Supply Chain: The Bullwhip Effect and Effective Ordering System for Optimal Operation Schedule

Daryono [1], Retno Widuri[2]

[1]Faculty Economics and Bussiness Unsoed, daryono@unsoed.ac.id, Indonesia
*corresponding author

ABSTRACT

Consumer awareness of proper handling of shipments as well as the increasing prevalence of product resale in stores. The purpose of this study is to analyze the supply chain of goods to ensurethat goods are delivered on time and in the right quantity to prevent misinformation lead time and to improve the delivery system. The bullwhip effect is a term used to describe how supply chain variability increases over time. The impact of the Bullwhip can be reduced in the supply chain at the relevant level, allowing the collection of useful information that can then be combined to mitigate the Bullwhip effect and improve business operations. Bullwhip Effect was observed in Lima as a result of data elaboration and in-depth analysis, according to those results.retail and at Distributors, caused by: According to unconfirmed information about retailer-distributor transactions, the lead time for the current transaction is 5 days, but it can be shortened to 1 day in the future because of the high probability that the product will be damaged during the trip. Based on the results of those calculations, it was determined that the reorder system had given more optimal results, indicated by smaller N and T values compared to the initial conditions, which made inventory costs more accurate than ever before.

Keywords : Supply Chain, Bullwhip Effect, Inventory

1. Introduction

Aris KUD located in Banyumas , is one of the official distributors of rice in Banyumas Regency. Rice can be categorized as the main need for the community, so that the availability of rice in sufficient quantities when needed at affordable prices. Inreality, on the contrary, the supply of rice cannot meet the needs of the people. Therefore, Aris KUD is needed but what is often experienced is the lack of fulfillment of public or retailer demand. Fluctuating demand conditions and the absence of definite and possibly incomplete sales data will result in uneven distribution of rice and for the time of fulfillment of demand desired by customers is not appropriate. So that retailers or even customers will feel less satisfied.

This problem can increase the level of customer satisfaction if no suitable solution is found, so it is necessary to find the right solution to overcome the problems that arise from the problem before. By reducing the Bullwhip effect in the supply chain and building sound systems for reassembly, it will be possible to gather useful information, increase the effectiveness of the distribution system to reduce the Bullwhip effect, get the optimal biayes per unit, and improve the efficiency of the ordering system.

2. Literature Review

2.1 Supply Chain Management

A supply chain is a system that allows an organization to deliver finished goods and customer orders to other parties. In addition, the Chain is a network of organizations that work together and share the same goal, which is to ensure that barging and procurement have been completed. (2002) (Indrajit).

The supply chain can also be described as a business process that involves the participation of retailers, producers, distributors, and consumers. Since each element has a unique function related to the occurrence of trade laws, the chain in question is no longer limited to eight chains. It is possible for this harsh word to develop, as shown by distributors, tertiary producers sourced from suppliers, and other examples. However, the function of the chain is changed to four pieces.

2.1.1 Supply Chain Components

Supply chain is Network. Inthe logistics network there are several components that have a close relationship, namely (Indrajit, 2002)

- Chain 1: Suppliers

  This SC network is called suppliers who are the first suppliers of raw materials, raw materials, commodities, spare parts, etc.
- Chain 1-2: Supplier Manufacturing

  The first chain is connected to the second chain, which is a producer or other type of business that does work to make, make, assemble, or even sell goods (finishing). The connection with the first chain mat has thepotential to make savings. The targets of this investigation include the distribution of raw materials, semi-finished materials, and finished materials in suppliers, factories, and transportation centers. It is not uncommon for 40%–60% or even more savings from the costof storing inventory in this market. Savings can be achieved by implementing supplier partnership strategies, for example.
- Chain 1-2-3: Supplier Manufacturing Distributor

  Items already manufactured by the manufacturer must now begin to be distributed to customers. While there are other ways to deliver goods to customers, the most common method is through distributors, and this method is usually supported by a number of supply chains. Goods by manufacturers are distributed to distributors, wholesalers, or wholesalers in bulk, and in time wholesalers flow small quantities to retailers or retailers.
- Chain 1-2-3-4: Supplier Manufacturing Distributor Retail Outlets

  Wholesalers usually have warehouses that are used to pack goods before they are shipped to purchasing organizations. In this environment, there is an opportunity to manage inventory levels and development costs by redesigning the process of shipping goods, whether from the manufacturer's warehouse or a retailer's store.

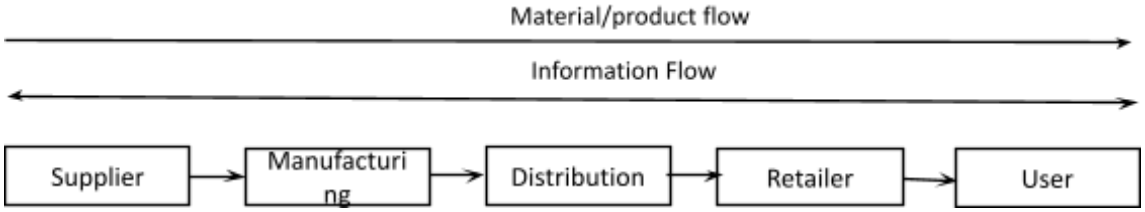
- Chain 1-2-3-4-5: Supplier 🡺 Manufacturing 🡺 Distributor 🡺 Retail Outlets Consumers

From the shelves, these retailers offer goods to customers or consumers directly. Terms of outlets include "shop", "stall", "convenience store", "supermarket", "mall", andother similar items. Despite the fact that these can be characterized as final rants, there is only one rant left, and that is rude words from the buyer (who enters the store) to the original customer or user nyata, because the buyer is not necessarily the user in question. Once an item in need of repair fails to be purchased quickly (or, more often, at all), the supply line is suddenly fully operational.

2.1.2 Principles of Supply Chain Management

The basic principle of supply chain management is the coordination and synchronization of activities within and across the organization that have a direct relationship with the flow of materials or goods. The principles of Supply Chain Management consist of:

- Use logistics networks to reach different types of customers.
- Getting market signals and making these signals as a basis for planning needs to get forecast results, consistency and allocation of funding sources.
- Adjust product points to be closer to the consumer and maintain smooth conversions across the path of rants.
- Use the supply of strategic sources to reduce the cost of ownership of materials or services.
- Develop a technology strategy for the entire supply chain of hierarchical decision making and provide a clear picture of the flow of products, services, and information.
- Adopt overall performance measurement for a single supply chain with a focus on maximizing customer service for future customers.
- Segmentation of consumers based on their needs.



2.1.3 Functions of Supply Chain Management

Supply chain management has two functions, according to Zabidi (2001):

- According to strict physical principles, supply chain management transforms raw materials and transfers them to the final consumer. This function deals with physical costs, such as material costs, production costs, transportation costs, and other costs.
- **Bullwhip Effect**
  The first time the "Ms. bullwhip effect" was used by Procter & Gamble (P&G) employees when they had reinforced negative feedback regarding their "pampering" products. The bullwhip effect is defined as an increase in supply chain variability at any point in time. Information misunderstood from one source to another can contribute to widespread financial instability. Examples

include overstocking or being stored in the back room, problems with ordering products, poor customer service, low production capacity, low productivity, unreliable payment methods, and inefficient transportation.

- **Inventory**
  Inventory as a key attribute of an organization carries significant business risks. Inventory in a manufacturing environment can include parts inventory, raw material inventory, auxiliary material inventory, work-in-progress inventory, and finished goods inventory.
- Every business must be able to maintain inventory at the right level to determine the needs of their core business initiatives in the right quantity and quality and at reasonable prices. To be able to achieve the best possible level of inventory, which can fully meet the needs of the organization in terms of quantity, quality, timeliness as well as quality and quantity of revenue, an inventory monitoring system is needed.

2.2 Definition of Inventory

Inventory is a collection of data and analysis that tracks resource inventory levels. The goal ofthis system is to capture and validate the current state of source power in the appropriate amount and time frame. Inventory is a general method to solve problems related to a company's policy in the procurement of raw materials and finished goods in connection with a particular activity.

The hallmark of the inventory model is the best solution to constantly focus on ensuring that inventory is maintained at a reasonable cost. According to analystsis the inventory system problem consists of two things:

- The number of goods or products that must be produced (ordered).
- The time required to deliver any item or product must be completed.

2.2.1 Inventory Function

The function of inventory is divided into three, namely:

- Decoupling Function
  Features that enable seamless internal and external business operations so demand can be met without having to rely on suppliers.
- Economical Lot Sizing Function
  There may besome function where, through a process of persuasion, a firm can produce or purchase power in quantities that can increase the cost per unit.

2.3 EOQ (Economic Order Quantity)

The most common and widely known inventory control technique is EOQ (Economic Order Quantity), which is the most important inventory model. Ford W. Harris developed this technique in 1915. The goal of EOQ is to minimize overall annual expenses; These expenses can be classified as preparation costs, ordering costs, and storage.

3. Research Methodology

Data collection is greatly facilitated by data processing equipment, data processing techniques, or data processing procedures, both used for initial and final data, consisting of:

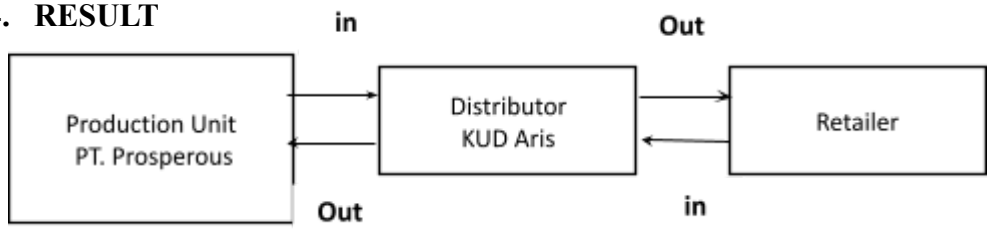
- Primary Data

Primary data is data obtained from the results of continuous and continuous observations. Using this method

- Obervasi: By introducing an ongoing dialogue between distributors and retailers regarding the supply chain as a whole.
- Interview with company leaders by continuing to ask.
- Secondary Data
  The external data is the full version of the primary data. The data in question were not obtained using field-based observations.
- Data Internal
  Data about the supply chain derived from common data that exists in the business, such as:
  - General data of the company
  - The system of distributing goods to retailers.
  - Number of retailers or retailers.
- External Data
  Depending on the journal or alternative sources currently used by the company.

Aris KUD located in Banyumas, is one of the official distributors of rice in Banyumas Regency. Rice can be categorized as a major need for the community, so that the availability of rice in sufficient quantities when needed at affordable prices.

4. RESULT



Information:

: Distribution Chain

: Information Chain

The results of the Economic Order Quantity (EOQ) model will be favorable under the following assumptions:

- The demand for goods is continuous with a uniform rate, but this model is still quite good to use because the variation in demand is not too large. The variationper request on this particular barge is not very large and can be assumed to be consistent based on the level of demand for goods from year to year.
- The long waiting time remains to be mentioned, in this case for the delivery of goods to the buyer's address or lead time constant, which is five days.
- Inventory Cost is considered to have been pre-understood. Inventory costs from current studies, such as ordering costs, purchase costs, and storage costs, are understood with certainty.
- No volume discount No potentiometer for the purchase price made in any quantity or quantity.

Data Lead Time

Data regarding lead time, which is the period of five days that distributors must have to ship goods from distributors to retailers, can be obtained from this study. However, PT. Makmur takes two days to complete the process, starting with the

delivery of the bars to the distributor and ending with the receipt of a surcharge notice sent from the distributor organization to Gudang Makmur.

Product Price Data

Price of Rice : 57.500/Sak

Cost Data – Cost

Booking Fee

- Administration Fee

: Rp 2.500,-/order.

- Saving Cost (a): Annual storage costs are calculated as a percentage of maintenance, warehouse, electricity, and labor costs.

The data needed is oriented to fluctuations in consumer demand which is quite high.the product taken has a fairly high fluctuating level of demand because the product is a consumer product and needs commonly used by farmers. In the supply chain system at PT. Prosperous, from the factory will be distributed on the tor distribution. Where KUD Aris, which is a distributor in the Banyumas area, will serve requests from retailers in the Blora area. And for this research 5 retailers were taken, namely:

Retailer 1 : Life
Retailer 2 : Blessing
Retailer 3 : Usaha Jaya
Retailer 4 : Mulyo Rice
Retailer 5 : Rice Sustenance

The measurement of *the Bullwhip effect* value from retailer to *distributor* is:

CV (Sell) = STD (Sell) / AVR (sell)
= 22.3437 / 149.17
= 0.1497

CV (message) = STD (message) / AVR (message)
= 24.4329 / 158.33
= 0.1543

BE(ω) = CV(message) / CV(sell)
= 0.1543 / 0.1497
= 1,030

The measurement of the Bullwhip effect value at the distributor level is:

CV (Sell) = STD (Sell) / AVR (sell)
= 8127.28 / 10135.8
= 0.8018

CV (message) = STD (message) / AVR (message)
= 8127.17 / 10291.67
= 0.7896

BE(ω) = CV(message)/CV(sell)
= 0.7896/ 0.8018
= 0.985

Based on the results of the investigation, it was found that the distribution of orders from retailer to distributor and from distributor to retailer increased. This means that the variability of the distribution of regularity across the supply chain is also increasing. In addition, the bullwhip effect in a particular supply chain can be identified by comparing distributor and retailer estimates of order variance placed with regard to time and lead time functions.

Settlement model :

Retailer-level measurement.

$$\frac{var\ Q}{var\ D} \geq 1+\frac{2L}{P}+\frac{2L^2}{P^2}$$

$$\frac{499.2424}{596.9697} \geq 1+\frac{2(0,16)}{12}+\frac{2(0,16)^2}{12^2}$$

$0.8362944 \geq 1.030385802$

Measurement at the *Distributor* level

$$\frac{var\ Q}{var\ D} \geq 1+\frac{2L}{P}+\frac{2L^2}{P^2}$$

$$\frac{66052608}{66050852} \geq 1+\frac{2(0,06)}{12}+\frac{2(0,06)^2}{12^2}$$

$1.000027 \geq 1.011172$

If the conditions mentioned above persist, the bullwhip effect will not occur, that is, if the ratio of inventory variation to demand variation is greater than or equal to the ratio of period and lead time.

Identify the cause of the bullwhip effect

From the results of these experiments it can beconcluded that the Bullwhip effect occurs in almost every retail setting. This suggests that the variability and variation of demand is greater than the variability and variation of supply. In addition, both at the distributor and store levels, in order for Bullwhip effect to increase, it is necessary to take precautions.

Lead time for a period of time

Lead time is reduced by addressing each mature condition, such as temporal tension between distributors and retailers, so that it can be achieved in certain situations.

1. From distributor to retailer lead time

The initial lead time is five days, but if the location of the distributor and retailer is considered, the lead time can be reduced to one day. If the lead time is more than one day, the main comparison between the period length and the lead time is as follows:

$$1 + + = \frac{2L}{P}\ \ 1 + \frac{2L^2}{P^2} + = \frac{2(0.03333)}{12}\ 1.005570988 \frac{2(0,03333)^2}{12^2}$$

From the results of the calculation above, in order to minimize the Bullwhip effect, it should be attempted that the magnitude of the Q variance value must be greater than the D Variance and the magnitude of the comparison of the two (Var Q / Var D) must be greater than 1.005570988

2. Factory lead time to distributor

After seeing the temporal lead time between manufacturers and distributors which was originally 2 days, the lead time cannot be shortened or minimized further.

5. IMPLICATION

In this study, observing the flow of goods and information in the supply chain of PT. Makmur (manufacturer) – KUD Aris (Distributor) – 5 retail namely UD. Life, UD. Blessings, UD. Usaha Jaya, UD. Mulyo Rice, UD Rice Sustenance. All of these retailers are located in the Banyumas area. The product studied is rice, the product studied is rice with the highest sales level in the Banyumas region.

Identify the Cause of the Bullwhip Effect

From the results of the analysisusing fishbone diagrams, it can be concluded that distribution system management and distribution system are factors causing the bullwhip effect. The failure of an order to be completed on time when receiving an uncertain request is a contributing factor. On the contrary, the requirements of the

distribution system for the timely delivery of goods mean that late delivery of goods can seriously hinder the progress of production.

In the retail sector, the root of the problem is an untimely delivery system and too long delivery times. This may result in stock restrictions on the above-mentioned products. To prevent stockouts, retail stores buy products that don't necessarily suit the needs of their customers. The next issue is with information systems; At present, the information system of the retail industry is not very powerful. Data is only obtained from records and reports from sales, so data about requests and inventory obtainedis less accurate. With inaccurate information this is what causes information distortion.

Proposed Improvements

It is unlikely to reduce the strength or threshold of bullwhip impact on any given supply chain in the context of this study. The technique that can be used is to increase the size of the bullwhip effect. The most ideal situation is when the bullwhip effect is equal to 1, because once it deviates from that point, the distribution of the product will proceed normally or slowly. According to research using fishbone, the product assembly and distribution system are the two main causes of the bullwhip effect. It is important to conduct a more thorough analysis of delivery times and waiting times, as well as the systems that manage them, to come up with improvement solutions that allow businesses to manage their internal processes more effectively.

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6. CONCLUSION

From data collection and analysis, it was determined that the Bullwhip Effect occurred in four samples. This is the result of a number of factors, including damage to the marking of the trunk and the distribution system.

b. The method used to reduce or eliminate the Bullwhip Effect is to: Improve the distribution system so that there is no shortage of goods. Taking into careful consideration the waiting time for delivery of goods. The distributor's lead time to reach customers, which was originally five days, was shortened to one day. Based on the test results with a five-day lead time, the average ratio of function periods to lead times is 1.030385802. The lead time on one working day is the benchmark between the fusion periodand the lead time of 1.005570988. By comparing the function period and wait time more precisely, the two variables are also more closely related.

The second way to reduce the bullwhip effect is to make sure there are no flaws in theordering process so that the order cost does not increase because goods are often ordered once every one or two weeks. This is done to prevent store staff from being distracted while both organizations are working on their respective tasks. in an effort toget more favorable shipping prices.

Information systems, provide the most excellent and efficient information systems, such as entering all records of orders or receipts of goods on a computer, to produce real information needed by consumers quickly to ensure that consumer needs for the goods they buy can be satisfied quickly and accurately. Because this is likely to have an impact on the distribution system, consumer confidence can be overwhelming.

2. From the results of data collection and analysis, it is known that the re-repair system has provided more optimal results, evidenced by smaller N and T values than the initial condition. As a result, inventory costs are also more accurate thanat the initial condition.

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