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Research and proposal some solutions in optimization for warehouse at inland container depot (ICD) in Vietnam

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Abstract— In the context of strong economic growth of the major economies in the world, logisitics service provider of Vietnam is also developing, the demand for import and export of goods to overseas increasingly, it contributes a small proportion to Vietnam's GDP (6). Enterprises for warehousing service (inland container depot) are increasingly developing and becoming large distribution centers (Logistics Centers) in big economical regions of Vietnam. This paper focuses on researching on theory of optimazation and applying for the warehouse for inland container depot (ICD) in Vietnam.

Index Terms— Distribution, logistics, inland container depot, optimization, warehouse management.

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1 Introduction

Warehouses are places where raw materials, fuels, finished products and semi-finished products are stored for the production and business activities of the enterprise throughout the process of moving from the beginning to the end of the supply chain, it also provides information on the status, storage conditions and location of stored goods. The term "Warehouse" and "Distribution Center" are often used interchangeably because some people think the two terms do not have much difference. On the other hand, the two terms can be clearly distinguished by very basic differences. According to the European Logistics Platforms Association (1), "Logistics centers are an area that covers all activities related to transport, logistics and distribution of domestic as well as international goods, made by many different subjects. (2)" The application of modern advanced technologies in warehouse management of large distribution centers in the world is increasingly bringing high economic efficiency in the field of transport services, logistics - warehouse campaign. This proves that warehouses have a very important role in the whole supply chain in general and logistics service in particular.

Currently, the tools for managing inventory in large distribution centers around the world have been developed by many countries with modern advanced technologies such as Warehousing Management System). (3)Therefore, this article focuses on theoretical models of optimization in warehouses, thus calculating the efficiency of warehouses according to the cost-optimal economic model and the model of economic order (EOQ) on the basis of the input data (2). From the results of data collection and field surveys, the author uses two models of economic order (EOQ) to determine the optimal inventory levels and reserves of the warehouse at the inland container port. , on this basis, propose some solutions for warehouse optimization applied in the warehouse exploitation business of ICD Tien Son inland container port.

2 Main Contents

2.1 Research methods

Research methods: common methods of research such as statistical methods, qualitative analysis methods, modeling methods, specialized research methods of economic science .... These methods are used to analyze the optimization models of warehousing, warehousing and data analysis at warehouses which are then applied to the storage at the inland container terminal (ICD Tien Son - Bac Ninh).

2.2 Area of research

Area of research: collecting data, surveying the actual status of the warehouse of Bac Ky Investment Joint Stock Company (Tien Son ICD Logistics Center) from 2015-2017 (7).

2.3 Result of implementation

2.3. 1. Theoretical optimization methods in the warehouse

a. Inventory model of customer order (Cost of ordering): Inventory policy in warehouses affects profitability, the choice between policies depends on their relative profitability. By analyzing the inventory optimization theory of Frank et al. (2003), the costs of determining this benefit consist of six factors: (1) cost of order, (2) cost of storage, and (3) cost shortfall. Other relevant factors include (4) turnover, (5) freight cost, and (6) discount rate.

The costs of ordering an amount of money z (through acquisition or production) can be expressed by a function of c (z). The simplest form of this function is proportional to the quantity ordered, that is, z = c x z.

Where c represents the unit price paid. Another popular hypothesis is that c (z) consists of two parts: one is propor-

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tional to the quantity ordered and one is the constant K for z> 0 and 0 for z = 0.

In this case, c (z) is the ordering cost, we have two hypotheses:

c (z) = {(_K + cz if z> 0 ^ (= 0 if z = 0)) ┤ (2.1)
Where: K is the cost of establishing the order and c is the unit price.
The constant K consists of the cost of order management or upon production, the cost involved in setting up to start running the production program.

b. Economic order quantity (ECO): Two main models

The most common inventory situation faced by manufacturers, retailers or wholesalers is the amount of inventory depleted over time and then added as a series of new orders. A simple model that represents this situation is the economic order quantity model, in short, the EOQ economic order model (sometimes referred to as the economic shipment size model).

The units of the product in question are assumed to be withdrawn from continuous inventory at a known constant rate, denoted by a; That is, storage needs are units per unit of time. It is assumed that inventory is added as needed by ordering (through purchase or production) of a fixed volume shipment (Q unit) in which all Q units come at the same time at the desired time.

Model 1: Basic EOQ Model - over time t.

For the basic EOQ model presented earlier, the only cost to be considered is

- K is the cost of setting up to place a shipment,
- c is the unit cost for the production or purchase of each unit of goods,
- h is the cost of storage per unit of goods over a period of time in stock,

The goal is to determine when and how much to replenish inventory to minimize the total inventory cost per unit of goods by minimum storage time criterion.

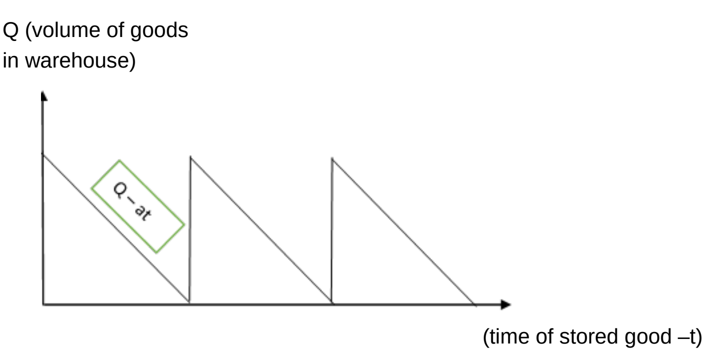

Figure 1: The basic EOQ model represents the inventory level as a function of time

In summary, in addition to the aforementioned costs, the underlying economic model assumes the following assumptions.

- The rate of continuous storage demand per unit of time.
- Quantity ordered (Q) to replenish inventory until all customer goods arrive at the same time only when desired, namely, when the inventory level drops to 0.
- No plan is allowed.

In relation to Assumptions 2, there is usually a delay between when an order is placed or when the goods arrive at the warehouse. As stated in the above hypothesis, the time between the order time and the time the order arrives is called lead time. The amount of inventory items in the order in which they are placed is referred to as reorder point. In response to Assumption 2, this rearrangement point needs to be placed in the cargo volume according to the demand and lead times. Therefore, the two hypothetical assumptions are a constant conduction time. The time between consecutive inventory additions (the vertical segments in Figure 1 above are called cycles).

The total cost per unit time T is obtained from the following components.

Production cost or order per cycle = K + cQ (2.2)

The average inventory level in a cycle is ((Q + 0))/2= Q/2units and the corresponding cost is hQ / 2 per unit time. Because cycle length is Q / a. Cost of occupying each cycle = (h Q2) / 2a

In there, total cost per cycle = K + cQ + (hQ2) / 2a (2.3)

So the total cost per unit of time is T = (K + cQ + (h Q2) / 2a) / (Q / a) = ak / Q + ac + hQ / 2 (2.4)

The value of Q, say Q *, which minimizes T is found by setting the first derivative to zero (and note that the second derivative is positive).

dT / dQ = - ak / Q2 + h / 2 = 0 (2.5)

So we have: Q * = √ (2aK / h) (2.6)

That's the famous EOQ formula (it's also sometimes called the square root formula). The cycle time corresponding, so t *, is:

t * = (Q *) / a = √ (2K / ah) (2.7)

It is interesting to observe that Q * and t * change in a reasonably intuitive way when the change is made by K, h, or a. As the cost of setting K increases, both Q * and t * increase (less set up). As units keep costs h, both Q * and t * decrease (smaller inventory levels).

Model 2: Economic Order Model (EOQ) with planned inventory shortage

The economic order model (EOQ) with the lack of plan mentioned in this scenario is by substituting only the third assumption of the basic EOQ model with the following new assumption. here: the time of lack of planning allowed. When inventory deficiencies occur, affected customers will wait for the product to become available again. Their borders are filled up immediately when the quantity of orders comes to replenish the goods in stock. According to these assumptions, the model of inventory levels over time appears as shown in Fig. The aliasing is similar to that shown in Figure 1. However, the reserve extends down to the negative value that reflects the number of units of the ordered product, assuming:

- p is short of cost per unit over a short time,
- S is the reserve level after a series Q unit is added to the inventory level,

And Q - S is short of inventory immediately before a unit Q

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plot is added. Total cost per unit time is now taken from the following components.

Production cost or order per cycle = K + cQ.

In each cycle, the reserve level is positive for a period is S / a. The average inventory level during this period is (S + 0) / 2 = S / 2 and the corresponding cost is hS / 2 per unit time.

Therefore, the storage cost per cycle = hS / 2 x S / a = (hS2) / 2a (2.8)

Similarly, the inventory shortage in a warehouse occurs over a period of time: (Q-S) / a. The average quantity of goods missing during this period is (0 + Q-S) / 2 = (Q-S) / 2 units and the corresponding cost is (p (Q-S)) / 2 per unit time.

Thus, the cost of goods shortages in each cycle = (p (Q-S)) / 2 x ((Q -S)) / a = (p ⟦(Q-S)⟧2) / 2a (2.9)

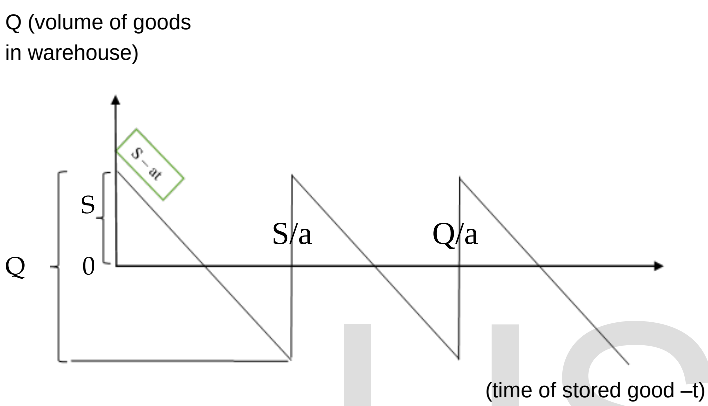

Figure 2: Inventory is a function of time for an EOQ model with a planned shortage.

Therefore, the total cost per cycle (TC) = K + cQ + (hS2) / 2a + (p ⟦(Q-S)⟧2) / 2a (2.10)

Total cost per unit of time: T = TC / (Q / a) = aK / Q + ac + (hS2) / 2Q (2.11)

In this model, there are two decision variables (S and Q), so the optimal values (S * and Q *) are found by setting the partial derivatives dT / dS and dT / dQ. = 0.

Then we have: dT / dS = hS / Q - (p (Q-S)) / Q = 0

and dT / dQ = - aK / Q 2 – (p (q-S) 2) / (2Q2) = 0 (2.12)

Solving this equation also leads to (2.13) where ((2aK / h) x √ (p / h)

So the optimal cycle length t * is defined as follows:

t * = (q *) / a = (√ (2aK / h) x √ ((p + h))/a

The maximum deficit is Q * - S * = √ (2aK / h) (√ (p + h) / p) / (p + h) (2.15)

From Figure 2, the time portion without inventory is calculated: ((S *) / a) / ((Q *) / a) = p / (p + h) (2.16)

This formula is independent of K. When either factor p or h is executed much larger than the number of orders processed in visual ways. In particular, as p approaches infinity, with constant h (hence the cost overrun dominates the cost of enterprise), Q * - S * approaches zero, while both Q * and t * converge with Their value for the basic EOQ model. Although the current model allows shortages in stock, with the condition that p approaches infinity, implying that p is not worthwhile.

On the other hand, h approaches infinity, with fixed p (so the cost overrun takes over the cost of the business, S * goes to zero. So, h goes to infinity, making it zero. Economically to have a positive inventory level, so each new shipment of Q * units does not go beyond eliminating the current inventory shortage.

Survey database, survey and some results

Within the scope of this paper, the author analyzes and calculates optimum theory based on survey data at warehouse of ICD Tien Son container port, Bac Ninh for calculation. ICD Tien Son is located near Ha Noi capital (21 km from center) and is the center of the Red River delta, located on the highway 1B with easy access to Hai Phong, Quang Ninh, Hai Phong. Noi Bai International Airport, Guangxi (China) and Ho Chi Minh City. It is located between big industrial zones of Bac Ninh, Bac Giang, Thai Nguyen, Vinh Phuc.

Tien Son is located in the north of the Red River where multinational corporations in the electronics sector are investing heavily such as Samsung, Canon, Foxconn, Wintek.

According to survey data and collected about container volume of customers in 2017 of ICD Tien Son Inland Container Port, the number of containerized cargo out of port such as SEV (4613 containers), Damco IKEA (2631 containers)), Cannon (2306 containers)), Foxconn (2297 containers)), Nissin Electric (1572 containers)).

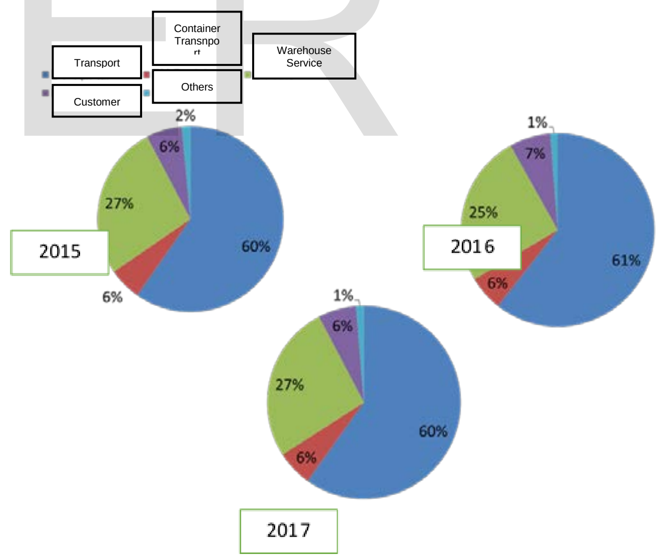

Figure 3: Share of revenue by type of service (2015 – 2017)

According to the statistics, the warehouse leasing service accounted for approximately 1/3 of total sales of Tien Son ICD (approximately 26%). This figure is mainly found in electronic components, cameras, furniture, home appliances. From the above data, in this study, the author proposes two economic order models (EOQs) for calculating consumer electronic components (DAMCO IKEA).

Calculated results using two specific economic order models (EOQs) were calculated with the following results:

The first model: Applying the economic order model over time t (EOQt)

For an example of electronic components, a cycle can be considered as the time between two consecutive runs of the production process of the DAMCO IKEA factory. The data of the manufacturer is 24,000 electronic components (speakers) are produced in each production run and used at a production rate of 8,000 speakers per month, the cycle length (Tck) is 24,000 / 8000 = 3 months. As storage demand increases, Q * increases (larger batches) but t * decreases (more frequent set-ups).

The appropriate parameter values from the above are: Set cost for placing 1 lot K = 12,000 USD; Storage costs h = 0.30 USD, monthly production rate a = 8000 speakers,

Substitutions and formulas (2.6) and (2.7) have the optimal volume of production orders:

Q * = √ ((2 x 8000 x 12000) / 0.3) = 25 298 units

Instead of the formula (2.14), we have the optimal production time in the cycle:

t * = √ ((2x12000) / (8000 x 0.3)) = 3.2 months.

Therefore, the optimal solution is the proposed warehouse with the DAMCO IKEA enterprise produced to produce the loudspeaker once in a cycle of 3.2 months and the quantity needed to produce is 25,298 speakers each time. The total cost curve is quite flat near this optimal value, so any similar manufacturing activity may be more convenient, say 24,000 speakers for a 3 month cycle, will be almost optimal.

Second model: Economic order model (EOQ) shortage of goods in stock

If the planned shortage model is allowed in the speaker example, the cost deficit is estimated in Figure 2. With the data p = 1.1 when K = 12000 USD, h = 0.3, a = 8000

Now substitute the value in formula (2.13) where: S * = 22 424 and Q * = 28450

And t * = (Q *) / a = 28450/8000 = 3.6 months is the time of inventory shortage

Thus, the production enterprises will be set up a time limit of 3.6 months to produce the largest volume of 28,540 loudspeakers. The shortage of warehouse space for cargo storage is maximum 6116 speakers.

Calculated results show that the application of model 1 or model 2 of theoretical optimization of time-based or cost-based economic orders and EOQs is planned as planned for optimum inventory management. At the ICD Tien Son inland container port, this service provider offers solutions such as:

Warehouse optimization according to the period of storage according to the production cycle of enterprises having demand for warehouses.

Optimized volume orders of customers with storage needs.

To set up the space deficit for stockpiling of warehouse service providers.

Warehouse service businesses have plans for production and business to suit each time of the month or in the year, the strategy to expand and develop their warehouse system to suit each condition and circumstance. Existing partners and customers in the present and in the future.

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3. Conclusion

Based on the optimized theoretical research in existing warehouses in the world, this research is applied to the calculation of electronic components (loudspeakers) at Tien Son ICD container terminal-Bac Ninh. The results show that the application of economic optimization theory (EOQ) is very important in warehouse management, especially in proposing effective solutions, as well as building business strategies for warehouses and inventory levels. This helps the warehouse business enterprises to improve more and more about the organization and management of warehouse operations at the domestic container ports in Vietnam today. Finally, this study has both scientific and practical implications, continuing to open new research directions in applying theoretical models that are optimal and applicable to other commodities. The management and exploitation of warehouse services is more effective.

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