 0{,}078$$

Using table z. Substitute 0.078 so that z is 1.42 and the value of L (z) is 0.036. After both values are obtained, the value of R can be calculated.

$$R = \sigma z + \mu \quad (12)$$

$$R = (1{,}15)\ (1{,}41) + 2{,}67$$

$$R = 4{,}29$$

$$n\ (R) = \sigma\ L(z) = (1{,}15)\ (0{,}036) = 0{,}0414$$

Using equation (10), to calculate the lot size of Q1 in a single order.

$$Q_1 = \sqrt{\frac{2\lambda\ [K + pn(R)]}{h}} \quad (10)$$

$$Q_1 = \sqrt{\frac{(2)(32)\ [10{,}000 + (10{,}000(0{,}0414)]}{1{,}000}}$$

$$Q_1 = \sqrt{666.496}$$

$$Q_1 = 25.816 \text{ unit} \approx 26 \text{ unit}$$

Then, calculate safety stock:

$$s = R - \mu \quad (13)$$

$$s = 4.29 - 2.67$$

$$s = 1.62 \approx 2 \text{ unit}$$

3.4. Service Level in (Q, R) Systems

To apply Service Level in (Q, R) Systems, first we must know the value of EOQ by using equation (1). In this study based on data from internal company, the total requirement of NSR material in 2017 is 32 units. The cost of ordering each order is USD 3,500 and the material deposit per unit is USD 680.

$$Q_1 = \sqrt{\frac{2\lambda\ [K + pn(R)]}{h}} \quad (10)$$

$$Q_1 = \sqrt{\frac{(2)(32)\ [10{,}000 + (10{,}000(0{,}0414)]}{1{,}000}}$$

$$Q_1 = \sqrt{666.496}$$

$$Q_1 = 25.816 \text{ unit} \approx 26 \text{ unit}$$

Furthermore, the most reasonable time for ordering can be calculated by equation (2).

$$T = \frac{EOQ}{D} \quad (2)$$

$$T = \frac{25}{32} = 0{,}78 \text{ year} = 9{,}375 \text{ months} \approx 9 \text{ months}$$

Next look for the values of z and R, using equation (11).

$$1 - F(R) = Q_0 h / p\lambda \quad (11)$$

$$\text{F (R)} = 1 - \frac{Q_0 h}{pd}$$

$$\text{F (R)} = 1 - \frac{(25)(1{,}000)}{(10{,}000)(32)}$$

$$\text{F (R)} = 1 - \frac{25}{320}$$

$$\text{F (R)} = 1 - 0.078$$

$$\text{F (R)} = 0.922$$

$$R = \sigma z + \mu \quad (12)$$

$$R = (1.15)\ (1.41) + 2.67$$

$$R = 4.29$$

Furthermore, calculate the safety stock and the most reasonable time for ordering can be calculated by equation (2).

$$s = R - \mu \quad (13)$$

$$s = 4.29 - 2.67$$

$$s = 1.62 \approx 2 \text{ unit}$$

Next calculate the storage cost in the following equation:

$$Holding\ Cost = H\frac{Q_0}{2} + s \quad (3)$$

$$Holding\ Cost = 1{,}000\ \left(\frac{25}{2} + 2\right)$$

$$Holding\ Cost = USD\ 14{,}500$$

$$Holding\ Cost = USD\ 1{,}611 \text{ per month}$$

Furthermore, the most reasonable time for ordering can be calculated by equation (2).

$$T = \frac{Q_1 + s}{H} \quad (2)$$

$$T = \frac{26}{32}$$

$$T = 0.8125 \text{ years} = 9.75 \text{ months} \approx 10 \text{ months}$$

Using the Q_2R level service, assuming the probability that all requests are met in one cycle is 90%, then:

$$Q_2 = Q_1 + s = 28 \text{ unit}$$

$\alpha = 0.9$ using the attachment table 1 obtained the value of z = 1.28, so

$$R = \sigma z + \mu \quad (12)$$

$$R = (1.15)\ (1.28) + 2.67$$

$$R = 4.142 \approx 4$$

If the probability assumption is increased to 96%, then:

$$Q_2 = Q_1 + s = 28 \text{ unit}$$

$\alpha = 0{,}96$ using the attachment table 1 obtained the value of z = 1,76, so

$$R = \sigma z + \mu \quad (12)$$

$$R = (1.15)\ (1.76) + 2.67$$

$$R = 4.67 \approx 5$$

After analysing the calculation of the amount of expenses charged to the company for the storage of NSR

materials, the analysis is done by comparing the five inventory strategies, including the Traditional System used by the company today, Economic Order Quantity (EOQ), Newsvendor Model, Lot Size Reorder Point System and Service Level in (Q, R) Systems. The five inventory strategies have proposed the most reasonable inventory amount and the most reasonable ordering time as well. Furthermore, the results of analysis and calculation are summarized in Table 5.

4. Discussion

The purpose of this study is to analyse the inventory strategy that is currently being implemented by oil and gas service companies in Cikarang which are considered to be the most reasonable or even become a source of waste in the company. Then a literature study of various inventory strategies has the potential to be a proposed as a new and more reasonable inventory strategy, the most reasonable inventory strategy is an inventory strategy with high availability but low inventory cost.

After analysing and studying some inventory strategies, this research creates a new proposal inventory strategy. This research will also calculate the most reasonable inventory level to reduce waste for NSR material at oil and gas services company in Cikarang. In addition to considering the advantages and disadvantages of each new inventory strategy proposal, the inventory cost factor is also a determinant factor in choosing the most reasonable inventory strategy at the lowest possible cost.

4.1. Traditional Inventory

Currently the inventory model that companies apply is a traditional inventory model with a high inventory level. As an initial reference and comparison with other inventory proposals. This research will calculate the amount of inventory costs at the beginning that the company spent on applying this inventory model.

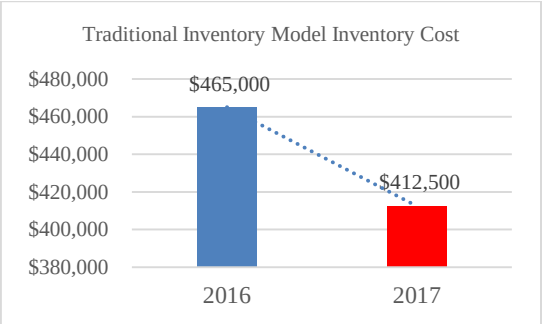

Figure 2. Graph of Inventory Costs with Traditional Inventory Model
(Source: Company Data Processed)

Table 4. Quantity, Order Time and Material Storage Cost by Using Lot-Sized Reorder Point System

No	Product Code	Material	Month	Number of Needs (unit)	Number of Order	Average of Storage Cost (USD)
1	RA 01US	NSR	Jan-17	1		1,500
2	RA 01US	NSR	Feb-17	3		1,500
3	RA 01US	NSR	Mar-17	3		1,500
4	RA 01US	NSR	Apr-17	3		1,500
5	RA 01US	NSR	May-17	2		1,500
6	RA 01US	NSR	Jun-17	2	28 Unit	1,500
7	RA 01US	NSR	Jul-17	3	per 10 Months	1,500
8	RA 01US	NSR	Aug-17	4		1,500
9	RA 01US	NSR	Sep-17	2		1,500
10	RA 01US	NSR	Oct-17	1		1,500
11	RA 01US	NSR	Nov-17	3		1,500
12	RA 01US	NSR	Dec-17	5		1,500
	Total			32		18,000

Source: Company Inventory Data 2017 Processed

Table 5. Summary of Analysis of Each Inventory Strategy

No	Inventory Strategy	Average Number of NSR Material Order (Unit)	Average Monthly NSR Material Storage Cost (USD)	Total NSR Material Annual Storage Cost (USD)
1	Traditional	71 per 12 Month	65,500	786,000
2	EOQ	25 per 9 Month	1,388	16,666
3	Model Newsvendor	3 per 1 Month	4,166	49,999
4	Lot Size Reorder Point System	28 per 10 Month	1,500	18,000
5	Service Level in (Q, R) System	28 per 11 Month	1,363	15,000

Source: Company Inventory Data 2017 Processed

4.2. Newsvendor Model

After studying inventory strategy using Newsboy or Newsboy Model it can be concluded that the most reasonable amount of NSR material inventory in 2017 is 36 units for 12 months usage. With each inventory amount each month is 3 units. The company is expected to make regular orders every month to ensure all requests in 2017 can be met. By applying the Newsvendor Model as a new inventory strategy, the company is expected to reduce the amount of high inventory as applied to its inventory system before it. In the previous section, paper already compares the inventory cost difference between the traditional inventory strategy that the company applies today to the proposed inventory strategy using the Newsvendor Model.

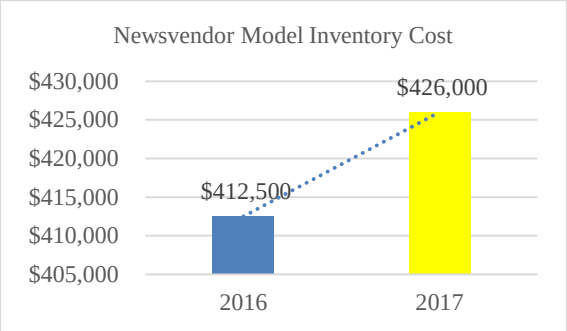

Figure 4. Graph of Inventory Costs with Newsvendor Model
(Source: Company Data Processed)

By using an inventory system with the Newsvendor Model, the company is expected to reduce the amount of funds spent on NSR material inventory capital. Previously with the traditional system the company will issue funds amounting to USD 412,500 in 2017 but otherwise, if the company implements the Newsvendor Model the company will instead spend more funds for a larger inventory capital of USD 426,000. This is because the company is required to make regular reservations every month. Of course, the shipping costs will increase drastically. Instead, the company will raise USD 13,500 or 3.27% from its previous budget if it wants to implement the Newsvendor Model. Increased capital cost of material inventory can be seen clearly in Figure 4.

4.3. Lot Size Reorder Point System

After studying inventory strategy by using Lot Size Reorder Point System, it can be concluded that the most reasonable amount of NSR material inventory in 2017 is as much as 26 main units and added 2 units as safety stock so total 28 units for 10 months usage. By applying the Lot Size Reorder Point System as a new inventory strategy, the company is expected to reduce the amount of high inventory as applied to its inventory system before it. The comparison of inventory cost between the traditional inventory strategy that the company is currently implementing with the proposed inventory strategy by using the Lot Size Reorder Point System.

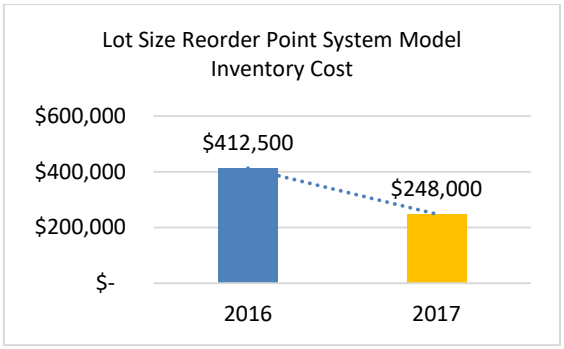

Figure 5. Graph of Inventory Costs with Lot Size Reorder Point System Model
(Source: Company Data Processed)

By applying the Lot Size Reorder Point System as a new inventory strategy, the company can reduce the amount of funds spent on NSR's material inventory capital. Previously with the traditional system the company will spend USD 412,500 in 2017 for NSR material inventory capital, but by applying Lot Size Reorder Point System, the company only has to spend the fund for inventory capital of USD 248,000 for 10 months. The Company can directly save up to USD 164,500 or 39.88% of the previous budget. The decrease in capital cost of material inventory can be seen clearly in Figure 5.

4.4. Service Level in (Q, R) Systems

After studying inventory strategy using Service Level in (Q, R) Systems, it can be concluded that the most reasonable amount of NSR material inventory in 2017 is 28 main units and 2 units added as safety stock so total 28 units. The calculation of the inventory amount is used in the same way as the Lot Size Reorder Point System, but the difference lies in when the company will reorder material inventory. By implementing Service Level in (Q, R) Systems, the most reasonable time to place an order is when the material inventory in the warehouse is 4 units. By implementing Service Level in (Q, R) Systems as a new inventory strategy, the company is expected to reduce the high inventory amount as applied to its inventory system before. As previously described, the proportion of inventory cost between the traditional inventory strategy that the company applies today to the proposed inventory strategy by using Service Level in (Q, R) Systems.

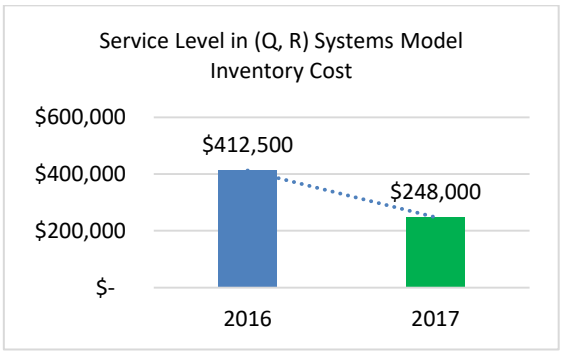

Figure 6. Graph of Inventory Costs with Service Level in (Q, R) Systems Model
(Source: Company Data Processed)

By implementing Service Level in (Q, R) Systems as a new inventory strategy, the company can reduce the amount of funds spent on NSR material inventory capital. Previously with the traditional system, the company will spend USD 412,500 in 2017 for NSR material inventory capital, but by applying Lot Size Reorder Point System, the company only has to spend the fund for inventory capital of USD 248,000 for 11 months. Companies can directly save funds amounting to USD 164,500 or 39.88% of the previous budget. Decrease in capital cost of material inventory can be seen clearly in Figure 6.

4.5. Selection of Proposed Inventory Strategies

Based on the findings given, and the advantages and disadvantages proposed by each inventory model and completed with the calculation by using several inventory models such as Traditional Model, Economic Order Quantity (EOQ), Newsvendor Model, Lot Size Reorder Point System and Service Level in (Q, R) Systems, it is clearly shown that the results of the analysis and calculation will be the cornerstone of the selection of the most reasonable inventory strategy where we have high levels of availability and low inventory costs.

Table 6 describes the total inventory cost of each inventory model used in this study. Overall the proposed inventory model tends to be better than the inventory strategy that companies apply today. However, the most appropriate inventory strategy proposal based on the research results is the Service Level in (Q, R) Systems model. Because this inventory mode perfects the previous inventory models of Economic Order Quantity (EOQ) and Lot Size Reorder Point System.

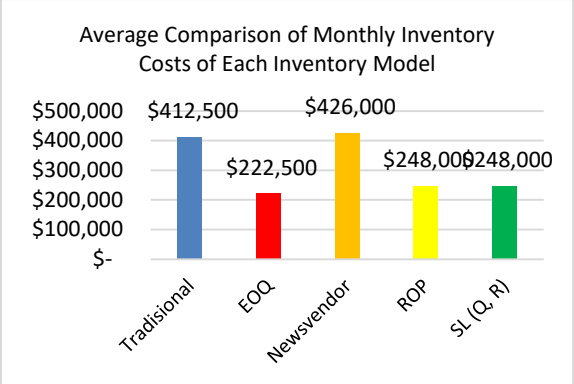

Figure 7. Average Monthly Inventory Cost
(Source: Company Data Processed)

Conclusion

From the results of research and discussion conducted, it can be concluded as follows. Based on the results of this study, the company is advised to apply the inventory model proposal with Service Level in (Q, R) Systems. Because this inventory model is the most reasonable model to solve the inventory problem at oil and gas service company in Cikarang. This inventory model can determine the most reasonable amount of inventory for company needs in the year 2017 that is as much as 26 units and added 2 units as safety stock so that it can save inventory cost equal to 30.50% every month. The reorder point is also determined based on the remaining inventory amount, which is 4 units. Also, by applying this method based on analysis and calculation from literature, the company can meet all customer demands with a probability of success rate more than 70%.

Table 6. Total Inventory Cost of Each Inventory Model

No	Inventory Model	Capital Cost (USD)	Ordering Cost (USD)	Storage Cost (USD)	*Lifetime* Storage (Month)	Total Annual Storage Cost (USD)	Average Monthly Cost (USD)
1	Traditional	340.000	20.000	52.500	12	412.500	34.375
2	EOQ	212.500	10.000	12.500	9	235.000	26.111
3	Newsvendor	306.000	120.000	50.000	12	476.000	39.667
4	ROP	238.000	10.000	15.000	10	263.000	26.300
5	SL (Q, R)	238.000	10.000	15.000	11	263.000	23.909

(Source: Company Data Processed)

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