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INVENTORY MANAGEMENT ANALYSIS OF FAST-MOVING CONSUMER GOODS AT STOCK POINT: CASE STUDY IN A DISTRIBUTION COMPANY

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INVENTORY MANAGEMENT ANALYSIS OF FAST-MOVING CONSUMER GOODS AT STOCK POINT: CASE STUDY IN A DISTRIBUTION COMPANY

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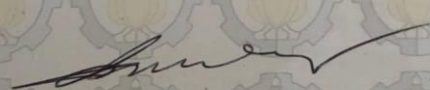Surabaya, Indonesia

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INVENTORY MANAGEMENT ANALYSIS OF FAST-MOVING CONSUMER GOODS AT STOCKPOINT: CASE STUDY ON DISTRIBUTION COMPANY

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ABSTRACT

` PT. Indomarco Adi Prima established as product distributor that connect factory as a producer, with retailer as the consumer with all Indonesia coverage. Product that distributed by PT. Indomarco Adi Prima categorized as FMCG product. Therefore, high service level is critical for product distribution of PT. Indomarco Adi Prima. Service level is measured by the product order quantity fulfilled for each order. In order to have closer distance to their customer, PT. Indomarco Adi Prima placed stock points all around Indonesia, to also help the company increase their service level. However, the performance of stock points, especially on service level is under the company target. This mainly caused by high number of stockout on the stock point. Current system control provides lower total cost, but low service level that has not achieved the target. Therefore, we build an improvement method by using continuous review (s, S) to increase the service level while maintaining low total cost. ABC analysis used to choose stock points and product as samples, with service level and net sales contribution as the factors of analysis. Lead time of the product based on the delivery frequency of each stock point and the demand used is probabilistic. There are 4 output to be compared, which are unused inventory, stockout, total cost, and service level. Service level target will be adjusted as the scenario of this research, and demand will be adjusted as the sensitivity test of this research. As the result, improvement method is applicable for A and B class product. There are 3 products that fail to achieve company target on sensitivity analysis, and changes on service level target does not have high impact on actual service level changes.

Keywords: Continuous Review (s, S), Inventory Management, Monte Carlo, Service Level

ACKNOWLEDGEMENT

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CHAPTER I

INTRODUCTION

In this chapter, the background, problem formulation, objectives, benefits, assumption, and limitation of the research will be explained.

1.1   Background

Indonesia, as one of the biggest countries in the world, is recognized as one of the most consumptive country in term of household consumption. According to the data of the World Bank, Indonesia Household Final Consumption Expenditure touch 581.992 million US$ on 2017, which made Indonesia placed on 16th in the world. This condition drives an open opportunity for fulfilling the needs of household product in Indonesia. Most Indonesian fulfill their household needs by buying products from retailers.

Table 1. 1 Number of Household Final Consumption Expenditure of Country around the world (Source: World Bank)

No	Country	HFCE (millions of USD, nominal)	% of GDP	Year
1	United States	13,321,407	68%	2017
-	European Union	9,613,986	56%	2017
2	China	5,634,823	43%	2017
3	Japan	2,756,598	56%	2017
4	Germany	1,952,625	53%	2017
5	United Kingdom	1,724,051	66%	2017
6	India	1,528,691	59%	2017
7	France	1,396,436	54%	2017
8	Brazil	1,303,885	63%	2017
9	Italy	1,181,424	61%	2017
10	Canada	956,788	58%	2017
11	Russia	826,390	52%	2017
12	Spain	756,975	58%	2017
13	Mexico	753,475	65%	2017
14	Australia	752,261	57%	2017
15	South Korea	736,214	48%	2017
16	**Indonesia**	**581,992**	**57%**	**2017**

According to Sujana (2005) There are 2 types of retail based on their size, which are small store/kiosk, minimarket, supermarket, and hypermarket. A small store (Kiosk) generally a traditional retailer, operated as a small business with a sales area of less than 100 m2. Smaller stores usually offer a little number and low variety of products, and often provide primary household needs such as shampoo, soap, food & snacks, cigarette, etc. Minimarket has around 100m2 and 1000m2 sales area coverage. Minimarket usually has more variated produced compared to the kiosk. Some examples of minimarket in Indonesia are Indomaret, Alfamart, Sakinah, etc. Supermarket is a bigger retailer compared to minimarket, with around 1000m2 and 5000m2 sales area coverage. Them mostly placed on the mall, or main road of a city. The supermarket offers a huge variety of product for their customer. Many supermarkets also sell electronic devices like phone, television, washing machine, etc. And last, Hypermarket is retail that operated with more than 5000m2 sales area, with a massive variety of product, starting from household needs until the furniture.

One of the aspects that critical for retail business process is logistics, where logistics move the products from the producer to every retailer. Logistics contribute a huge number of costs to the retail industry. Therefore, logistics management is needed to control the cost of logistics as well maintaining service level to the customer. To answer this challenge, PT. Indomarco Adi Prima established as product distributor that connect factory as a producer, with retailer as the consumer. PT. Indomarco Adi Prima is a national distribution network. PT. Indomarco Adi Prima has one of the most extensive distribution networks in Indonesia.

PT. Indomarco Adi Prima supply chain model consist of 5 main elements, which are Principal, Head Office, DC & Sub DC, Stock-point, and Outlets. Principal is the factory that produces product that distributed by PT. Indomarco Adi Prima. PT. Indomarco Adi Prima has around 17 Principals that spread around Indonesia. Next, Head Office is the main warehouse of the company. PT. Indomarco Adi Prima has 2 Head Office, which are Head Office Surabaya and Head Office Jakarta. PT. Indomarco Adi Prima has 65 DCs & Sub DCs in Indonesia, that almost cover all around Indonesia. DC & Sub DC responsible to make estimation of product demand based on their sales estimation according to stock-point demand,

and make Confirm Monthly Order (CMO) or Confirm Weekly Order (CWO) to Head Office or directly to the Principal. The product then delivered to DC & Sub DC corresponding to Purchase Order (PO) that published.

Stock-point, as the closest element to the customer of PT. Indomarco Adi Prima, which are Outlet, responsible as the frontier of demand capturer, with the help of their salesman. Stock-point build to juxtapose PT. Indomarco Adi Prima to their customer, so PT. Indomarco Adi Prima can increase their service level as well as extending their market. PT. Indomarco Adi Prima has Outlet as their consumer, that divided by 2 categories, which are Modern Trade and General Trade. Modern Trade defined as an outlet that has its own holding company, such as *Indomaret, Alfamart, Superindo, Giant*, etc. Modern Trade demand fulfilled directly by the DC & Sub DC. General Trade defined as traditional outlet, that is owned by an individual, such as kiosk, grocery, etc. General trade demand fulfilled by the stock-point.

PT. Indomarco Adi Prima has 144 stock-points for Surabaya coverage. In order to measure stock-point business performance, PT. Indomarco Adi Prima use percentage of order fulfillment based on the product quantity, which called as service level of stock-point. PT. Indomarco Adi Prima has 90% service level as a target for each stock-point. Based on the data for last year service level, PT. Indomarco Adi Prima stock-points reach 90.17% service level on average, which achieved the target, but there are some stock-points that have not achieved the target. The data below is the service level of 72 stocks-points in Surabaya coverage.
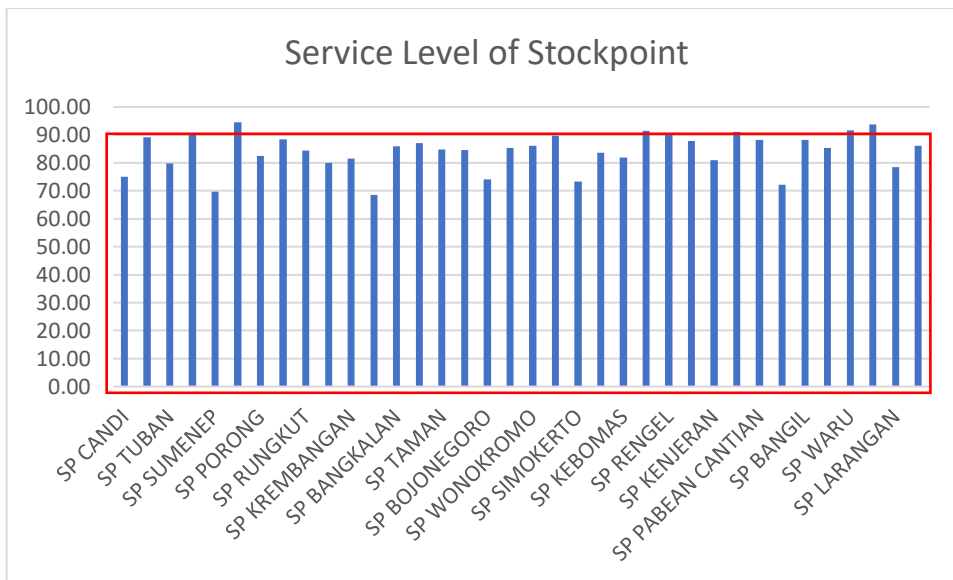
Figure 1. 1 Service Level of the Stock points

As we can see from the data above, there are many stock-points that have not achieved the service level target. Based on the data, there are 62.5 % (90 out of 144) stock-point that has not met the service level target. While one of the components of service level achievement is the number of safety stock, this reflects how safety stock of the stock-point is not optimal to boost the service level in the stock-point.

To check the performance of the safety stock for each stock-point, we try to check the number of understock and overstock of stock-points. Understock consist of not available SKU items and understock SKU. While there are 60 stock-points used as the sample for the checking.
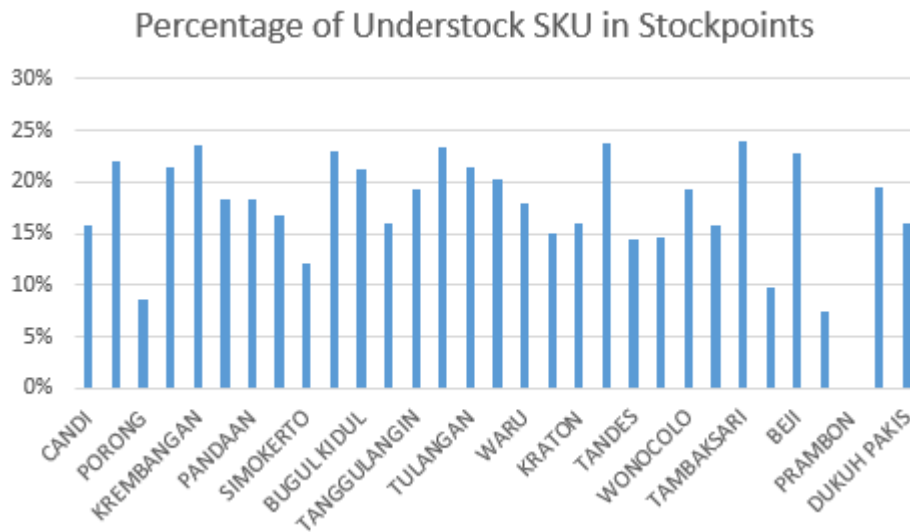
Figure 1. 2 Percentage of Understock SKU of the Stock points

As we can see from figure 1.4 that almost all sample has understock SKUs, which writer found that the average number of understock SKU for all stock-points is 20%. This reflect why stock-points have low level of service level. Writer also check the number of overstocked SKU for each sample, and as we can see from figure 1.5, all sample has SKU overstock problem, moreover, there are stock-point that have 100% overstocked SKU, which is Prambon.
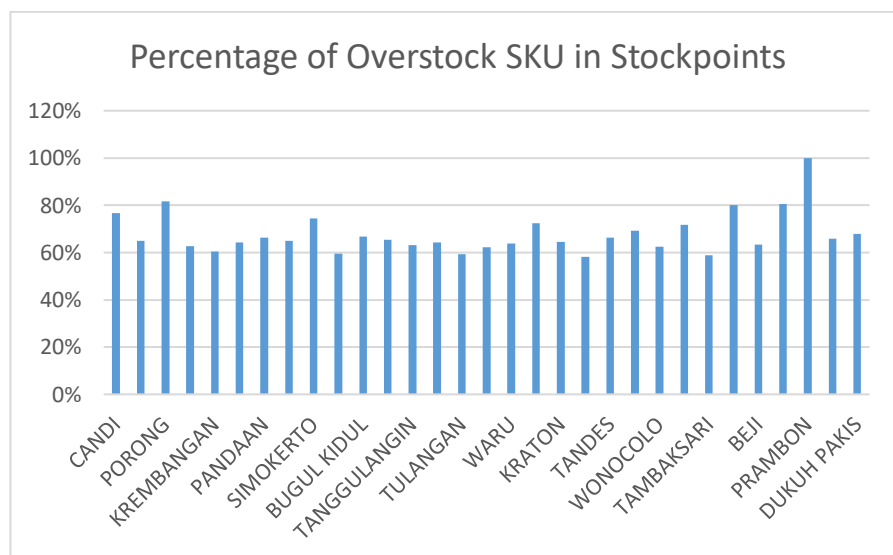
Figure 1. 3 Percentage of Overstock SKU of the Stock points

By having those problems, we decide to do some research on finding better inventory policy for critical product of the chosen stock-point. This research conducted to increase the service level of the stock-points, so they can achieve the target set by the company, while having the optimum stock of critical product. This research will also compare the existing method to the method that proposed based on output parameters that have been set.

This research focused on product inventory management on stock-point, based on stock-point ABC Classification and product ABC Classification on chosen stock-point, based on the size of the stock-point (Big, Medium, Small). The categorization of stock-points will be conducted by Analysis Based Costing (ABC) analysis. For each category of stock-point, there will be critical product chosen and analyzed by using continuous review (s, S). Inventory parameter that would be calculated is safety stock. Then, inventory cost that used as consideration is ordering cost and holding cost. Next, we would compare total cost and service level of the product that earned by the inventory management process that currently used by the company compared to the improvement method with continuous review (s, S) method.

1.2 Problem Formulation

Based on the background explained above, this research is designed to find better inventory policy for critical product on critical stock-point by comparing inventory parameter, stockout, inventory cost and service level between current method that used by the company and improvement method with continuous review (s, S).

1.3 Objectives of Research

Objective that want to be achieved by the end of this research is:
1. Finding better inventory policy for most critical stock-point and most critical product.

2. Compare inventory parameters which are minimum and maximum inventory level between current method applied by the company and the recommended value obtained from the method proposed in the study.

3. Compare total cost, service level, stockout, and unused inventory that earned between current company method and improvement method.

1.4 Benefits of Research

Benefits that would be earn by the end of this research is:

1. This research can be company reference on how to improve their business process, especially on their inventory management.

2. This research could show which are the most critical stock-point and product, so company have more awareness of those stock-point and product.

1.5 Scope of Research

1.5.1 *Limitation*

The limitations of this research determine the focus of this research, which are defined as follows:

1. The focus of the research is only the stock in stock-point in Surabaya area.

2. Inventory management based on demand from 2 previous years, which are 2017 and 2018.

3. Shortage and backorder cost are neglectable.

4. Does not consider time value of money.

5. Product used as sample is non-seasonal product

1.5.2 *Assumption*

Assumption that used on this research is:

1. Cost of product is not changed with the changes of order size.

2. Warehouse capacity and funding is sufficient.

3. Principal, DC & Sub DC are able to supply all demand.

4. All products are delivered in good shapes.

5. There is no significant trend for product demand

1.6 Research Outline

The research report outline provides the big picture of this research report as below:

CHAPTER I: INTRODUCTION

This chapter is the initial chapter of this research report, which contains the research background, problem formulation, research objectives, research benefits, and research scope, along with an outline of this research report, which serves as a big picture of this research report's writing sequence, at the end of the chapter.

CHAPTER II: LITERATURE REVIEW

This chapter provides the theories and concepts that support this in order to help readers to understand this research easier and help the readers to have the same perspective as the writer, in the form of literature review. The literatures presented in this chapter will include retail, logistics and supply chain management, inventory theory and function, inventory cost component, ABC classification, safety stock, inventory control policy and *Monte Carlo* simulation.

CHAPTER III: RESEARCH METHODOLOGY

This chapter consist of the methodology used in the process of this research. Research methodology used as reference of conducting the research to make the research running systematically according to the goal set. The methodology starts with the problem identification and background, literature study, data collection and processing, analysis, and conclusion and suggestion.

CHAPTER IV: DATA COLLECTION AND PROCESSING

This chapter consist of primary and secondary data collection that given by the company. This chapter also provide data processing that will be done by methods that has been mentioned before and present data processing result. Then, scenario and sensitivity analysis to the model will be designed.

CHAPTER V: ANALYSIS AND INTERPRETATION

This chapter describes the data interpretation and analysis of the result that earned from data processing before. Then, there will be comparison between current method that used and proposed method to know which method that optimum for inventory management in the company.

CHAPTER VI: CONCLUSION AND SUGGESTION

This chapter is the last chapter of this research, which consists of the conclusions and the recommendations. The conclusions that can be drawn will be elaborated to answer all the research objectives, while recommendation will be given to the observation object of this research, which is the company, also the future researchers who wish to conduct similar or more advanced research regarding this topic.

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CHAPTER II
LITERATURE STUDY

In this chapter, the explanation of literature study that has been done by the writer is provided.

2.1 Retail

According to HCL Tech (2018), Retail is the way producers of goods and services deliver their products to the consumer. Retailers often get their goods directly from the manufacturer. That is when a commodity becomes a finished product. Retailers can also buy products from a middleman, known as a wholesalers or distributors. Wholesales companies consolidates products from around the world. The company repackages them for easier marketing and distribution. Retailers are the last stop on the supply chain before the products end up in your shopping cart. Retailers make money by raising prices well above their labor, equipment, and distribution costs. Everyone along the supply chain does the same thing. Retailers can sometimes make more money if they pass through the wholesaler and purchase directly from the factory. Some large retailers often manufacture best-selling items themselves. This is called vertical integration.

Retail Supply Chain Management is the process of managing the entire supply chain of retail organizations. The differentiating factor of retail supply chain management from other supply chain management is in the volume of product movement and the fast-moving nature of the retail industry products. Retail supply chain has to be monitored very closely and has to be free from defects because the products are always moving and the cycle times are very low. Furthermore, the continuous movement of materials across the supply chain is crucial to the success of any organization in the retail industry. Therefore, retail management is very important for any organization in the retail industry and has to be monitored closely and maintained properly.

2.2 Logistics

According to Zaroni (2017), Logistics contains a series of movement activities of goods from suppliers to factories, factory warehouses to distributors,

distributors to retailers, and retailers to end consumers, according to the distribution channels of their respective companies. In logistics activities, in addition to the flow of goods movement, it also includes the flow of information and financial flows.

Logistics performance is always measured and the results are evaluated regularly so that performance improvements can be carried out continuously. Generally, logistics performance is measured based on: (1) logistics cost indicators and (2) logistics service quality indicators.

The logistics cost indicator shows the total logistics costs for running all of the company's logistical activities in the supply chain process. While the logistics service quality indicators show service performance resulting from logistics activities. Logistics service performance is generally measured in the form of time performance, lead time, security, damage level, tracking & tracing, and others.

In general, logistics costs are grouped into three classification costs for logistics: (1) transportation costs, (2) goods storage costs, and (3) administrative costs. Based on the logistic cost grouping, the logistics costs include all the cost components as follows:

- Transportation costs for each transportation mode;
- Storage costs for each warehousing activity;
- Cost of working capital investment for inventory;
- The cost of marking goods and packaging, identifying goods, and recording goods;
- Cost of stacking / unstacking activities;
- Packing costs;
- The cost of activities for consolidation / deconsolidation;
- Information and communication system (ICT) application costs and integration;
- Logistics management system costs;
- Costs that occur due to the stockout.

2.3 Inventory Theory and Function

According to Fogarty (1991) inventory includes all goods and materials used in the production and distribution process. Inventory conditions affect two things that trade off one to each other, which are service level and cost. To maintain a high level of service requires more inventory, but it creates a high storage cost. There are several types of inventory according to Waters (2003), including the following:

1. Raw Material Inventory (Raw Material Inventory).

    Is an inventory that has been purchased from a supplier, but has not been processed until there is an order.

2. Semi-finished goods inventory (Work in Process Inventory)

    Is a supply of components or raw materials that have passed several manufacturing processes, but have not yet been completed?

3. Finished Product Inventory

    Is an inventory for products that have passed all stages of the manufacturing process, then waiting to be sent to the consumer.

4. Component Inventory (Spare Parts)

    Is an inventory used for machinery or equipment used by companies to produce a product?

5. Consumables Inventory (Supplies)

    Is an inventory that is used for normal functions of a company and not for producing a product or item.

Inventory exists because it is difficult to balance the frequency of supply and demand that are often different. According to Tersine (1994), the reasons for these differences can be explained by four inventory functions, including:

1. Time Factor

    The demand for an item cannot be fulfilled immediately if the item is not available beforehand, because in a procurement there are lead times or waiting times for production and distribution processes, such as time for preparing production scheduling, sending material from vendors, inspection, production, and sending products to consumers.

2. Discontinuity factors

This factor allows treatment of a variety of interdependent operations (retailing, distribution, warehousing, manufacturing, and purchasing) independently and economically.

3. Uncertainty factor

Includes a variety of factors that can disrupt company planning, including errors in estimating demand, delays in delivery, broken machines, and others. If the company has inventory, the company can still fulfill the demand during an uncertain event.

4. Economic factors

Economic factors such as rising prices will affect companies to provide a greater amount of supply to benefit from these conditions.

2.4 Inventory Cost Component

According to Juneja (2018), Inventory is an idle stock of physical goods that contain economic value, and are held in various forms by an organization in its custody awaiting packing, processing, transformation, use or sale in a future point of time.

Any organization which is into production, trading, sale and service of a product will necessarily hold stock of various physical resources to aid in future consumption and sale. While inventory is a necessary evil of any such business, it may be noted that the organizations hold inventories for various reasons, which include speculative purposes, functional purposes, physical necessities etc.

Inventory costs are basically categorized into three headings:

1. Ordering Cost
2. Carrying Cost
3. Shortage or stock out Cost & Cost of Replenishment

Here are the explanations of each cost.

1. Ordering Cost

Cost of procurement and inbound logistics costs form a part of ordering cost. Ordering cost depends and varies based on two factors - The cost of ordering excess and the cost of ordering too less. Both these factors move in opposite directions to each other. Ordering excess quantity will result in carrying cost of

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inventory. Whereas ordering less will result in increase of replenishment cost and ordering costs. These two costs above together are called total stocking cost (TSC). If you plot the order quantity vs. the TSC, you will see the graph declining gradually until a certain point after which with every increase in quantity the TSC will proportionately show an increase.

This functional analysis and cost implications form the basis of determining the Inventory Procurement decision by answering the two basic fundamental questions, which are how much to order and when to order. How much to order is determined by finding the Economic Order Quantity (EOQ).

2. Carrying Cost

Inventory storage and maintenance involves various types of costs named as Inventory Storage Cost and Cost of Capital. Inventory carrying involves inventory storage and management either using in house facilities or external warehouses owned and managed by third party vendors. In both cases, inventory management and process involve extensive use of building, material handling equipment, IT Software applications and hardware equipment coupled managed by the operations and management staff resources.

a. Inventory Storage Cost

Inventory storage costs usually include building rental cost and facility maintenance and related costs. Cost of material handling equipment, IT hardware and applications, including purchase cost, depreciation or rental or lease depending on the problem. Further costs include operational costs, consumables, communication costs and utilities, besides the cost of human resources employed in operations as well as management.

b. Cost of Capital

Includes the investment costs, working capital interest, taxes on inventory paid, insurance costs and other costs associate with legal liabilities. The inventory storage costs as well as the capital cost is varying with the management decision to manage inventory in house or through outsourcing vendors and third-party service providers.

2.5   ABC Classification

According to Fritsch (2014), Inventory ABC Classification (as known as ABC Analysis) is a term used to define an inventory categorization technique often used in materials management. The ABC classification provides a mechanism for identifying items that will have a significant impact on overall inventory cost, while also providing a mechanism to identify different categories of stock that will require different policy settings and inventory control.

The ABC analysis is done to manage different stocked items (or SKU's) that are not all equal in value or order frequency. The best practice is for an organization to group their inventory into three categories (A, B, and C).
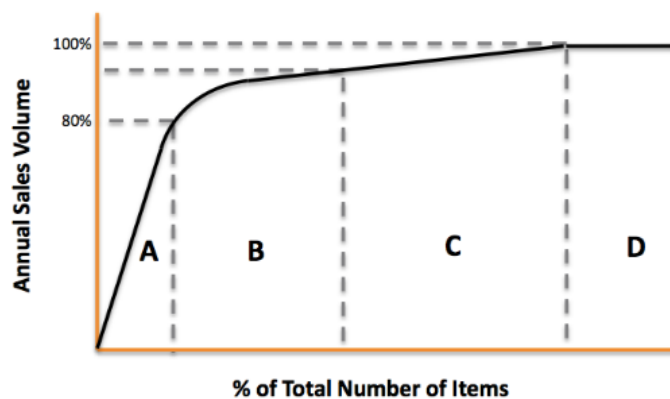
Figure 2. 1 ABC Classification Graph
(Fritsch, 2014)

1. Class A

Class A items are very important for an organization. Because of the high demand of these items, frequent value analysis is required. These are fast moving items and are usually of lower value, which drive the largest percentage of your target service levels and customer satisfaction rates.

2. Class B

Class B items are important, but of course less important than 'Class A' items and more important than 'Class C' items. These are typically mid-range in inventory value and order frequency.

3. Class C

Class C items are marginally important. Typically, very low order frequency and high inventory value. These items are usually stocked with very low quantities or not at all due to the high carrying costs associated with the stock levels.

When it comes to classifying the inventory, it is usually safe to follow the Pareto Principle, also known as the 80/20 rule. The Pareto Principle is the theory that most businesses see 80% of their sales come from roughly 20% of customers, which should fall into your A classification category.

The steps taken in classifying inventory based on ABC analysis are:
1. Make a list of all classified items and the purchase price of each item.
2. Determine the average number of sales per year for each item.
3. Determine the usage value per year for each item by multiplying the average number of sales per year with the price of each item.
4. Add the annual sales value of all items to get the total sales value.
5. Calculate the sales percentage of each item from the quotient between the value of sales per year for each item and the total sales value per year.
6. Sort in such a way that the annual sales value of all inventories has the highest to the lowest value of money so as to facilitate the distribution of inventory for groups A, B, or C in accordance with the regulations used.

2.6 Safety Stock

Safety stock is a small emergency amount of stocks that can be used when things gets tough and the situation is on the verge of selling out. Business would want to have enough in it to help them to overcome the storms when they roll around, but not too much so that the carrying costs end up straining the business finances. While this sounds like common sense, the trick is to decide on how much safety stock to carry.

There is a temptation to stock enough to last until a fresh shipment (or two) comes through, but always remember that the more the stock, the higher the carrying costs become. Just think about it; whatever the business sell does not only

have to cover its own carrying costs - it has to cover the carrying costs of the safety stock as well.

According to Fritsch (2014), Safety stock is needed to:

- Stock to protect against variation in Supply or demand (if the demand is bigger that the forecast)
- It has the purpose to prevent disruptions in manufacturing or customer deliveries
- Stock maintained to provide a required customer service level.
- Safety stock can be maintained on finished goods level, but also at component / raw material level.
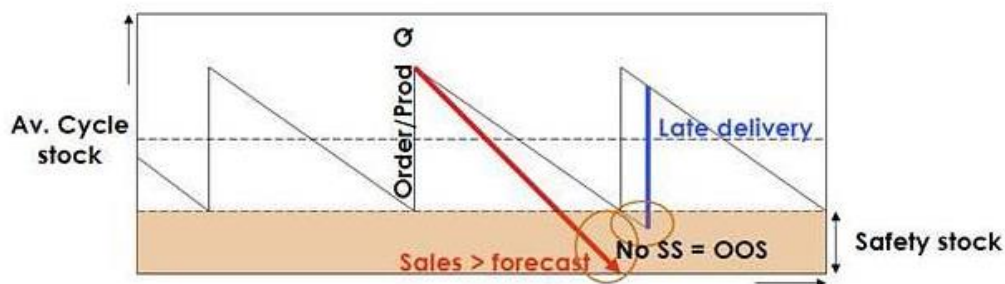
Figure 2. 2 Safety Stock Visualization
(Fritsch, 2014)

There are several ways to calculate safety stock, depends on the variability of the elements, which are:

Variability in demand

$$Safety\ Stock = Z\ x\ \sqrt{\frac{PC}{T_1}}\ x\ \sigma_D \qquad (2.1)$$

Variability in lead time

$$Safety\ Stock = \left(Z\ x\ \sqrt{\frac{PC}{T_1}}\ x\ \sigma_D\right) + (Z\ x\ \sigma_D\ x\ D_{avg}) \qquad (2.2)$$

Cycle service level and fill rate

$$Safety\ Stock = Z\ x\ \sqrt{(\frac{PC}{T_1}\ x\ \sigma_D^2) + (\sigma_{LT}\ x\ D_{avg})^2} \tag{2.3}$$

Where:

Z = Z-score

PC = Performance cycle, another term for total lead time

T_1 = Time increment used for calculating standard deviation of demand

σ_D = Standard deviation of demand.

2.7   Inventory Control Model

2.7.1   Probabilistic Inventory Control Model

The probabilistic inventory control model is a model which assumes that the parameters possessed indicate uncertainty and are random variable. This uncertainty is related to the number of requests (demand) and delivery time (lead time). Both of these will result in a shortage of inventory, which has an impact on decreasing service level.

The lead time makes it necessary to determine the value of the reorder point or the point of reorder. Furthermore, probabilistic demand makes it possible for supplies to run out while orders have not arrived. To overcome this problem, it is necessary to calculate safety stock. Safety stock will be useful if the actual demand is greater than the demand during lead time. To know the uncertainty of the lead time, data regarding the standard deviation of the lead time is needed.

Table 2. 1 Interaction between Demand and Lead Time Variability on Safety Stock Determination

		Constant	Variable
Demand	Variable	Sdl =sdl × √l **(2.1)** Safety stock determined by demand uncertainty	$Sdl=\sqrt{(d2 × Sl2)+ l × Sd2}$ **(2.2)** Safety stock determined by interaction of two uncertainty
	Constant	Sdl =0 No need of safety stock	$Sdl = d × sl$ **(2.3)** Safety stock determined by lead time uncertainty
		Lead Time	

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Source: Pujawan, 2017

Where:

S_d = Demand Standard Deviation

S_l = Lead Time Standard Deviation

Next, to calculate the order quantity we used EOQ equation that shown by the formula 2.4 below

$$Q = \sqrt{\frac{2 \ x \ R \ x \ RC}{HC}} \tag{2.4}$$

Where:

Q = Order Quantity

R = Annual Demand

RC = Order Cost

HC = Holding Cost

Then, to calculate when to reorder (ROP) that occur by uncertainty of the lead time, we can use formula 2.5 as below:

$$ROP = D \times LT + SS \tag{2.5}$$

Where:

D = Demand,

LT = Lead Time

SS = Safety Stock

According to Silver (1998) there are two types of probabilistic inventory control, which are continuous review and periodic review.

2.7.1.1 Continuous Review Policy

Continuous review policy is the control of inventory, the amount or condition of the inventory is monitored continuously. In this system the value of the maximum inventory level is not specified. This policy requires technology that can monitor the inventory conditions. The methods used in continuous reviews are as follows:

a. Method (s, Q)

This method is known as two bin system since there are two inventory bins, namely the cycle of inventory and other inventories which consist of demand during lead time and safety stock. In this method, if the inventory is below or equal to reorder point s, then an order will be made for economic order quantity Q.
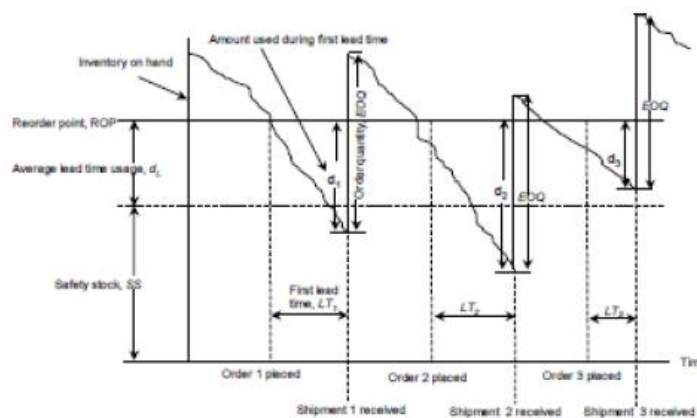
Figure 2. 3 Inventory Management (s, Q) Method
(Liu, 2006)

In Figure 2.3, a description of the inventory and order unit is displayed with the method (s, Q). This is a simple method so that it is easier to understand by officers who work in the warehouse. However, this method cannot be modified and is less effective if there is a large number of requests. A large demand will trigger a large number of replenishments, so the size of a replenishment of Q cannot increase the inventory position above the reorder point.

b. Method (s, S)

This method is known as the min-max, because inventory is always at the minimum s and maximum S values. In Figure 2.4, the policy regarding the continuous review method (s, S) is displayed. In this method if the amount of

inventory is equal to or below s or reorder point, then the order will be made up to the maximum S level of inventory limit. Same as the system (s, Q) where the replenishment quantity variable is used or ordered to reach the order up to level S, where. One of the disadvantages of this system is that the order quantity varies. This often causes vendors to make mistakes because they prefer to send in a fixed and predictable quantity.
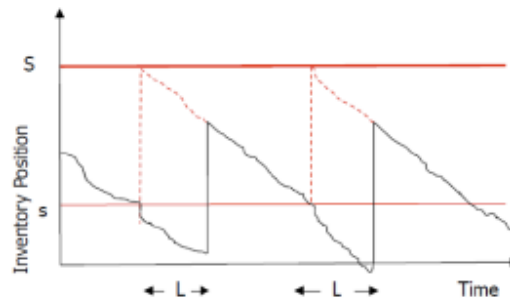
Figure 2. 4 Inventory Management (s, S) Method
(Singh, 2016)

2.7.1.2 Periodic Review Policy

In the periodic policy review the time intervals between fixed and determined orders at the beginning of the period, while the order size will vary according to the inventory condition at the end of the period. The purpose of this policy is to determine the optimum value of the order time period (R) and the maximum inventory value (S) which minimizes the total cost of inventory. Order size can reach the maximum inventory limit specified by the company. The amount of safety stock that exists must be greater than continuous review, in order to anticipate demand during the lead time.

a. *Periodic Review, Order Up to Level (R, S) System*

According to Silver (1998) in the method (R, S) the order is made every time R unit. The R value has been set in advance to be able to calculate the optimal S value. Figure 2.5 will show the inventory control method (R, S). The main disadvantage of this method is that the amount of replenishment quantity varies and the amount of cost incurred is greater than continuous review.
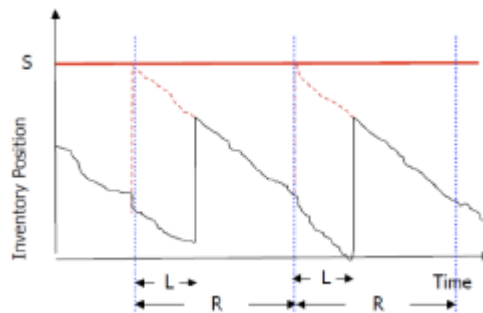
Figure 2. 5 Inventory Management (R, S) Method
(Singh, 2016)

The important parameters in this method are as follows:

1. *Interval Review (R)*

   Is the period of fulfillment of orders. The amount of R has been set beforehand to get the optimum S value.

2. *Order up to Level (S)*

   The value of S is the maximum amount of inventory allowed. The value of this S must be able to fulfill the demand during the R + L period. Shortages or shortages can occur if the total demand in the interval R + L exceeds the value of S.

b. *Periodic Review (R, s, S) System*

   This method is a combination of systems (s, S) and (R, S). In this system inventory checks are carried out every time unit R. In Figure 2.6, the inventory control method (R, s, S) is shown, where if the number of inventories is below or equal to reorder point or s, the order will be re-ordered until the inventory position reaches the maximum number S. According to Silver (1998) method (s, S) is a special case where R = 0, and (R, S) are special cases where s = S-1.
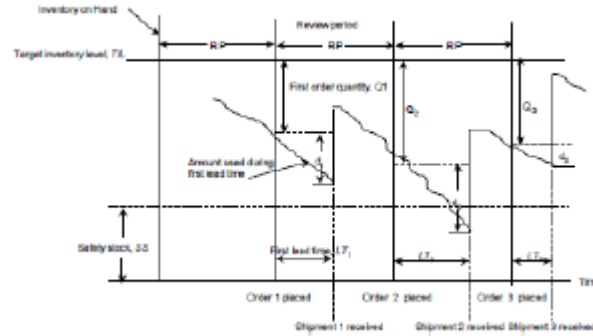
Figure 2. 6 Inventory Management (R, s, S) Method
(Liu, 2016)

2.7.2 Current Inventory Control Model

PT. Indomarco Adi Prima uses min-max Inventory Control Method. Where the min-max formulation used by the company is different with the min-max (s, S) method. Factor that considered on inventory control with the company method is lead time and the demand of each products for the last 13 weeks without considering any holding cost. Here is the formulation used by the company on calculating min-max of each product.

$$Demand\ (week) = \frac{\sum Demand\ for\ the\ last\ 13\ weeks}{13} \tag{2.6}$$

$$Demand\ (day) = \frac{Demand\ (week)}{Working\ days\ (5)} \tag{2.7}$$

$$Minimum\ Stock = \begin{cases} Demand\ (day)\ x\ 2\ , Fast\ Moving\ Item \\ Demand\ (day)\ x\ 5\ , Moderate\ Moving\ Item \\ Demand\ (day)\ x\ 10\ ,\ Slow\ Moving\ Item \end{cases} \tag{2.8}$$

$$Maximum\ stock = minimum\ stock + Normalized\ Lead\ Time \tag{2.9}$$

$$Norm.\ Lead\ Time = \begin{cases} 3\ , If\ 1\ day\ 1\ delivery\ (\ stockpoint\ ) \\ 5\ , If\ 2-3\ \ day\ 1\ delivery\ (\ stockpoint\ ) \\ 8\ , If\ 4-5\ \ day\ 1\ delivery\ (\ stockpoint\ ) \\ N+4, If > 6\ \ day\ 1\ delivery\ (\ stockpoint\ ) \end{cases} \tag{2.10}$$

Where:

N = Range of 1 delivery to the next delivery (in days)

*the number of 2, 5, 10 (stock-point multiplier) and 5 for maximum stock is set by the management of PT. Indomarco Adi Prima

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2.7.3 Improvement Inventory Control Model

Improvement inventory control model that used in this research based on the frequency of product delivery of each stock-point. Lead time of the product will be derived from the maximum time range between delivery. The data used for the calculation will be the 2 years data. The demand data assumed as normal, with insignificant trend. All the product that chosen is unaffected by seasonality. Here is the calculation of minimum and maximum stock of the product.

$$Demand\ (day) = \frac{Total\ Demand\ for\ 2\ years}{2\ years\ working\ days} \tag{2.11}$$

$$Minimum\ Stock = SS + ROL \tag{2.12}$$

$$ROL = \begin{cases} Demand\ (day)\ x\ 2\ ,\ Fast\ Moving\ Item \\ Demand\ (day)\ x\ 5\ ,\ Moderate\ Moving\ Item \\ Demand\ (day)\ x\ 10\ ,\ Slow\ Moving\ Item \end{cases} \tag{2.13}$$

$$Q = LT\ x\ Demand\ (day) \tag{2.14}$$

$$LT = \begin{cases} 1\ ,\ Everyday\ Delivery \\ 2\ ,3\ Times\ a\ week\ delivery \\ 3,2\ Times\ a\ week\ delivery \end{cases} \tag{2.15}$$

$$Maximum\ stock = minimum\ stock + Q \tag{2.16}$$

2.8 *Monte Carlo* Simulation

Monte Carlo simulation according to Tersine (1994) is a study by incorporating the manipulation of a model from an objective by evaluating alternative designs or decision rules. The flowchart for solving problems using *Monte Carlo* simulations is shown in Figure 2.7. *Monte Carlo* simulations offer solutions to problems by sampling random processes. A number of random numbers are used to describe the movement of each random variable over a period of time and allow for additional but have a sequence of relationships for an event. This simulation is able to accommodate managers to measure how variations in policies or organizational conditions will be influenced by random behavior or temporary influence. There are five stages in conducting a *Monte Carlo* simulation, which are:

1. Make a possible distribution of important variables,

2. Build a cumulative distribution of possibilities for each variable in the first stage.

3. Determine the random number interval for each variable.

4. Generate random numbers.

5. Make a simulation based on the random numbers.
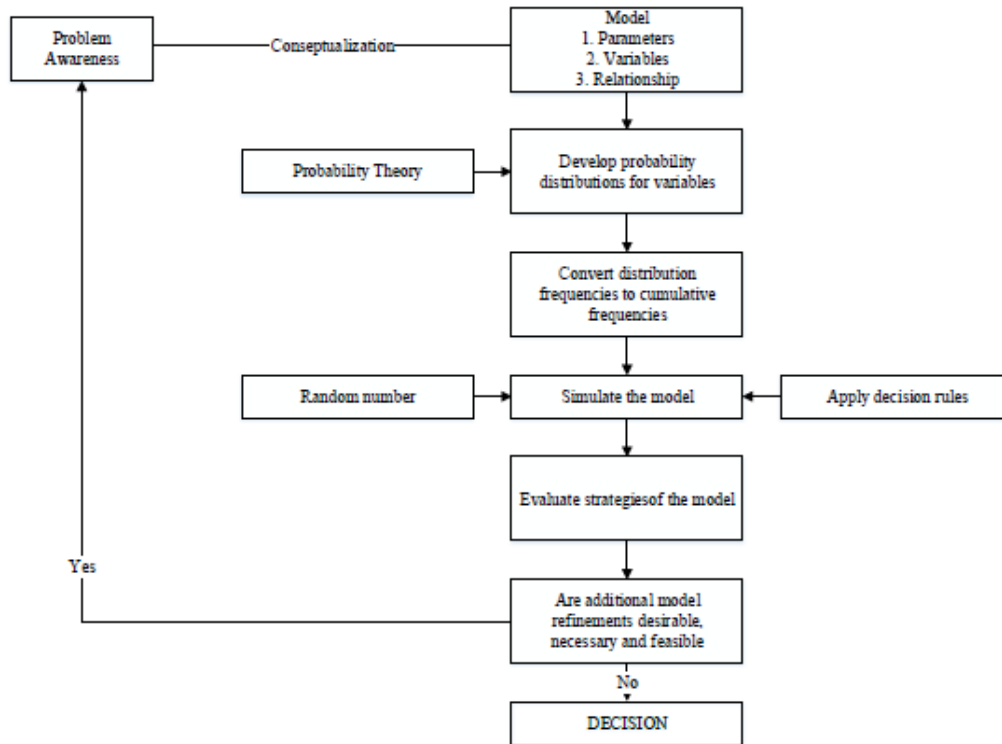
Figure 2. 7 Monte Carlo Simulation Flowchart
(Tersine, 1994)

Here is the formula of probability determination of each event:

$$Pi = (\frac{fi}{n}) \hspace{5cm} (2.17)$$

Where:

Pi = Probability of the occurrence of i-event

Fi = Frequency of i-event

n = Frequency of all event

One of the most important things to do in *Monte Carlo* simulation is determining number of replications to know whether the number of simulations is enough as an evidence for decisions making. Here are the replication number determination steps:

1. Experiment with the initial number of (n) replications.

2. Explain simulation model and gather output that focused for the observation.

   Determine halfwidth (*hw*) value or error with the formulation below:

   $$hw = e = t_{(\frac{\alpha}{2}n-1)} \: x \: \frac{s}{\sqrt{n}} \qquad (2.18)$$

   Where:

   $t_{(\frac{\alpha}{2}n-1)}$ = Value from t distribution table with (n-1) degree of freedom

   α = 5%

   s = Standard deviation of simulation sample

   n = Replication number

3. Evaluate the *hw* value, if it is sufficient then use *n* on the first try. But if smaller *hw* value is needed, then do the *n'* calculation by using the new *hw* as the input calculation.

$$n' = \left[\frac{\left(t_{\frac{\alpha}{2}, n-1} s \right)}{hw'} \right]^2 \qquad (2.19)$$

2.9   **Previous Research**

There are several researches that focus on inventory management. A research conducted by Dio Putera Hasian (2012) with the title "*Konsep Persediaan Minimum-Maksimum Pengendalian Part Alat Berat Tambang PT. Semen Padang*" explains how inventory management of mining machinery parts on cement manufacturer with minimum-maximum method (s, S) that focus on finding optimum safety stock to achieve 95% service level set by the company.

Then, a research conducted by Maria do Carmo Povoa (2015) with the title "Reducing Minimum Stock Cover Levels in Fast-Moving Consumer Goods Industry using Classification Schemes" focus on resolving problem in Fast-Moving Consumer Goods manufacturer with classification method, following with using "optimizer tools" that provided by the company. The output of this research is optimized safety stock by processing data with add-on to the software. Analysis Based Costing (ABC) method used on the classification of the FMCG product.

Table 2.2 below shown the position of this research compared to other research. This research will develop previous research. First step of this research will be choosing stock-point by scatter plot method, then product classification of chosen stock-point by ABC method. Then inventory management analysis with *Monte Carlo* simulation. Simulation would be conducted with 100 replications and 5000 iterations. The demand would be probabilistic and follow normal distribution.

Table 2. 2 Research Position Compared to Previous Research

Research Characteristic	Dio Putera Hasian (2012)	Maria do Carmo Povoa (2015)	This Research
Demand			
Deterministic		√	
Probabilistic	√		√
Lead Time			
Constant		√	
Variable	√		√
ABC Classification		√	√
Continuous Review Inventory Policy	√		√

CHAPTER III
RESEARCH METHODOLOGY

This chapter explain the methodology of this research so this research can be done systematically. Generally, the research methodology contains system study phase, data collection, data processing, scenario generation, sensitivity test, data analysis and interpretation, as well as conclusion and recommendation. The flowchart of the research methodology can be seen on Figure 3.1.
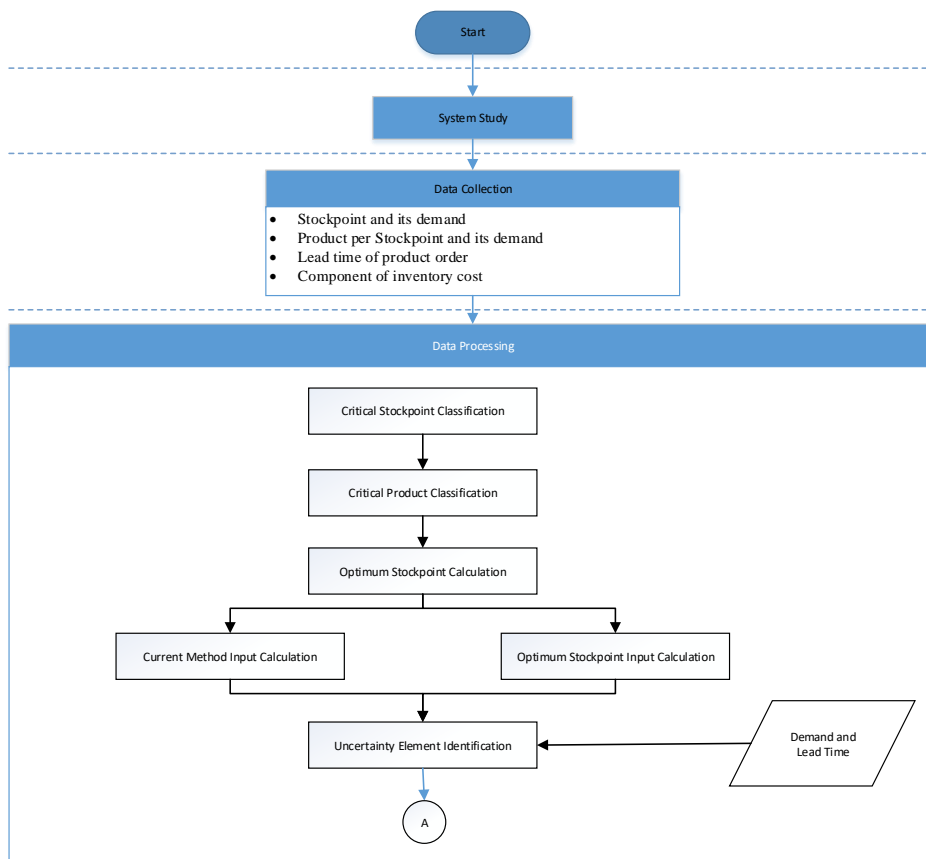
Figure 3. 1 Research Methodology Flowchart
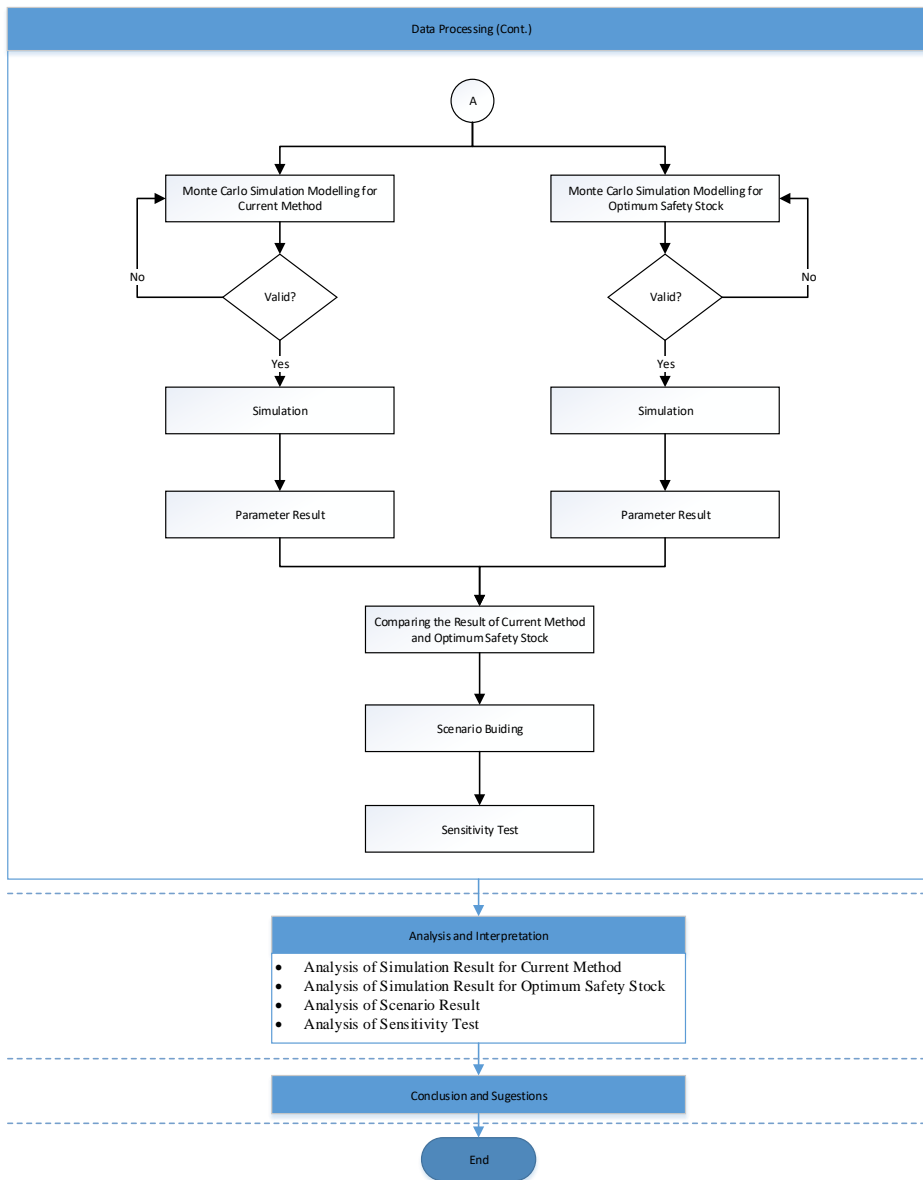
Figure 3.1 Research Methodology Flowchart (Cont.)

3.1 System Study Phase

In this phase, writer study the research object system. The element system that will be identify in this research are:

1. Goals

   Goals of this research is to minimize cost that incurred by inventory management process of PT. Indomarco Adi Prima by finding better inventory policy to have better performing number of safety stock for

chosen stock point, while achieving service level target that has been set by the company.

2. Decision

   On this research there are two decision that can be taken by PT. Indomarco Adi Prima, which are implement inventory management with current method or continuous review (s, S).

3. Uncertainty

   Uncertainty occur on number of each product demand that observed.

4. Consequences

   On this research, consequences that produced which are total cost, service level, number of unused inventory and number of stockout.

3.2   Data Collection

In this phase, the data that needed to support this research will be collected. The following is the data needed to support this research:

1. List of stock point and their service level and stock by amount.
2. List of products for each stock point.
3. Data of product demand per stock point from January 2017 to December 2018.
4. Data of existing level stock for each stock point.
5. Data of inventory policy in the company.
6. Data of product characteristics.
7. Data of lead time for each product.
8. Another inventory cost component such as purchasing cost, holding cost, and ordering cost.

Those data will be obtained directly from the company by direct observation and interview with related function.

3.3   Data Processing

Data will be processed by using continuous review (s, S) policy on inventory planning and management of the products in the stock points. Data processing phase will consist of several step, as follow:

3.3.1 Critical Stock-point Classification

There are 144 stock-points under the Surabaya DC, and they will be classified into 3 class, which are big stock-point, medium stock-point, and small stock-point based on the sales to trade amount per stock-point. Every class will have different lead time for the products. Classification of stock-point will be done by scatter plot method. There will be 10 stock-points that used as the samples, which are 5 A class, 3 B class, and 2 C class. This done to give more impact to the company direct business, but also considering improvement for all stock-points for the company.

3.3.2 Product Classification

With around 6000 products variation for the stock-points, writer need to know which product have highest contribution to the company business. Product that will be analyzed based on their ABC classification. This should be done in order to give wider view about variety of product demand and how to tackle the issue of each category of the product.

3.3.3 Initial Input Calculation

Initial input calculation done for 2 conditions, which are using the current method that used by the company and the optimal safety stock method. Initial input calculation does not consider uncertainty in demand and lead time hence demand and lead time are deterministic based on the data provided by the company.

3.3.3.1 Current Method Initial Input Calculation

Initial input from the current company method will be used as reference for comparison to the simulation output. Initial input calculation done by using current company method that called as min-max method, with inventory parameter such as demand per week, demand per day, minimum stock, maximum stock, safety stock, and reorder point. Formula that used for current company method refer to formula 2.6 – 2.9 as explained on previous chapter. Followed by the calculation of inventory cost component which is holding cost, that consist of capital cost, warehouse cost, and employee salary cost.

3.3.3.2 Improvement Method Input Calculation

Initial input calculation for improvement method follow the continuous review (s, S) inventory policy. Continuous review (s, S) inventory policy is chosen since the method has the most similar characteristics to fast-moving consumer goods product compared to the other method (s, Q and R, s, S). Initial input calculation also uses historical demand and lead time on real condition. Where the calculation follows formula 2.3-2.5, following with the calculation of inventory cost component. Lead time of the product will be referring to the delivery schedule of each chosen stock-point.

3.3.4 Identification of Uncertainty Element

There is 1 uncertainty element of this research, which is demand. To know the distribution of demand products that has been chosen, we use @Risk for Excel software with the step as follows:

@Risk menu – Distribution Fitting – Fit Distribution to Data – Choose Discrete Sample Data – Fit

The software would show several distribution and parameter based on priority of acceptance. First priority distribution does not always provide the best output, it only shows distribution pattern of the demand that fit the actual condition based on available data.

3.3.5 Monte Carlo Simulation Model Building

Here is the step of the Monte Carlo simulation building:
1. Define probability distribution for important variables.
2. Build cumulative probability distribution for each variable on the first step.
3. Determine random number interval for each variable
4. Generate random number
5. Make a simulation based on the random number

Next, there will be simulation model building for the current method that used by the company and optimal safety stock method with continuous review (s, S). There are 8 simulation model elements that used for both simulation model

which are initial inventory, demand, available inventory, ending inventory, stockout, lead time, holding cost and service level. Output parameter that will be considered is number of stockout, unused inventory, holding cost, and service level.

3.3.5.1 Current Method Monte Carlo Simulation Model Building

Monte Carlo simulation model building for current method done by considering the uncertainty of demand. Output of initial input calculation will be used as the reference for the Monte Carlo simulation model. For current method, purchase will be made when stock is under ROP to the maximum stock.

3.3.5.2 Improvement Method Monte Carlo Simulation Model Building

Monte Carlo simulation building for improvement method consider the uncertainty of the demand. Formula that will be used for this step is formula 2.10 - 2.15. Output of the initial input calculation will be used as the reference for this Monte Carlo simulation model. Identical to the current method, for improvement method, purchase will be made when the stock under the ROP until maximum limit of stock.

3.3.6 Simulation Testing

On simulation testing phase, there will be validation from Monte Carlo simulation model that has been build. Validation is a step to assure that the model that has been build act like the real system. One of the approaches from a validation is comparing simulation model output with the real system with f-test or t-test. Here is the hypothesis that would be used on validation

$H0$

$= There\ is\ no\ difference\ between\ real\ demand\ data\ and\ simulation\ data$

$H1$

$= There\ is\ difference\ between\ real\ demand\ data\ and\ simulation\ data$

Here is the step that would be taken to validate the model in this research:

1. Simulate the demand data based on the 2017-2018 demand data.

2. Find the standard deviation of the real demand data and simulation data

3. We set 5% error, and by using t-test, calculate the t value of the data

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4. Compare the t-value to the t-table, if t-value < t-table, then accept *H0*

3.3.7 Simulation Run

After simulation model is validated, next we move to the simulation by adding initial input to find the best combination of parameter value from products that were observed. Simulation will be conducted with @Risk for Excel application with 100 replications and 5000 iterations. Output of the simulation are total cost, service level, number of stockout, and unused inventory.

3.3.8 Scenario Building

Scenario building done for improvement method by changing the input parameter. In this case, parameter that will be changed are the service level target for each product. Scenario is done to find out optimal output from current inventory control method by comparing the total cost that incurred and service level that achieved by the method.

3.3.9 Sensitivity Test

Sensitivity test done by changing the number of the product demand. This done to know the effect of input parameter changes to output parameter. Parameter output that will be considered is number of stockout, unused inventory, total cost, and service level.

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CHAPTER IV
DATA COLLECTION AND PROCESSING

This chapter provide the data that has been collected in this research, as well as the data processing step taken in order to finish this research. This chapter consist of 12 sub-chapter, which are company procurement system, stock-points contribution data, stock-points classification, product demand data for chosen stock-points, product classification, chosen product as sample, inventory cost component, distribution fitting for product demand data, calculation of inventory condition, scenario building, and sensitivity.

4.1   Company Procurement Flow

PT. Indomarco Adi Prima has 2 procurement flow, which are flow from Principal to Distribution Center (DC) and DC to Stock-point. Distribution Centers have 3 types of procurement process based on the order frequency and entities that they connected, which are Confirm Monthly Order (CMO), Confirm Weekly Order (CWO), and Product Order Planning (RPB). CMO contains the order quantity for each product for one cycle (4-5 weeks). It contains the information of outstanding product, estimated sales, buffer needed, and the total order for the products. CMO used for non-Club and Noodles principal, since the Club and Noodles principal usually have a higher quantity of sales. For those principals, the company provide CWO in order to make order per weeks for the products. Meanwhile RPB used to place order via Head Office (HO), which have the information similar to CMO, but have differences in product delivery. With CMO, product delivery will be fully decided by the principals, meanwhile with RPB, product delivery will be managed by the HO. After sending information to the principals and HO in the form of CMO, CWO, and RPB, DC and HO will send purchase order (PO) for each principal that contain the information of product that they order, expected time of arrival and when the order placed. Principal can either sent the product to the DC or directly to the Stock-point (SP) based on the order placed by the DC. Figure 4.1 provide the information and product distribution flow of PT. Indomarco Adi Prima.
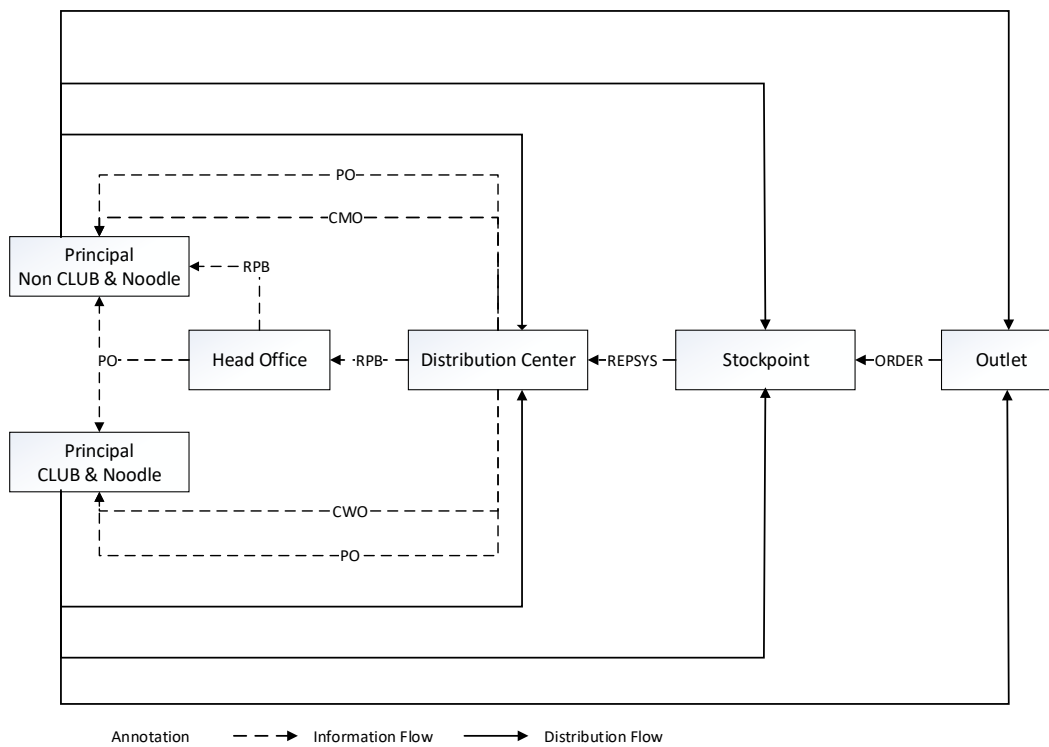
Figure 4. 1 Information and Distribution Flow of PT. Indomarco Adi Prima

Stock-point procurement system utilize Repsys as the information flow of product stock and order. Stock-point product stock is highly controlled by the DC with min-max system that applied by the company. Min-max system is the core of product stock control system for the stock-point. Min-max determined by Net Sales Amount of each product, that categorized by using ABC classification for each stock-point. The data of Net Sales Amount is earned by averaging the data of Net Sales Amount for the last 13 weeks for the product. ABC classification will follow the rule of contribution, with 80% of the highest contribution product will be categorized as class A, the next 15% will be categorized as B, and the last 5% will be categorized as C. After knowing the product class, next step will be the setting of min-max demand delivery time based on the product class. Class A product will have 2 days of demand for the min, and 7 days of demand for the max. For class B product will have 5 days of demand for the min, and 12 days of demand for the max. And class C product will have 10 days of demand for the min, and 15 days of demand for the max. Next step will be the calculation of min-max based on carton quantity of each product based on the Net Sales Quantity and the min-max of

demand delivery time. After knowing the min-max indicator of each product, next the company will be calculating delivery frequency for each stock-point, including the number of trucks used per delivery based on the capacity of the truck, volume, and weight of the product. And the last step will be arrangement of delivery schedule for each stock-point based on the ABC classification and delivery frequency. Graphics representation provided on figure 4.2.
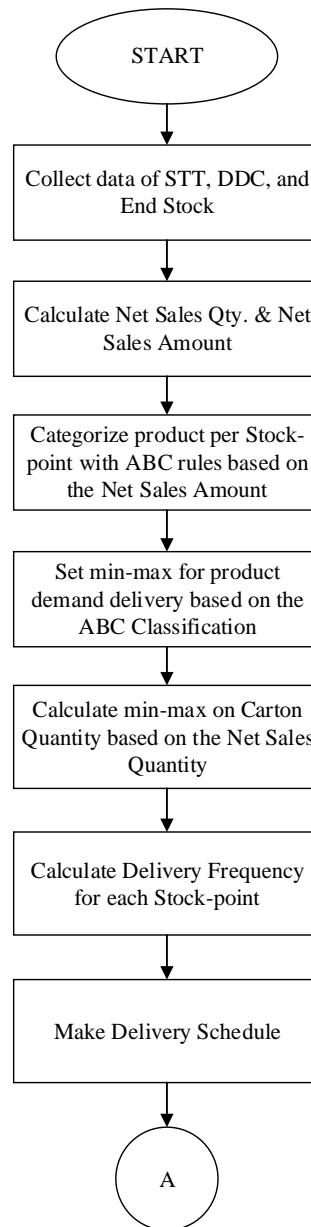
Figure 4. 2 Procurement Process Flowchart for Stock-point
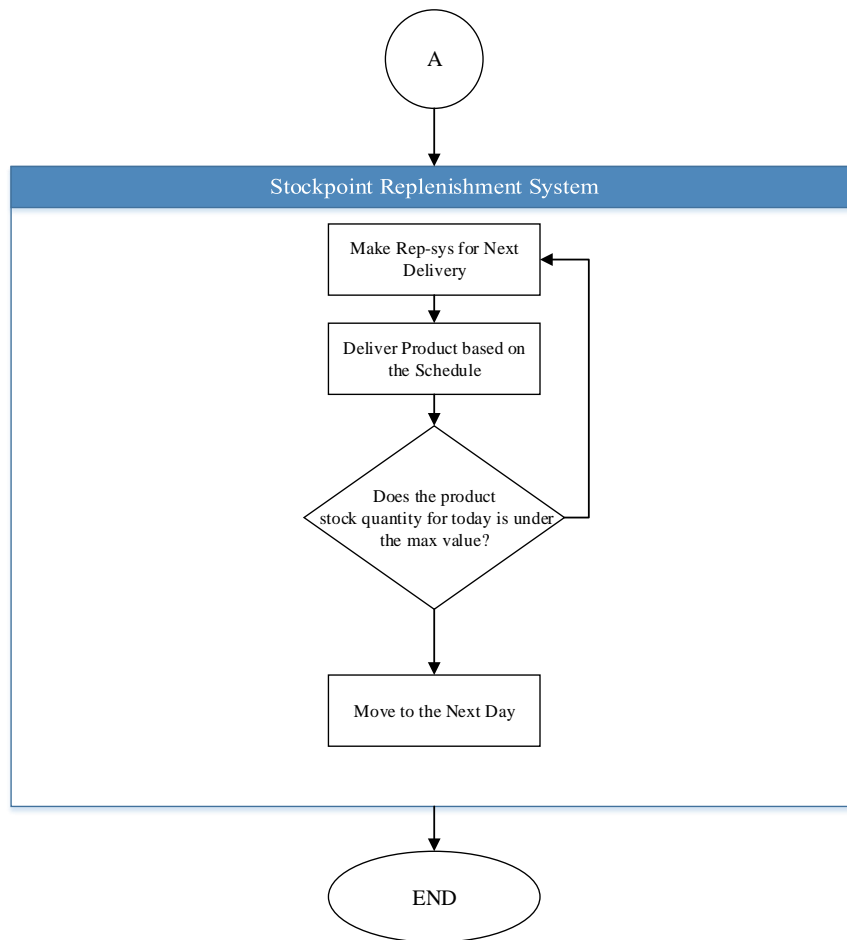
Figure 4. 2 Procurement Process Flowchart of Stock-point (Cont.)

After the arrangement of delivery schedule, DC will control the stock of each stock-point day-by-day based on the min-max that has been set before. Whenever the stock of the product in the stock-point below the max value, DC publish rep-sys for the next delivery, so on the next delivery they will send certain amount of product to keep the stock of the product on the stock-point on maximum level. Stock-point have the role of updating sales quantity and amount for all of their product per day, simultaneously with the ending stock for all their product day-by day. With a good collaboration between stock-point and DC role, PT. Indomarco Adi Prima has survived to be one of the biggest retail distribution company for more than 68 years in Indonesia.

4.2   Stock-points Contribution Data

PT. Indomarco Adi Prima Surabaya DC has cover 143 stock-points in East Java region. Every stock-point have different characteristic, based on where do they placed, what products that has been their focus on selling, and how their performing based on their Net Sales and Service Level. Decision of which stock-point to be chosen as the sample for this research will be taken based on the stock-point contribution to the business. We have 2 indicator of contribution that will be used on this research, which are Average Net Sales and Service Level.

4.2.1   Average Net Sales

Average Net Sales of each stock-point will be considered as how impactful the sales of each stock-point to the total sales of the company. We used the data of the last 3 cycles to find the average net sales of all stock-points. We decide to used only the last 3 cycles data (Cycle 2 – 4, 2019) since it has the nearest level of net sales to the recent performance of the business. Here is the equation used to calculate the average net sales:

$$Average\ Net\ Sales = \frac{(Net\ Sales\ of\ Cycle\ 2 + Cylce\ 3 + Cycle\ 4\ )}{3} \qquad (4.1)$$

The calculation result of Average Net Sales for each stock-points is shown on the Table 4.1

Table 4. 1 Stock-points Net Sales for the last 3 Cycle

No.	Stock-point	Net Sales Per Cycle (Rp.)			Average Net Sales
		Cycle 2	Cycle 3	Cycle 4	
1	SP BUGUL KIDUL	2,462,501,544	2,558,004,866	2,910,431,294	2,643,645,901
2	SP KRIAN	2,057,759,943	2,515,983,028	2,362,369,170	2,312,037,380
3	SP TAMBAKSARI	1,993,525,778	2,657,839,267	1,922,335,686	2,191,233,577
4	SP RUNGKUT	2,147,988,029	2,207,044,347	1,803,102,839	2,052,711,738
5	SP TAMAN	1,976,499,464	2,434,149,126	1,686,490,625	2,032,379,738

No.	Stock-point	Net Sales Per Cycle (Rp.)			Average Net Sales
		Cycle 2	Cycle 3	Cycle 4	
6	SP BANGIL	1,668,229,277	2,369,860,577	1,748,058,994	1,928,716,283
7	SP TUBAN	1,590,319,423	1,851,764,818	2,212,609,528	1,884,897,923
8	SP CANDI	1,575,074,039	1,975,076,486	2,038,103,331	1,862,751,285
9	SP BOJONEGORO	1,458,716,792	1,868,855,775	2,125,072,428	1,817,548,332
10	SP UNGGUL-CLUB	1,453,167,599	1,979,925,862	1,958,796,097	1,797,296,519
…	…	…	…	…	…
…	…	…	…	…	…
143	SP IFL SIDOARJO	151,668,501	173,892,283	117,795,028	147,785,271

4.2.2 Service Level

Beside Net Sales, we also consider service level as one of the contribution indicators of stock-points to the business. Service level in PT. Indomarco Adi Prima calculated based on their order fulfillment quantity, which means that having more order that not fulfilled will turn their service level lower. Service level data used is the newest (15 May 2019). The recapitulation of service level and service level percentage for each stock-point is provided on Table 4.2.

Table 4. 2 Service Level of Stock-points

No.	Stock-point	Service Level Percentage
1	SP BATU MARMAR	60.93%
2	SP BOJONEGORO	65.02%
3	SP PURWOREJO	67.99%
4	SP SIMOKERTO	68.63%
5	SP TUBAN	69.71%
6	SP PAMEKASAN	71.69%
7	SP WIYUNG	73.65%
8	SP KREMBUNG	74.99%

No.	Stock-point	Service Level Percentage
9	SP TARIK	75.07%
10	SP GRESIK 2	75.38%
…	…	…
…	…	…
143	SP IFL SIDOARJO	100.00%

4.3 Stock-points Classification

After having the contribution data for each stock-point, next we do the stock-points classification based on the contribution data. This has to be done to know each stock-point class based on the ABC Classification method. The classification will be following ABC Rules and it would depend on the combination of each stock-point service level and net sales value. We aimed to have samples that have high number of net sales, but having a low service level that has not achieved the company target. Stock-point will be divided into 3 class based on their ranks of combined contribution, with A class stock-points will be 20% from the highest rank, B class stock-points is the next 30%, and C class stock points is the last 50%. In order to have clearer information of how they performing, we weight each indicator.

4.3.1 Elimination of Stock-points with >95% Service Level

First step of the stock-points classification will be eliminating stock-points that has achieved service level target that has been set by the company, which is 95%. There are 27 stock-points that has achieved the target, and left 116 stock-points that will be used on the classification of the stock-points. We eliminate those stock-points since they do not need to be improved in safety stock efficiency. Stock-point that will be classified is shown on the Table 4.3

Table 4. 3 Stock-points that have Service Level under 95%

No.	Stock-point	Service Level Percentage
1	SP BATU MARMAR	60.93%

No.	Stock-point	Service Level Percentage
2	SP BOJONEGORO	65.02%
3	SP PURWOREJO	67.99%
4	SP SIMOKERTO	68.63%
5	SP TUBAN	69.71%
6	SP PAMEKASAN	71.69%
7	SP WIYUNG	73.65%
8	SP KREMBUNG	74.99%
9	SP TARIK	75.07%
10	SP GRESIK 2	75.38%
…	…	…
…	…	…
116	SP BALONGPANGGANG	94.92%

4.3.2 Weighting of Net Sales

Next step of the classification is weighting of net sales for each stock-points. The data used to do the weighting is the average net sales that has been calculated on previous sub-chapter. Weighting is needed to have comparison between stock-points on the average net sales, and to know the significance of net sales of each stock-points compared to the others. Weighting is done by following the equation below:

$$Weighting\ of\ Net\ Sales = \frac{(Net\ Sales\ X - Lowest\ Net\ Sales)}{(Highest\ Net\ Sales - Lowest\ Net\ Sales)} \qquad (4.2)$$

The recapitulation data of net sales weighting results is provided on Table 4.4.

Table 4. 4 Weighting of Net Sales

No.	Stock-point	Average Net Sales (Rp.)	Weighting of Net Sales
1	SP BUGUL KIDUL	2,643,645,901	1
2	SP KRIAN	2,312,037,380	0.862

No.	Stock-point	Average Net Sales (Rp.)	Weighting of Net Sales
3	SP TAMBAKSARI	2,191,233,577	0.811
4	SP RUNGKUT	2,052,711,738	0.754
5	SP TAMAN	2,032,379,738	0.745
6	SP BANGIL	1,928,716,283	0.702
7	SP TUBAN	1,884,897,923	0.684
8	SP CANDI	1,862,751,285	0.675
9	SP BOJONEGORO	1,817,548,332	0.656
10	SP PAMEKASAN	1,742,366,529	0.624
…	…	…	…
…	…	…	…
116	SP SENORI	244,405,695	0

4.3.3   Weighting of Service Level

Next step will be the weighting of service level. It conducted in order to know the significance of service level for one stock-point compared to others. As explained before that we aimed to find stock-points that has lowest service level, so we modify the equation to have the equation accommodate that needs. Stock-point that has lowest service level will have highest number of normalized service level data. Here is the equation used to calculate the weighting of service level:

$$Weighting\ of\ SL = 1 - \frac{(SL\ X - Lowest\ SL)}{(Highest\ SL - Lowest\ SL)} \qquad (4.3)$$

The recapitulation data for the results of the service level weighting is provided on table 4.5

Table 4. 5 Weighting of Service Level

No.	Stock-point	Service Level Percentage	Weighting of Service Level
1	SP BATU MARMAR	60.93%	1
2	SP BOJONEGORO	65.02%	0.880

No.	Stock-point	Service Level Percentage	Weighting of Service Level
3	SP PURWOREJO	67.99%	0.792
4	SP SIMOKERTO	68.63%	0.773
5	SP TUBAN	69.71%	0.742
6	SP PAMEKASAN	71.69%	0.683
7	SP WIYUNG	73.65%	0.626
8	SP KREMBUNG	74.99%	0.586
9	SP TARIK	75.07%	0.584
10	SP GRESIK 2	75.38%	0.575
…			
…			
116	SP BALONGPANGGANG	94.92%	0

4.3.4 Stock-points ABC Classification

Next, we do ABC Classification. The classification is based on both the weighting results of net sales and service level. The objective of this ABC Classification is to know the significance of each stock-point, and categorized them by following ABC rules, with A class stock-points is 20% of the highest rank stock-points, B class stock-points is the next 30% stock-point, and C class product is 50% of the lowest rank stock-point. There are 23 stock-points that belongs to class A, 35 stock-points belongs to class B, and 58 stock-points belongs to class C. Recapitulation of classification of the stock-point is provided on Table 4.6 Weighting results is calculated by following this equation:

$$Weighting\ Results = Weighting\ of\ Net\ Sales\ x\ Weighting\ of\ SL \qquad (4.4)$$

Table 4. 6 ABC Classification for Stock-points

No.	Stock-point	Weighting of Net Sales	Weighting of Service Level	Weighting Results	Class
1	SP BOJONEGORO	0.656	0.880	0.577	
2	SP TUBAN	0.684	0.742	0.507	A
3	SP PAMEKASAN	0.624	0.683	0.427	

No.	Stock-point	Weighting of Net Sales	Weighting of Service Level	Weighting Results	Class
4	SP PURWOREJO	0.508	0.792	0.403	
5	SP KRIAN	0.862	0.380	0.328	
…	…	…	…	…	
24	SP KENJERAN	0.306	0.416	0.127	
25	SP BABAT	0.512	0.245	0.125	
26	SP SIDOARJO	0.397	0.313	0.124	
27	SP BALEGA	0.352	0.346	0.122	B
28	SP BENOWO	0.300	0.381	0.114	
…	…	…	…	…	
58	SP WARU	0.283	0.186	0.053	
59	SP BURNEH	0.175	0.288	0.050	
60	SP PABEAN CANTIAN	0.181	0.276	0.050	
61	SP SAMPANG	0.245	0.198	0.049	C
62	SP NGORO	0.158	0.297	0.047	
…	…	…	…	…	
116	SP BALONGPANGGANG	0.111	0.000	0.000	

4.3.5 Stock-points chosen as Sample

After knowing the ABC Class for each stock-point, we choose which stock-point that will be used as sample for this research. We decide to choose 5 stock-points that belong to class A, 3 stock-points that belong to class B, and 2 stock-points that belong to class C. We choose the samples from all class since there are differences in the calculation of min-max, and delivery frequency based on the stock-point class on the current company method, and we sure that by having sample from all class will shows the differences of each class and how to treat different class of stock-point. The stock-point that chosen is the highest rank of each class. We choose 5 samples from A class in order to give a higher impact to the company from this research results. The list of stock-points that chosen as samples for this research is provided on table 4.7.

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Table 4. 7 Stock-point chosen as Sample

No.	Stock-point	Weighting Result	Class
1	SP BOJONEGORO	0.577	A
2	SP TUBAN	0.507	
3	SP PAMEKASAN	0.427	
4	SP PURWOREJO	0.403	
5	SP KRIAN	0.328	
6	SP KENJERAN	0.127	B
7	SP BABAT	0.125	
8	SP SIDOARJO	0.124	
9	SP WARU	0.053	C
10	SP BURNEH	0.050	

4.4   Product Demand Data of Chosen Stock-points

This sub-chapter will provide the demand data of products on chosen stock-points based on the net sales, as the consideration for choosing product samples for each stock-point. We used the last 3 cycle net sales data for the calculation of average net sales for each product. We exclude product that categorized as New Product Launch (NPL) that shown by 4xxxxx material number, and promotional product that shown by 7xxxxx material number. We also find the sum average for the classification needs that would be explained on the next sub-chapter. Below is provided one of the examples for product demand data calculation for Bojonegoro stock-point, and you can find the calculation for other stock-point on appendix A.

There are total of 558 non NPL and promotional product on Bojonegoro Stock-point. Bojonegoro stock-point has total of Rp. 1,839,217,781 on average net sales. The data of average net sales of each product will be shown on the table 4.8.

Table 4. 8 Product Average Net Sales of Bojonegoro Stock-point

No.	Material No.	Product	Net Sales per Cycle (Rp.)			Average Net Sales
			Cycle 2	Cycle 3	Cycle 4	
1	100488	Mi Instan Ind. Ayam Bawang	19,414,615	26,591,299	27,102,573	24,369,496
2	100489	Mi Instan Ind. Ayam Special	4,548,167	6,551,782	5,153,548	5,417,832
3	100491	Mi Instan Ind. Goreng Pedas	2,611,859	3,585,220	7,679,434	4,625,504
4	100493	Mi Instan Ind. Goreng Special Plus	91,704,533	147,860,769	167,549,024	135,704,775
5	100496	Mi Instan Ind. Gr Ayam Panggang Jumbo	1,152,600	652,517	5,204,075	2,336,397
6	100497	Mi Instan Ind. Goreng Spesial Jumbo	6,953,032	5,147,918	6,297,843	6,132,931
7	100506	Mi Instan Ind. Soto Mi	3,109,887	5,363,601	9,366,929	5,946,806
8	100507	Mi Telor Kuning	1,597,369	492,454	1,848,270	1,312,698
9	100508	Mi Telor Merah	3,338,889	997,379	1,567,757	1,968,008
10	100766	Mi Instan Sar. Grg Ayam Kecap Dua	7,101,482	6,319,588	15,843,809	9,754,960
…	…	…	…	…	…	…
…	…	…	…	…	…	…
558	199914	QUAKER 3IN1 SIC COKLAT RENCENG 29GR-P	-30,309	-	-	-30,309
Total			1,435,598,307	1,824,524,478	2,041,810,531	1,839,217,781

4.5 Product Classification

This sub-chapter will provide the product classification for each stock-point by using ABC Classification method based on the cumulative contribution percentage of the products. First step of the classification is to arrange the product

based on their average net value from the highest to the lowest one. Then, we calculate contribution percentage and cumulative contribution percentage. Class A product belongs to the product that has 0 – 80% cumulative contribution percentage. Class B product belong to the product that has 80 – 95% cumulative contribution percentage. Class C product belong to the product that has >95% cumulative contribution percentage. The calculation of contribution percentage is following the formula below:

$$Contribution\% \ for \ Product \ X = \frac{Average \ Net \ Value \ Product \ X}{Sum \ of \ Average \ Net \ Value} \qquad (4.5)$$

The following sub-chapter contains the classification of products for each stock-points and the list of chosen products as the samples for this research. Calculation will be done for all of the stock-points. The table below is one of example for Bojonegoro stock-point calculation.

Bojonegoro stock-point has 120 products on class A, 144 products on class B, and 394 products on class C. Product that has the highest contribution percentage on Bojonegoro stock-point is *Mi Instan Ind. Goreng Special Plus* with 7.378%. The classification of product in Bojonegoro stock-point is provided in table 4.9.

Table 4. 9 ABC Classification of Product on Bojonegoro Stock-point

No.	Material No.	Product	Average Net Value (Rp.)	Contribution Percentage	Cumulative Contribution Percentage	Class
1	100493	Mi Instan Ind. Goreng Special Plus	135,704,775	7.3784%	7.378%	
2	155032	Ichi Ocha Melati PET 350ml	76,905,532	4.1814%	11.556%	
3	172694	Trenz Sandwich Lemon Bucket 240 gr	65,150,001	3.5423%	15.102%	A
4	129153	Susu Steril Indomilk Choco 190 ml	51,640,237	2.8077%	17.910%	
5	199660	Mi Instan Indomie Gr Ayam Geprek	50,782,049	2.7611%	20.671%	
…	…	…	…	…	…	
121	138891	Sun BC Susu Beras Merah Sachet	3,254,866	0.1770%	80.172%	B

No.	Material No.	Product	Average Net Value (Rp.)	Contribution Percentage	Cumulative Contribution Percentage	Class
122	193164	Soffell Botol Bengkoang 80gr	3,252,704	0.1769%	80.349%	
123	180511	Gowell Chocolate Sachet	3,231,851	0.1757%	80.525%	
124	158553	Mi Instan Pop Mie Goreng Pedas Jumbo 12	3,225,588	0.1754%	80.700%	
125	175112	Mi Instan Ind Goreng Sambal Matah	3,152,749	0.1714%	80.872%	
…	…	…	…	…	…	
265	174462	Snack Qtela Ubi Ungu PEM 45G	974,400	0.0530%	95.032%	
266	108387	SAPS-N/Sambal Pedas Sch 504 x 9 gr	973,963	0.0530%	95.085%	
267	184547	SAPB335/IF Sambal Pedas Botol 335 ml	972,273	0.0529%	95.138%	
268	173598	Genki Moko Pants L7	966,573	0.0526%	95.191%	C
269	192625	KAHURIPAN KLASIK VANILLA KOTAK	963,718	0.0524%	95.243%	
…	…	…	…	…	…	
558	185646	AISHADERM LIGHTENING DAY CREAM 20G	-535,716	-0.0291%	100%	

4.6   Product Chosen as Sample

After the ABC classification of products on each chosen stock-point, next we pick 3 products for each stock-point as the samples for the research. 1 product is picked for each class A, B, and C for each stock-point. Instant noodle (ISM principal) and mineral water (TSP principal) products are neglectable since the product supply is not arranged by PT. Indomarco Adi Prima. The delivery of those products follows the needs of the principals, and it out of stock-points control. Product that would be chosen also need to have data sufficiency from January 2017 up to May 2019. The list of products that chosen as samples for the research is provided on table 4.10.

Table 4. 10 List of Product that Chosen as Samples

Stock-point Class	Stock-point	Product Class	Product
A	SP BOJONEGORO	A	Ichi Ocha Melati PET 350ml
		B	Sun BC Susu Beras Merah Sachet
		C	SAPS-N/Sambal Pedas Sch 504 x 9 gr
	SP TUBAN	A	Susu Steril Indomilk Choco 190 ml
		B	Snack Qtela BBQ 60g
		C	ID-68 PEL KATUN KOTAK MEDIUM SET (12)
	SP PAMEKASAN	A	Krimer Kental Manis Kremer Plain 37g
		B	Genki Moko Moko Pants L1A
		C	IKMT-N/Indofood Kecap Manis PET 275 ml
	SP PURWOREJO	A	Susu Steril Indomilk Choco 190 ml
		B	Bukrim Oxyklin Romantic Floral 800
		C	SUN BC SUSU BERAS MERAH KOTAK
	SP KRIAN	A	Susu Steril Indomilk Choco 190 ml
		B	MINYAK GORENG BIMOLI 5LT JRG
		C	Bubur Bayi SUN BC Kacang Hijau Ekonomis
B	SP KENJERAN	A	Ichi Ocha Melati PET 350ml
		B	Bubur Bayi SUN BC Beras Merah Ekonomis
		C	Susu UHT Indomilk Choco 190 ml
	SP BABAT	A	Krimer Kental Manis Kremer Plain 500g
		B	GARAM MEJA REFINA REF500GR BAL
		C	Susu UHT Indomilk Vanila 190 ml
	SP SIDOARJO	A	Kental Manis Indomilk Putih Sachet 37g
		B	RNG/Bumbu Racik Nasi Goreng 200x20gr
		C	ID-T57 BASIC - SABUT STAINLESS
C	SP WARU	A	Susu UHT Indomilk Kids Choco 115 ml
		B	PSPS/PL SAMBAL PEDAS SCH 960 x 8 gr
		C	Snack Chiki Ball CHO 10G
	SP BURNEH	A	Susu UHT Indomilk Kids Choco 115 ml
		B	Bubur Bayi SUN BC Beras Merah Ekonomis
		C	Sun Marie Roll Kecil New

4.7   Sample Demand Data

After finding out products that will be used as the samples for this research, next we do data collection regarding the demand for those products. The demand data used for this research will be the demand data for selected products from January 2017 to May 2019. Demand data will be shown by working day of the company. The demand data on 2017 will be provided on Table 4.11, and the rest will be provided on appendix C.

Table 4. 11 Demand Data for Samples - 2017

Stock-point	Material No	Product	Unit	Cycle	1					...	12
				Week	1						52
				Days	1	2	3	4	5	...	5
SP BOJONEGORO	155032	Ichi Ocha Melati PET 350ml	Car	2017	2	8	5	20	17	...	2066
SP BOJONEGORO	138891	Sun BC Susu Beras Merah Sachet	Car		0	0	0	0	1	...	6
SP BOJONEGORO	108387	SAPS-N/Sambal Pedas Sch 504 x 9 gr	Car		0	0	2	1	0	...	0
SP TUBAN	129153	Susu Steril Indomilk Choco 190 ml	Car		4	12	14	11	46	...	336
SP TUBAN	109950	Snack Qtela BBQ 60g	Car		0	0	0	0	0	...	0
SP TUBAN	125971	ID-68 PEL KATUN KOTAK MEDIUM SET (12)	Car		0	0	0	0	0	...	0
SP PAMEKASAN	158606	Krimer Kental Manis Kremer Plain 37g	Car		4	13	33	12	70	...	150
SP PAMEKASAN	173597	Genki Moko Moko Pants L1A	Car		0	0	0	0	0	...	0

| Stock-point | Material No | Product | Unit | Cycle | | 1 | | | | | ... | 12 |
| | | | | Week | | 1 | | | | | | 52 |
				Days	1	2	3	4	5		...	5
SP PAMEKASAN	155983	IKMT-N/Indofood Kecap Manis PET 275 ml	Car		0	0	0	0	0		...	0
SP PURWOREJO	129153	Susu Steril Indomilk Choco 190 ml	Car		0	98	138	0	0		...	588
SP PURWOREJO	165942	Bukrim Oxyklin Romantic Floral 800	Car		0	0	0	0	0		...	10
SP PURWOREJO	138823	SUN BC SUSU BERAS MERAH KOTAK	Car		0	0	1	0	0		...	1
SP KRIAN	129153	Susu Steril Indomilk Choco 190 ml	Car		17	15	32	37	343		...	26
SP KRIAN	107043	MINYAK GORENG BIMOLI 5LT JRG	Car		0	0	5	0	0		...	11
SP KRIAN	101470	Bubur Bayi SUN BC Kacang Hijau Ekonomis	Car		0	1	0	1	0		...	0
SP KENJERAN	155032	Ichi Ocha Melati PET 350ml	Car		0	3	0	1	5		...	51

| Stock-point | Material No | Product | Unit | Cycle | 1 | | | | | ... | 12 |
| | | | | Week | 1 | | | | | | 52 |
				Days	1	2	3	4	5	...	5
SP KENJERAN	101466	Bubur Bayi SUN BC Beras Merah Ekonomis	Car		0	0	0	0	2	...	0
SP KENJERAN	187296	Susu UHT Indomilk Choco 190 ml	Car		0	0	0	0	0	...	7
SP BABAT	148000	Krimer Kental Manis Kremer Plain 500g	Car		1	1	3	2	10	...	2
SP BABAT	107394	GARAM MEJA REFINA REF500GR BAL	Bal		0	2	2	2	6	...	0
SP BABAT	126009	Susu UHT Indomilk Vanila 190 ml	Car		0	0	0	0	0	...	2
SP SIDOARJO	176612	Kental Manis Indomilk Putih Sachet 37g	Car		0	0	0	0	0	...	38
SP SIDOARJO	110040	RNG/Bumbu Racik Nasi Goreng 200x20gr	Rcg		0	16	23	162	9	...	69
SP SIDOARJO	166097	ID-T57 BASIC - SABUT STAINLESS	Car		0	0	0	0	0	...	2

				Cycle			1			...	12
				Week			1				52
Stock-point	Material No	Product	Unit	Days	1	2	3	4	5	...	5
SP WARU	145210	Susu UHT Indomilk Kids Choco 115 ml	Car		7	28	1	0	0	...	46
SP WARU	161921	PSPS/PL SAMBAL PEDAS SCH 960 x 8 gr	Car		0	0	0	0	1	...	0
SP WARU	149273	Snack Chiki Ball CHO 10G	Car		0	0	0	0	2	...	0
SP BURNEH	145210	Susu UHT Indomilk Kids Choco 115 ml	Car		0	10	10	16	27	...	24
SP BURNEH	101466	Bubur Bayi SUN BC Beras Merah Ekonomis	Car		0	1	2	2	1	...	3
SP BURNEH	139967	Sun Marie Roll Kecil New	Car		0	0	0	0	0	...	0

4.8   Inventory Cost Component

This subchapter will provide the calculation of inventory cost component that consist of ordering cost and holding cost. Both of this cost component will be used to evaluate the implementation of the inventory control policy.

4.8.1   Ordering Cost

Ordering cost that observed consist of 5 costs, which are cost of electricity, administration, telecommunication, salary, and assets. All costs are pulled into unit per kilogram, to easily track how much it would cost for a product to be ordered. The first data, which is cost of electricity, telecommunication, and salary provided on table 4.12.

Table 4. 12 Cost of Electricity, Administration, and Telecommunication

N o	Cost Component	Total cost per month (Rp.)	Total cost / Year (Rp.)	PO/Worker /Year	Total Cost / PO (Rp.)
1	Electricity	300,000.00	3,600,000.00	7200	500.00
2	Administration (Print & Paper)	150,000.00	1,800,000.00	7200	250.00
3	Telecommunicatio n (Internet & telephone)	650,000.00	7,800,000.00	7200	1083.33
4	SAP License (1 user)	-	67,000,000.0 0	7200	9305.56
5	SAP Maintenance	-	4,690,000.00	7200	651.39
Total/PO					11790.28

Based on the statement of the supply chain manager, most of the cost comes from telecommunication, that they used SAP to control the stock of the stock-points, and also there are intense communication between DC and Stock-point in order to stock controlling, and order placement. Even though they used SAP to stock controlling, their order placement method still follows traditional ways, by

using Purchase Order in a form of document that printed on a paper. Electricity in stock-point used for lighting of the warehouse, as well as other usage process.

Another cost component of the ordering cost is cost of salary. The cost of salary is tracked from the salary of Procurement Staff. Table 4.13 provides the scheme of calculation of how the salary of the workers contribute to each PO. In a day, 1 Procurement Staff can publish around 30 PO, and assumed that 1 month consist of 20 working days. 1 Adm Officer has several workloads, and one of them is PO input to the system, which contribute 20% of the total workload of the Adm Officer. Picker Packer also have some workload that contribute to the reordering process with 40% of the total workload.

Table 4. 13 Cost of Salary

No	Title	Salary per month (Rp.)	Percentage of Workload	PO/ month	Salary / PO (Rp.)
1	PO Officer	3,900,000.00	100%	600	6,500.00
1	Adm Officer	3,900,000.00	20%	20	39,000.00
1	Picker Packer	3,900,000.00	40%	20	78,000.00
Total					123,500.00

Next, we have assets cost, which including the facilities used in reordering activity, which consist of 1 set of PCs, working desk and chair, printer, copier, and SAP related system. We use depreciation to calculate the contribution of each facility to 1 PO published. Table 4.1.4 shows the price for each facility.

Table 4. 14 Price for Facilities

No	Asset	Price per unit (Rp.)
1	1 Set of PC	15,000,000
2	Working Chair	1,050,000
3	Desk	2,000,000
4	Printer	7,000,000
5	SAP software	1,500,000

No	Asset	Price per unit (Rp.)
6	SAP server	10,000,000
7	SAP Training	50,000,000
8	Copier	33,500,000

After knowing the price for each facility, next we calculate the depreciation for each facility per 1 PO published. We use straight line method to calculate the depreciation as shown on formula 4.1. The recapitulation of depreciation for assets is shown on table 4.15 below.

$$Depreciation\ per\ PO = \frac{Initial\ Value - Ending\ Value}{Product\ Lifetime\ x\ PO(year)}$$

(4.1)

Annotation:

Initial Value   = Asset price as purchased

Ending Value   = Asset price when product lifetime over

Product Lifetime   = Duration of asset can be used

PO (Year)   = PO published per year per worker

Here is one example of depreciation calculation for 1 set of PCs:

$$Depreciation\ per\ PO = \frac{Initial\ Value - Ending\ Value}{Product\ Lifetime\ x\ PO(year)}$$

$$Depreciation\ per\ PO = \frac{Rp.\ 10,000,000.00 - Rp.\ 0}{5\ x\ 7200}$$

$$Depreciation\ per\ PO = \frac{Rp.\ 10,000,000.00 - Rp.\ 0}{5\ x\ 7200}$$

$$Depreciation\ per\ PO\ for\ 1\ Set\ of\ PC = Rp.\ 277.78$$

Table 4. 15 Cost of Assets

No	Asset	Life Time	Total price (Rp.)	Depreciation / year (Rp.)	PO/Year	Depreciation/ PO (Rp.)
1	1 Set of PC	5	15,000,000	3,000,000	7,200	416.67
2	Working Chair	1	1,050,000	1,050,000	7,200	145.83
3	Desk	1	2,000,000	2,000,000	7,200	277.78
4	Printer	3	7,000,000	2,333,333	7,200	324.07
5	SAP Software	5	1,500,000	300,000	7,200	41.67
6	SAP Server	3	10,000,000	3,333,333	7,200	462.96
7	SAP Training	5	50,000,000	10,000,000	7,200	1,388.89
8	Copier	5	33,500,000	6,700,000	7,200	930.56
Total / PO						3988.43

The total ordering cost for each product will be delivered per order made which provided on table 4.16.

Table 4. 16 Recapitulation of Reorder Cost

No	Cost Component	Cost per PO (Rp.)
1	Cost of Salary	123,500.00
2	Cost of Electricity, Administration, and Telecommunication	11,790.28
3	Cost of Assets	3,988.43
Total Cost / PO		139,278.70

4.8.2 Holding Cost

Holding cost is cost that incurred for storage activity of a product. Holding cost of this research consist of worker, non-worker, and cost of capital. All component of holding cost will be calculated for 1 year of holding. Worker cost calculated as salary cost that spend for each carton of product per year. From the

data of the company, 1 warehouse staff can manage up to 360000 carton per year. The calculation of salary cost per carton per year provided on table 4.17.

Table 4. 17 Salary Cost for Holding Cost

No	Title	Salary / Month	Salary / year (Rp.)	Carton/Year	Salary / Carton / year (Rp.)	Salary / Carton / Day (Rp.)
1	Warehouse Staff	3,900,000.00	46,800,000.00	360000	130.00	0.50

The next component of holding cost is non-worker cost. The calculation of non-worker cost will be consisted of 2 components, which are warehouse facility cost and pallet cost. Stock-point does not utilize any equipment in their warehousing activity, so that can be neglected on the cost calculation. Data of both warehouse facility and pallet will derived from renting cost, and it will be on m2/year (measurement of pallet/year). The data of non-worker cost is provided on table 4.18. The data of warehouse rent is got from www.rumah.com, and pallet from www.rentpallet.com.

Table 4. 18 Non-worker Cost for Holding Cost

No	Asset	Size	Unit	Price/year (Rp.)	Price/m2/Year (Rp.)	Price/m2/Day (Rp.)
1	Warehouse	550	m2	175,000,000	318,181.82	871.73
2	Pallet	1	m2	120,000	120,000.00	328.77
Total					438,181.82	1,200.50

Next, for calculating cost of capital, we used *WACC (Weighted Average Cost of Capital)*. Here is the formula used on the calculation of WACC.

$$WACC = (Cost\ of\ Equity\ x\ \%Equity) + Cost\ of\ Debt\ x\ \%Debt \qquad (4.1)$$
$$x\ (1 - Tax\ Rate)$$

For calculating WACC, first we need to find the beta value for the company. Since there are no stock registered by FMCG distribution company, and PT. IAP is one of the subsidiaries of Indofood, we used average of beta value of stocks that similar to Indofood. The beta value provided on table 4.19.

Table 4. 19 Beta Value of 3 FMCG Company Stock in Indonesia

Company Name	Stock Code	Beta
PT. Nippon Indosari Corpindo Tbk.	ROTI.JK	0.41
PT. Mayora Indah Tbk.	MYOR.JK	0.25
PT. Indofood CBP Sukses Makmur	ICBP.JK	0.28
Average		0.31

Source: https://finance.yahoo.com/

Next, we calculate the cost of equity by using the formula below.

$$Cost\ of\ Equity = Rf + (Rm - Rf)b + SR \qquad (4.2)$$

Annotation:

Rf   = Risk of free

b   = Relative market risk

Rm   = Average Expected Rate of Return on the Market

SR   = Specified Risk

On the calculation, the value of Rf is determined from the obligation yield FR0034 Series that has due date on 15 June 2021 with the value of 12.8%. The obligation yield subtracted by Indonesia country spread that have 4.6% value on 2017. Hence the risk of free will be 8.2%. Next, the value of Rm is determined by the value of IHSG rate on 2014-2019, which are 4.75%. The value of risk premium (Rm-Rf) will be -3.45%. Then, the average beta value for 3 similar company stocks is 0.44, and specified risk that used for this research is 5%, consist of risk of expired (5%), risk of obsolete (2%), and risk of defect (1%). It has quit big value since the research focus on fast moving consumer goods product. The recapitulation of data that used for calculation of cost of equity is provided on table 4.20.

Table 4. 20 Cost of Equity Component

Component of Cost of Equity	Value
Rf	8.2%
Rm	4.75%
Risk Premium	-3.45%
Beta	0.31
Specified Risk	8%
Cost of Equity	**15.12%**

PT. Indomarco Adi Prima incurred 25% of company tax. PT. Indomarco Adi Prima also have long-term debt with several bank, which are BCA, BSMI, MUFG, BRI, Permata Bank, and Rabobank, with 5.25%-10.80% interest rate per year. Then, the value of cost of debt is determined by using the formula below:

$$Cost\ of\ Debt\ (After\ Tax) = Interest\ (1 - Tax\ Rate) \qquad (4.3)$$

So, the calculation of cost of debt would be:

$$Cost\ of\ Debt\ (After\ Tax) = Interest\ (1 - Tax\ Rate)$$
$$Cost\ of\ Debt\ (After\ Tax) = 10.80\%\ (1 - 25\%)$$
$$Cost\ of\ Debt\ (After\ Tax) = 8.10\%$$

Based on Indofood 2018 financial statement, financing of the company consists of 84.03% of equity or company capital, and 15.97% of long-term debt. So, the calculation of WACC will be:

$$WACC = (Cost\ of\ Equity\ x\ \%Equity) + Cost\ of\ Debt\ x\ \%Debt$$
$$x\ (1 - Tax\ Rate)$$
$$WACC = (15.12\%\ x\ 84.03\%) + (8.10\%\ x\ 15.97\%)$$
$$WACC = 14.0\%$$

So, the value of cost of capital that incurred for each product is 9.7% of the product price. Then, the value of holding cost that incurred for each product will be:

$$Holding\ Cost = Worker\ Salary\ Cost + Non - Worker\ Cost \qquad (4.4)$$
$$+(14\%\ x\ Product\ Price)$$

Next, we need to know how much product can be placed on a pallet. The data of pallet capacity is provided on table 4.21.

Table 4. 21 Pallet Capacity of Each Product

Material No	Product	Car / Tier Pallet	Stack / Carton	Car / Pallet
155032	Ichi Ocha Melati PET 350ml	10	7	70
138891	Sun BC Susu Beras Merah Sachet	10	14	140
108387	SAPS-N/Sambal Pedas Sch 504 x 9 gr	14	7	98
129153	Susu Steril Indomilk Choco 190 ml	14	14	196
109950	Snack Qtela BBQ 60g	8	5	40
125971	ID-68 PEL KATUN KOTAK MEDIUM SET (12)	4	5	20
158606	Krimer Kental Manis Kremer Plain 37g	12	12	144
173597	Genki Moko Moko Pants L1A	5	3	15
155983	IKMT-N/Indofood Kecap Manis PET 275 ml	10	7	70
129153	Susu Steril Indomilk Choco 190 ml	14	14	196
165942	Bukrim Oxyklin Romantic Floral 800	10	8	80
138823	SUN BC SUSU BERAS MERAH KOTAK	15	10	150
129153	Susu Steril Indomilk Choco 190 ml	14	14	196
107043	MINYAK GORENG BIMOLI 5LT JRG	5	10	50

Material No	Product	Car / Tier Pallet	Stack / Carton	Car / Pallet
101470	Bubur Bayi SUN BC Kacang Hijau Ekonomis	14	14	196
155032	Ichi Ocha Melati PET 350ml	10	7	70
101466	Bubur Bayi SUN BC Beras Merah Ekonomis	14	14	196
187296	Susu UHT Indomilk Choco 190 ml	14	14	196
148000	Krimer Kental Manis Kremer Plain 500g	7	7	49
107394	GARAM MEJA REFINA REF500GR BAL	10	7	70
126009	Susu UHT Indomilk Vanila 190 ml	14	14	196
176612	Kental Manis Indomilk Putih Sachet 37g	12	12	144
110040	RNG/Bumbu Racik Nasi Goreng 200x20gr	140	10	1400
166097	ID-T57 BASIC - SABUT STAINLESS	5	5	25
145210	Susu UHT Indomilk Kids Choco 115 ml	14	15	210
161921	PSPS/PL SAMBAL PEDAS SCH 960 x 8 gr	6	10	60
149273	Snack Chiki Ball CHO 10G	8	10	80
145210	Susu UHT Indomilk Kids Choco 115 ml	14	15	210
101466	Bubur Bayi SUN BC Beras Merah Ekonomis	14	14	196

Here is the example of holding cost calculation for product Ichi Ocha Melati PET 350ml.

$$Holding\ Cost = Worker\ Salary\ Cost + Non - Worker\ Cost$$

$$+(14\% \; x \; Product \; Price)$$

$$Holding \; Cost = Rp. \, 156.000 + \left(\frac{Rp. \, 438{,}181.82}{70} \right)$$

$$+(14\% \; x \; Rp. \, 20{,}724.00)$$

$$Holding \; Cost = Rp. \, 156.000 + Rp. \, 6{,}259.74 + Rp. \, 2901.16$$

$$Holding \; Cost = Rp. \, 9290.90$$

After the calculation, we have found that in average, the holding cost is 20.48% of the product price. Recapitulation of holding cost for all product is provided on table 4.22.

Table 4. 22 Holding Cost Recapitulation per Product

No	Description	Car/Pal (m2)	Price/Car (Rp.) (UC)	Non-worker / Day (Rp.)	Worker / Day (Rp.)	Cost of Capital (Rp.)	Cost of Capital /Day (Rp.)	Holding Cost / Year (Rp.)	Holding Cost / Day (Rp.) (HC)	Percentage HC Per Year / (UC)
1	Ichi Ocha Melati PET 350ml	70	20,724.00	17.15	0.50	2,901.16	7.95	9,290.90	25.60	44.83%
2	Sun BC Susu Beras Merah Sachet	140	77,745.00	8.57	0.50	10,883.56	29.82	14,143.43	38.89	18.19%
3	SAPS-N/Sambal Pedas Sch 504 x 9 gr	98	102,866.00	12.25	0.50	14,400.26	39.45	19,001.50	52.20	18.47%
4	Susu Steril Indomilk Choco 190 ml	196	60,318.00	6.12	0.50	8,443.95	23.13	10,809.57	29.76	17.92%
5	Snack Qtela BBQ 60g	40	95,317.00	30.01	0.50	13,343.47	36.56	24,428.02	67.07	25.63%
6	ID-68 PEL KATUN KOTAK MEDIUM SET (12)	20	696,008.00	60.02	0.50	97,434.50	266.94	119,473.59	327.47	17.17%
7	Krimer Kental Manis Kremer Plain 37g	144	85,126.00	8.34	0.50	11,916.83	32.65	15,089.76	41.49	17.73%

No	Description	Car/Pal (m2)	Price/Car (Rp.) (UC)	Non-worker / Day (Rp.)	Worker / Day (Rp.)	Cost of Capital (Rp.)	Cost of Capital /Day (Rp.)	Holding Cost / Year (Rp.)	Holding Cost / Day (Rp.) (HC)	Percentage HC Per Year / (UC)
8	Genki Moko Moko Pants L1A	15	164,803.00	80.03	0.50	23,070.85	63.21	52,412.97	143.74	31.80%
9	IKMT-N/Indofood Kecap Manis PET 275 ml	70	214,304.00	17.15	0.50	30,000.52	82.19	36,390.26	99.84	16.98%
10	Susu Steril Indomilk Choco 190 ml	196	60,318.00	6.12	0.50	8,443.95	23.13	10,809.57	29.76	17.92%
11	Bukrim Oxyklin Romantic Floral 800	80	88,938.00	15.01	0.50	12,450.47	34.11	18,057.75	49.62	20.30%
12	SUN BC SUSU BERAS MERAH KOTAK	150	142,015.00	8.00	0.50	19,880.75	54.47	22,931.96	62.97	16.15%
13	Susu Steril Indomilk Choco 190 ml	196	60,318.00	6.12	0.50	8,443.95	23.13	10,809.57	29.76	17.92%
14	MINYAK GORENG BIMOLI 5LT JRG	50	225,043.00	24.01	0.50	31,503.88	86.31	40,397.52	110.82	17.95%

No	Description	Car/Pal (m2)	Price/Car (Rp.) (UC)	Non-worker / Day (Rp.)	Worker / Day (Rp.)	Cost of Capital (Rp.)	Cost of Capital /Day (Rp.)	Holding Cost / Year (Rp.)	Holding Cost / Day (Rp.) (HC)	Percentage HC Per Year / (UC)
15	Bubur Bayi SUN BC Kacang Hijau Ekonomis	196	115,724.00	6.12	0.50	16,200.26	44.38	18,565.88	51.01	16.04%
16	Ichi Ocha Melati PET 350ml	70	20,724.00	17.15	0.50	2,901.16	7.95	9,290.90	25.60	44.83%
17	Bubur Bayi SUN BC Beras Merah Ekonomis	196	115,724.00	6.12	0.50	16,200.26	44.38	18,565.88	51.01	16.04%
18	Susu UHT Indomilk Choco 190 ml	196	60,318.00	6.12	0.50	8,443.95	23.13	10,809.57	29.76	17.92%
19	Krimer Kental Manis Kremer Plain 500g	49	368,881.00	24.50	0.50	51,639.83	141.48	60,712.32	166.48	16.46%
20	GARAM MEJA REFINA REF500GR BAL	70	90,000.00	17.15	0.50	12,599.14	34.52	18,988.88	52.17	21.10%
21	Susu UHT Indomilk Vanila 190 ml	196	60,318.00	6.12	0.50	8,443.95	23.13	10,809.57	29.76	17.92%

No	Description	Car/Pal (m2)	Price/Car (Rp.) (UC)	Non-worker / Day (Rp.)	Worker / Day (Rp.)	Cost of Capital (Rp.)	Cost of Capital /Day (Rp.)	Holding Cost / Year (Rp.)	Holding Cost / Day (Rp.) (HC)	Percentage HC Per Year / (UC)
22	Kental Manis Indomilk Putih Sachet 37g	144	105,395.00	8.34	0.50	14,754.30	40.42	17,927.23	49.26	17.01%
23	RNG/Bumbu Racik Nasi Goreng 200x20gr	1400	221,107.00	0.86	0.50	30,952.88	84.80	31,395.86	86.16	14.20%
24	ID-T57 BASIC - SABUT STAINLESS	25	259,851.00	48.02	0.50	36,376.67	99.66	54,033.94	148.18	20.79%
25	Susu UHT Indomilk Kids Choco 115 ml	210	68,101.00	5.72	0.50	9,533.49	26.12	11,750.07	32.34	17.25%
26	PSPS/PL SAMBAL PEDAS SCH 960 x 8 gr	60	139,604.00	20.01	0.50	19,543.23	53.54	26,976.26	74.05	19.32%
27	Snack Chiki Ball CHO 10G	80	44,715.00	15.01	0.50	6,259.67	17.15	11,866.95	32.66	26.54%
28	Susu UHT Indomilk Kids Choco 115 ml	210	68,101.00	5.72	0.50	9,533.49	26.12	11,750.07	32.34	17.25%

No	Description	Car/Pal (m2)	Price/Car (Rp.) (UC)	Non-worker / Day (Rp.)	Worker / Day (Rp.)	Cost of Capital (Rp.)	Cost of Capital /Day (Rp.)	Holding Cost / Year (Rp.)	Holding Cost / Day (Rp.) (HC)	Percentage HC Per Year / (UC)
29	Bubur Bayi SUN BC Beras Merah Ekonomis	196	115,724.00	6.12	0.50	16,200.26	44.38	18,565.88	51.01	16.04%
30	Sun Marie Roll Kecil New	80	196,655.00	15.01	0.50	27,529.83	75.42	33,137.10	90.93	16.85%
Average								25,639.76	70.39	**20.48%**

4.9   Distribution Fitting for Product Samples Demand Data

The product used as samples are categorized as fast-moving product. The products also considerably do not have seasonality on the demand. Seasonality of product in fast-moving product, especially in Indonesia caused by several aspect, such as promotional event, feast day, or a new product launch (NPL). We have picked product that not have those aspects. The product selection also has been approved by PT. Indomarco Adi Prima supply chain manager.

Fast-moving product that not has seasonality can be treated with the approaches of normal distribution. Therefore, we choose normal distribution for all sample product that chosen. We conduct distribution fitting by using @risk software. Distribution fitting conducted for each quarter of demand, with the demand from 2017 and 2018. The distribution fitting done quarter by quarter since the min-max review of current method conducted quarterly, and in order to see the changes in min-max as real as possible, demand need to fitted quarterly. Since the products demand does not appear every day, we decide to build 3-4 clusters per product, to increase the accuracy of the data distribution. Here is the cluster definition and probabilities that has been calculated from the historical demand of PT. Indomarco Adi Prima.

Table 4. 23 Cluster Definition for Each Samples

Stock Point	Product Name	Q1				Q2				Q3				Q4			
		C1	C2	C3	C4	C1	C2	C3	C4	C1	C2	C3	C4	C1	C2	C3	C4
SP BOJONEGORO	Ichi Ocha Melati PET 350ml	0	0-10	10-100	>=100	0	0-10	10-100	>=100	0	0-10	10-100	>=100	0	0-10	10-100	>=100
	Sun BC Susu Beras Merah Sachet	0	0-1	1-5	>=5	0	0-1	1-5	>=5	0	0-1	1-5	>=5	0	0-1	1-5	>=5
	SAPS-N/Sambal Pedas Sch 504 x 9 gr	0	0-1	>=1		0	0-1	>=1		0	0-1	>=1		0	0-1	>=1	
SP TUBAN	Susu Steril Indomilk Choco 190 ml	0	0-10	10-100	>=100	0	0-10	10-100	>=100	0	0-10	10-100	>=100	0	0-10	10-100	>=100
	Snack Qtela BBQ 60g	0	0-1	>=1		0	0-1	>=1		0	0-1	>=1		0	0-1	>=1	
	ID-68 PEL KATUN KOTAK MEDIUM SET (12)	0	0-1	>=1		0	0-10	>=10		0	0-10	>=10		0	0-1	>=1	
SP PAMEKASAN	Krimer Kental Manis Kremer Plain 37g	0	0-10	10-100	>=100	0	0-10	10-100	>=100	0	0-10	10-100	>=100	0	0-10	10-100	>=100
	Genki Moko Moko Pants L1	0	0-1	>=1		0	0-1	>=1		0	0-1	>=1		0	0-1	>=1	
	IKMT-N/Indofood Kecap Manis PET 275 ml	0	0-1	0>=1		0	0-1	0>=1		0	0-1	0>=1		0	0-1	0>=1	
SP PURWOREJO	Susu Steril Indomilk Choco 190 ml	0	0-100	>=100		0	0-100	>=100		0	0-100	>=100		0	0-100	>=100	
	Bukrim Oxyklin Romantic Floral 800	0	0-1	>=1		0	0-1	>=1		0	0-1	>=1		0	0-1	>=1	
	SUN BC SUSU BERAS MERAH KOTAK	0	0-1	>=1		0	0-1	>=1		0	0-1	>=1		0	0-1	>=1	
SP KRIAN	Susu Steril Indomilk Choco 190 ml	0	0-100	>=100		0	0-100	>=100		0	0-100	>=100		0	0-100	>=100	
	MINYAK GORENG BIMOLI 5LT JRG	0	0-10	>=10		0	0-10	>=10		0	0-10	>=10		0	0-10	>=10	

Stock Point	Product Name	Q1				Q2				Q3				Q4			
		C1	C2	C3	C4	C1	C2	C3	C4	C1	C2	C3	C4	C1	C2	C3	C4
	Bubur Bayi SUN BC Kacang Hijau Ekonomis	0	0-1	>=1		0	0-1	>=1		0	0-1	>=1		0	0-1	>=1	
SP KENJERAN	Ichi Ocha Melati PET 350ml	0	0-10	10-100	>=100	0	0-10	10-100	>=100	0	0-10	10-100	>=100	0	0-10	10-100	>=100
	Bubur Bayi SUN BC Beras Merah Ekonomis	0	0-1	>=1		0	0-1	>=1		0	0-1	>=1		0	0-1	>=1	
	Susu UHT Indomilk Choco 190 ml	0	0-1	>=1		0	0-1	>=1		0	0-1	>=1		0	0-1	>=1	
SP BABAT	Krimer Kental Manis Kremer Plain 500g	0	0-10	>=10		0	0-10	>=10		0	0-10	>=10		0	0-10	>=10	
	GARAM MEJA REFINA REF500GR BAL	0	0-3	>=3		0	0-3	>=3		0	0-3	>=3		0	0-3	>=3	
	Susu UHT Indomilk Vanila 190 ml	0	0-1	>=1		0	0-1	>=1		0	0-1	>=1		0	0-1	>=1	
SP SIDOARJO	Kental Manis Indomilk Putih Sachet 37g	0	0-50	>=50		0	0-50	>=50		0	0-50	>=50		0	0-50	>=50	
	RNG/Bumbu Racik Nasi Goreng 200x20gr	0	0-50	>=50		0	0-50	>=50		0	0-50	>=50		0	0-50	>=50	
	ID-T57 BASIC - SABUT STAINLESS	0	0-1	>=1		0	0-1	>=1		0	0-1	>=1		0	0-1	>=1	
SP WARU	Susu UHT Indomilk Kids Choco 115 ml	0	0-10	>=10		0	0-10	>=10		0	0-10	>=10		0	0-10	>=10	
	PSPS/PL SAMBAL PEDAS SCH 960 x 8 gr	0	0-1	>=1		0	0-1	>=1		0	0-1	>=1		0	0-1	>=1	
	Snack Chiki Ball CHO 10G	0	0-5	>=5		0	0-5	>=5		0	0-5	>=5		0	0-1	>=1	
	Susu UHT Indomilk Kids Choco 115 ml	0	0-10	>=10		0	0-10	>=10		0	0-10	>=10		0	0-10	>=10	

Stock Point	Product Name	Q1				Q2				Q3				Q4			
		C1	C2	C3	C4	C1	C2	C3	C4	C1	C2	C3	C4	C1	C2	C3	C4
SP BURNEH	Bubur Bayi SUN BC Beras Merah Ekonomis	0	0-1	>=1	■	0	0-1	>=1	■	0	0-1	>=1	■	0	0-1	>=1	■
	Sun Marie Roll Kecil New	0	0-0.1	>=0.1	■	0	0-0.1	>=0.1	■	0	0-0.1	>=0.1	■	0	0-0.1	>=0.1	■

After building cluster of the demand data, next we calculate the probability of each cluster to occur in the simulation demand data based on the historical demand data. Here is the probability of occurrence for each cluster of demand data.

Table 4. 24 Probability Distribution for Each Clusters

Quarter			Q1				Q2				Q3				Q4			
Cluster			C1	C2	C3	C4	C1	C2	C3	C4	C1	C2	C3	C4	C1	C2	C3	C4
SP BOJONEGORO	Ichi Ocha Melati PET 350ml	Probability	0.1923	0.3000	0.4231	0.0846	0.1769	0.2615	0.4462	0.1154	0.146	0.238	0.369	0.246	0.161	0.346	0.376	0.115
		Cumulative	0.192	0.492	0.915	1.000	0.177	0.438	0.885	1.000	0.146	0.385	0.754	1.000	0.161	0.507	0.884	1.000

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Quarter			Q1				Q2				Q3				Q4			
Cluster			C1	C2	C3	C4	C1	C2	C3	C4	C1	C2	C3	C4	C1	C2	C3	C4
	Sun BC Susu Beras Merah Sachet	Probability	0.192	0.469	0.277	0.062	0.146	0.423	0.362	0.069	0.069	0.569	0.300	0.062	0.100	0.508	0.331	0.062
		Cumulative	0.192	0.662	0.938	1.000	0.146	0.569	0.931	1.000	0.069	0.638	0.938	1.000	0.10000	0.6077	0.9385	1.0000
	SAPS-N/Sambal Pedas Sch 504 x 9 gr	Probability	0.885	0.015	0.100	■	0.769	0.115	0.115	■	0.831	0.077	0.092	■	0.846	0.069	0.085	■
		Cumulative	0.885	0.900	1.000	■	0.769	0.885	1.000	■	0.831	0.908	1.000	■	0.84662	0.91554	1.0000	■
SP TUBAN	Susu Steril Indomilk Choco 190 ml	Probability	0.031	0.238	0.654	0.077	0.200	0.231	0.477	0.092	0.0615	0.1538	0.7077	0.0769	0.231	0.246	0.446	0.077
		Cumulative	0.031	0.269	0.923	1.000	0.200	0.431	0.908	1.000	0.062	0.215	0.923	1.000	0.2308	0.4769	0.9231	1.0000
	Snack Qtela BBQ 60g	Probability	0.769	0.123	0.108	■	0.754	0.108	0.138	■	0.792	0.085	0.123	■	0.538	0.185	0.277	■
		Cumulative	0.769	0.892	1.000	■	0.754	0.862	1.000	■	0.792	0.877	1.000	■	0.5385	0.7231	1.0000	■

Quarter			Q1				Q2				Q3				Q4			
Cluster			C1	C2	C3	C4	C1	C2	C3	C4	C1	C2	C3	C4	C1	C2	C3	C4
	ID-68 PEL KATUN KOTAK MEDIUM SET (12)	Proba bility	0.969	0.008	0.023		0.946	0.054	0		0.800	0.123	0.077		0.954	0.015	0.031	
		Cumu lative	0.969	0.977	1.000		0.946	1.000	1.000		0.800	0.923	1.000		0.9538	0.9692	1.0000	
SP PAMEKA SAN	Krimer Kental Manis Kremer Plain 37g	Proba bility	0.054	0.362	0.546	0.038	0.200	0.231	0.477	0.092	0.092	0.285	0.577	0.046	0.231	0.246	0.446	0.077
		Cumu lative	0.054	0.415	0.962	1.000	0.200	0.431	0.908	1.000	0.092	0.377	0.954	1.000	0.2308	0.4769	0.9231	1.0000
	Genki Moko Moko Pants L1	Proba bility	0.531	0.185	0.285		0.285	0.246	0.469		0.323	0.215	0.462		0.408	0.231	0.362	
		Cumu lative	0.531	0.716	1.001		0.285	0.531	1.000		0.323	0.538	1.000		0.40777	0.6385	1.0000	
	IKMT-N/Indofood	Proba bility	0.762	0.223	0.015		0.600	0.331	0.069		0.731	0.215	0.054		0.615	0.315	0.069	

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Quarter			Q1				Q2				Q3				Q4			
Cluster			C1	C2	C3	C4	C1	C2	C3	C4	C1	C2	C3	C4	C1	C2	C3	C4
	Kecap Manis PET 275 ml	Cumulative	0.762	0.985	1.000		0.600	0.931	1.000		0.731	0.946	1.000		0.6154	0.9308	1.0000	
SP PURWOREJO	Susu Steril Indomilk Choco 190 ml	Probability	0.131	0.654	0.215		0.115	0.700	0.185		0.100	0.662	0.238		0.115	0.700	0.185	
		Cumulative	0.131	0.785	1.000		0.115	0.815	1.000		0.100	0.762	1.000		0.1154	0.8154	1.0000	
	Bukrim Oxyklin Romantic Floral 800	Probability	0.785	0.054	0.162		0.708	0.069	0.223		0.708	0.038	0.254		0.762	0.085	0.154	
		Cumulative	0.785	0.839	1.001		0.708	0.777	1.000		0.708	0.746	1.000		0.7615	0.8462	1.0000	
	SUN BC SUSU BERAS MERAH KOTAK	Probability	0.669	0.262	0.069		0.785	0.169	0.046		0.731	0.215	0.054		0.754	0.200	0.046	
		Cumulative	0.669	0.931	1.000		0.785	0.954	1.000		0.731	0.946	1.000		0.7538	0.9538	1.0000	

Quarter			Q1				Q2				Q3				Q4			
Cluster			**C1**	**C2**	**C3**	**C4**	**C1**	**C2**	**C3**	**C4**	**C1**	**C2**	**C3**	**C4**	**C1**	**C2**	**C3**	**C4**
SP KRIAN	Susu Steril Indomilk Choco 190 ml	Probability	0.023	0.754	0.223		0.092	0.708	0.200		0.031	0.777	0.192		0.085	0.715	0.200	
		Cumulative	0.023	0.777	1.000		0.092	0.800	1.000		0.031	0.808	1.000		0.0846	0.8000	1.0000	
	MINYAK GORENG BIMOLI 5LT JRG	Probability	0.3	0.6	0.1		0.492	0.469	0.038		0.346	0.562	0.092		0.400	0.554	0.046	
		Cumulative	0.300	0.900	1.000		0.492	0.962	1.000		0.346	0.908	1.000		0.4000	0.9538	1.000	
	Bubur Bayi SUN BC Kacang Hijau Ekonomis	Probability	0.323	0.292	0.385		0.338	0.423	0.238		0.269	0.362	0.369		0.315	0.400	0.285	
		Cumulative	0.323	0.615	1.000		0.338	0.762	1.000		0.269	0.631	1.000		0.3154	0.7154	1.000	
SP KENJERAN	Ichi Ocha Melati PET 350ml	Probability	0.400	0.346	0.215	0.038	0.331	0.392	0.215	0.062	0.377	0.346	0.223	0.054	0.300	0.338	0.277	0.085
		Cumulative	0.400	0.746	0.962	1.000	0.331	0.723	0.938	1.000	0.377	0.723	0.946	1.000	0.3000	0.6385	0.9154	1.0000

Quarter			Q1				Q2				Q3				Q4			
Cluster			**C1**	**C2**	**C3**	**C4**	**C1**	**C2**	**C3**	**C4**	**C1**	**C2**	**C3**	**C4**	**C1**	**C2**	**C3**	**C4**
	Bubur Bayi SUN BC Beras Merah Ekonomis	Probability	0.154	0.223	0.623		0.200	0.254	0.546		0.123	0.223	0.654		0.185	0.262	0.554	
		Cumulative	0.154	0.377	1.000		0.200	0.454	1.000		0.123	0.346	1.000		0.1846	0.4462	1.0000	
	Susu UHT Indomilk Choco 190 ml	Probability	0.5	0.131	0.369		0.554	0.046	0.400		0.354	0.123	0.523		0.385	0.077	0.538	
		Cumulative	0.500	0.631	1.000		0.554	0.600	1.000		0.354	0.477	1.000		0.3846	0.4615	1.0000	
SP BABAT	Krimer Kental Manis Kremer Plain 500g	Probability	0.054	0.823	0.123		0.208	0.608	0.185		0.085	0.746	0.169		0.208	0.592	0.200	
		Cumulative	0.054	0.877	1.000		0.208	0.815	1.000		0.085	0.831	1.000		0.2077	0.8000	1.0000	
	GARAM MEJA	Probability	0.400	0.331	0.269		0.462	0.323	0.215		0.462	0.269	0.269		0.431	0.308	0.262	

Quarter			Q1				Q2				Q3				Q4			
Cluster			C1	C2	C3	C4	C1	C2	C3	C4	C1	C2	C3	C4	C1	C2	C3	C4
	REFINA REF500GR BAL	Cumulative	0.400	0.731	1.000		0.462	0.785	1.000		0.462	0.731	1.000		0.4308	0.7385	1.0000	
	Susu UHT Indomilk Vanila 190 ml	Probability	0.792	0.146	0.062		0.777	0.169	0.054		0.654	0.100	0.246		0.769	0.092	0.138	
		Cumulative	0.792	0.938	1.000		0.777	0.946	1.000		0.654	0.754	1.000		0.7692	0.8615	1.0000	
SP SIDOARJO	Kental Manis Indomilk Putih Sachet 37g	Probability	0.515	0.408	0.077		0.392	0.369	0.238		0.054	0.808	0.138		0.108	0.692	0.200	
		Cumulative	0.515	0.923	1.000		0.392	0.762	1.000		0.054	0.862	1.000		0.1077	0.8000	1.0000	
	RNG/Bumbu Racik Nasi Goreng 200x20gr	Probability	0.146	0.692	0.162		0.215	0.662	0.123		0.138	0.738	0.123		0.192	0.677	0.131	
		Cumulative	0.146	0.838	1.000		0.215	0.877	1.000		0.138	0.877	1.000		0.1923	0.8692	1.0000	

Quarter			Q1				Q2				Q3				Q4			
Cluster			C1	C2	C3	C4	C1	C2	C3	C4	C1	C2	C3	C4	C1	C2	C3	C4
	ID-T57 BASIC - SABUT STAINLESS S	Proba bility	0.73 1	0.26 2	0.00 8		0.83 1	0.16 2	0.00 8		0.60 8	0.35 4	0.03 8		0.50 8	0.44 6	0.04 6	
		Cumu lative	0.73 1	0.99 2	1.00 0		0.83 1	0.99 2	1.00 0		0.60 8	0.96 2	1.00 0		0.50 77	0.95 38	1.00 00	
SP WARU	Susu UHT Indomilk Kids Choco 115 ml	Proba bility	0.05 4	0.10 0	0.84 6		0.06 9	0.13 8	0.79 2		0.05 4	0.12 3	0.82 3		0.06 9	0.12 3	0.80 8	
		Cumu lative	0.05 4	0.15 4	1.00 0		0.06 9	0.20 8	1.00 0		0.05 4	0.17 7	1.00 0		0.06 92	0.19 23	1.00 00	
	PSPS/PL SAMBAL PEDAS SCH 960 x 8 gr	Proba bility	0.50 0	0.08 5	0.41 5		0.56 2	0.09 2	0.34 6		0.44 6	0.11 5	0.43 8		0.46 9	0.14 6	0.38 5	
		Cumu lative	0.50 0	0.58 5	1.00 0		0.56 2	0.65 4	1.00 0		0.44 6	0.56 2	1.00 0		0.46 92	0.61 54	1.00 00	
		Proba bility	0.60 0	0.36 9	0.03 1		0.76 2	0.20 8	0.03 1		0.86 9	0.06 9	0.06 2		0.81 5	0.03 1	0.15 4	

Quarter			Q1				Q2				Q3				Q4			
Cluster			C1	C2	C3	C4	C1	C2	C3	C4	C1	C2	C3	C4	C1	C2	C3	C4
	Snack Chiki Ball CHO 10G	Cumulative	0.600	0.969	1.000		0.762	0.969	1.000		0.869	0.938	1.000		0.8154	0.8462	1.0000	
SP BURNEH	Susu UHT Indomilk Kids Choco 115 ml	Probability	0.054	0.346	0.600		0.092	0.200	0.708		0.085	0.231	0.685		0.092	0.262	0.646	
		Cumulative	0.054	0.400	1.000		0.092	0.292	1.000		0.085	0.315	1.000		0.0923	0.3538	1.0000	
	Bubur Bayi SUN BC Beras Merah Ekonomis	Probability	0.1388	0.423	0.438		0.246	0.269	0.485		0.177	0.362	0.462		0.262	0.300	0.438	
		Cumulative	0.1388	0.562	1.000		0.246	0.515	1.000		0.177	0.538	1.000		0.2615	0.5615	1.0000	
	Sun Marie Roll Kecil New	Probability	0.638	0.031	0.331		0.808	0.038	0.154		0.462	0.108	0.431		0.415	0.069	0.515	
		Cumulative	0.638	0.669	1.000		0.808	0.846	1.000		0.462	0.569	1.000		0.4154	0.4846	1.0000	

After knowing the probability and cumulative probability for each product cluster, next we find the distribution for each cluster of products through distribution fitting by using @RISK for EXCEL. Here are the examples of the distribution fitting results for SUN BC Susu Beras Merah on Bojonegoro stock-point on the first quarter.
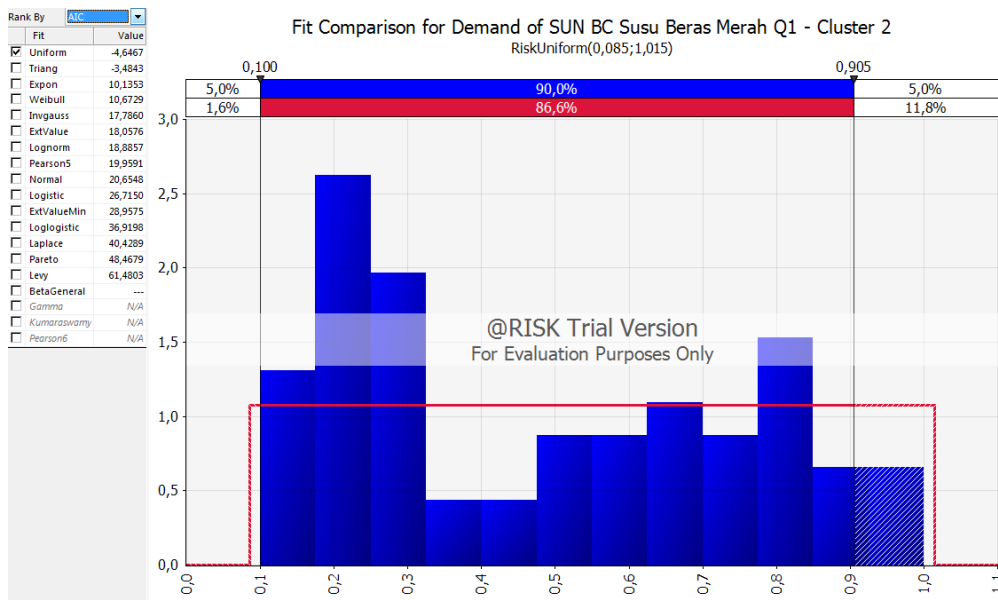
Figure 4. 3 Demand Distribution SUN BC Susu Beras Merah on SP Bojonegoro – Quarter 1 Cluster 2
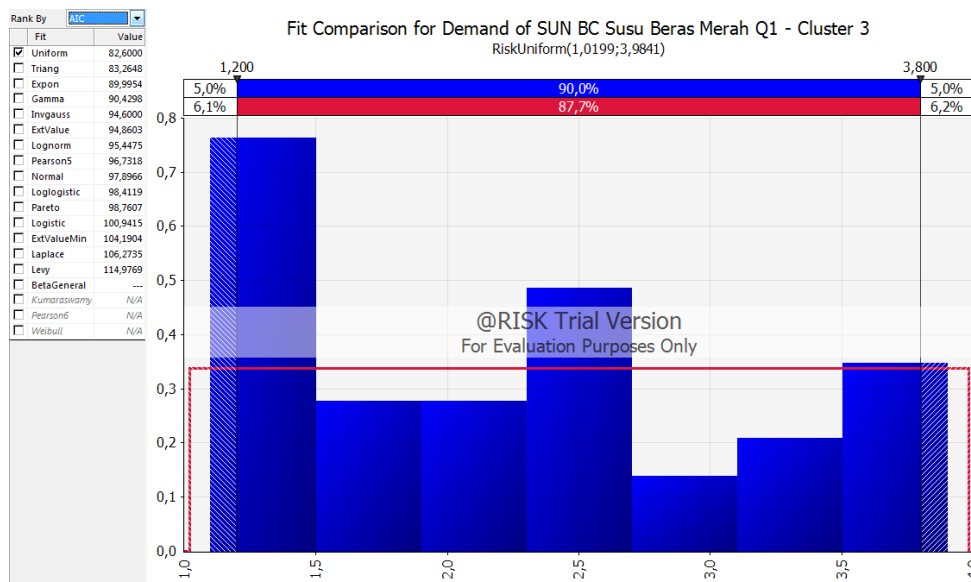
Figure 4. 4 Demand Distribution of SUN BC Susu Beras Merah on SP Bojonegoro – Quarter 1 Cluster 2

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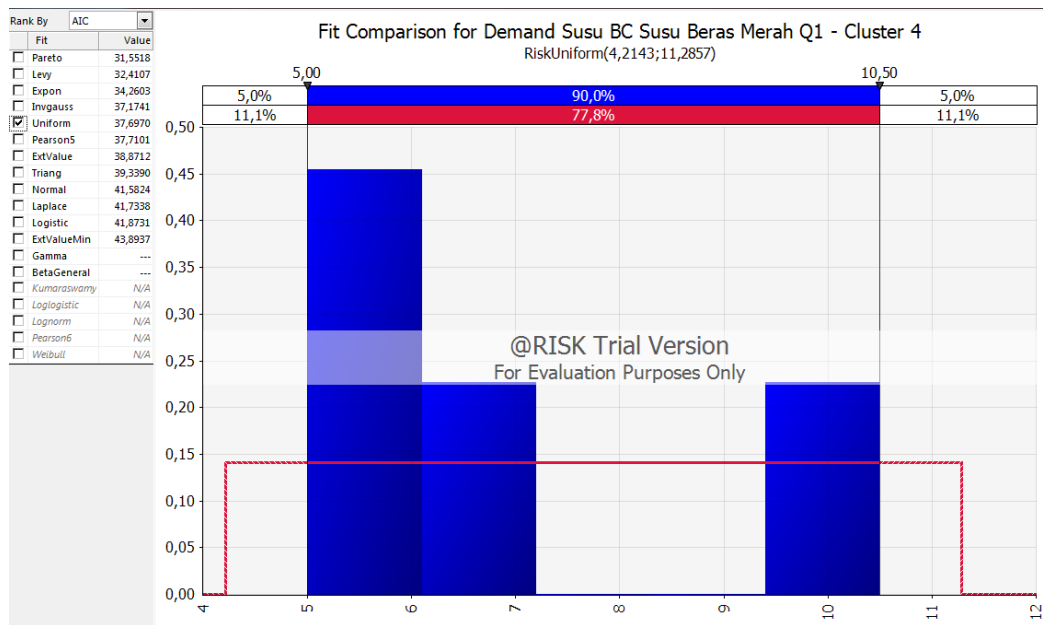
Figure 4. 5 Demand Distribution SUN BC Susu Beras Merah on SP Bojonegoro –
Quarter 1 Cluster 3

The recapitulation data of distribution fitting results for all product sample
is provided on appendix. Here is the example of distribution data for quarter 1 for
each sample per cluster.

Table 4. 25 Demand Distribution for Each Clusters for Quarter 1

Stock Point	Product Name	Q1			
		C1	C2	C3	C4
SP BOJONEGORO	Ichi Ocha Melati PET 350ml	0	Unif (0.421,10.245)	Unif (9.839,74.828)	Unif (98.839,2023.546)
	Sun BC Susu Beras Merah Sachet	0	Unif (0.085,1.015)	Unif (1.019,3.9841)	Unif (4.214,11.285)
	SAPS-N/Sambal Pedas Sch 504 x 9 gr	0	Norm (0.167,0.119)	Norm (2.076,1.497)	
SP TUBAN	Susu Steril Indomilk Choco 190 ml	0	Unif (1.913,10.088)	Norm (25.046,16.392)	Unif (180.48,687.15)
	Snack Qtela BBQ 60g	0	Norm (0.291,0.228)	Norm (3.733,1.802)	
	ID-68 PEL KATUN KOTAK MEDIUM SET (12)	0	0.5	1	
SP PAMEKASAN	Krimer Kental Manis Kremer Plain 37g	0	Unif (0.302,9.79)	Unif (9.375,86.724)	Unif (58.375,342.63)
	Genki Moko Moko Pants L1	0	Norm (0.33646,0.19904)	Norm (3.045,2.425)	
	IKMT-N/Indofood Kecap Manis PET 275 ml	0	Norm (0.3,0.261)	Norm (1.562,0.437)	
SP PURWOREJO	Susu Steril Indomilk Choco 190 ml	0	Norm (25.492,22.359)	Norm (240.57,176.63)	
	Bukrim Oxyklin Romantic Floral 800	0	Norm (0.357,0.149)	Norm (4.682,4.002)	
	SUN BC SUSU BERAS MERAH KOTAK	0	Norm (0.727,0.330)	Norm (1.444,0.299)	
SP KRIAN	Susu Steril Indomilk Choco 190 ml	0	Norm (24.807,16.562)	Norm (265.78,168.2)	

Stock Point	Product Name	Q1			
		C1	C2	C3	C4
SP KENJERAN	MINYAK GORENG BIMOLI 5LT JRG	0	Norm (3.346,2.12)	Norm (14.846,6.135)	
	Bubur Bayi SUN BC Kacang Hijau Ekonomis	0	Norm (0.443,0.231)	Norm (2.164,1.722)	
	Ichi Ocha Melati PET 350ml	0	Unif (0.795,10.204)	Unif (8.666,76.333)	Unif (287,377)
	Bubur Bayi SUN BC Beras Merah Ekonomis	0	Norm (0.521,0.277)	Norm (2.899,1.719)	
	Susu UHT Indomilk Choco 190 ml	0	Norm (0.411,0.190)	Norm (1.490,0.670)	
SP BABAT	Krimer Kental Manis Kremer Plain 500g	0	Norm (2.6,2.2)	Norm (17.506,6.147)	
	GARAM MEJA REFINA REF500GR BAL	0	Norm (1.337,0.66)	Norm (6.455,3.729)	
	Susu UHT Indomilk Vanila 190 ml	0	Norm (0.378,0.16)	Norm (2.220,1.77)	
SP SIDOARJO	Kental Manis Indomilk Putih Sachet 37g	0	Norm (20.559,11.822)	Norm (74.06,14.036)	
	RNG/Bumbu Racik Nasi Goreng 200x20gr	0	Norm (21.333,12.712)	Norm (88.538,34.8)	
	ID-T57 BASIC - SABUT STAINLESS	0	Norm (0.214,0.169)	2.861	
SP WARU	Susu UHT Indomilk Kids Choco 115 ml	0	Norm (5.851,2.718)	Norm (23.582,9.676)	
	PSPS/PL SAMBAL PEDAS SCH 960 x 8 gr	0	Norm (0.315,0.218)	Norm (2.148,1.566)	
	Snack Chiki Ball CHO 10G	0	Norm (1.501,1.194)	Norm (17.292,10.99)	
SP BURNEH	Susu UHT Indomilk Kids Choco 115 ml	0	Norm (5.967,2.710)	Norm (17.663,9.927)	

Stock Point	Product Name	Q1			
		C1	C2	C3	C4
	Bubur Bayi SUN BC Beras Merah Ekonomis	0	Norm (0.513,0.254)	Norm (3.066,4.284)	
	Sun Marie Roll Kecil New	0	Norm (0.068,0.012)	Norm (0.4,0.658)	

4.10 Calculation of Inventory Parameter

In this subchapter, the of inventory parameter calculation for current method and improvement method is provided. Inventory parameter that taken into consideration is safety stock (SS), minimum stock (s), reorder level (ROL), and maximum stock (S). The first step taken is to calculate the average demand for last 13 weeks of the samples. The recapitulation of the data is provided on table 4.26

Table 4. 26 Average Demand per Day

ABC SP	Stock-point	ABC	Product	Total Demand last 13 Week	Average Demand (Day)
A	SP BOJONEGORO	A	Ichi Ocha Melati PET 350ml	10893	168
		B	Sun BC Susu Beras Merah Sachet	107	2
		C	SAPS-N/Sambal Pedas Sch 504 x 9 gr	24	0
	SP TUBAN	A	Susu Steril Indomilk Choco 190 ml	3377	52
		B	Snack Qtela BBQ 60g	103	2
		C	ID-68 PEL KATUN KOTAK MEDIUM SET (12)	5	0
	SP PAMEKASAN	A	Krimer Kental Manis Kremer Plain 37g	3435	53
		B	Genki Moko Moko Pants L1A	87	1

ABC SP	Stock-point	ABC	Product	Total Demand last 13 Week	Average Demand (Day)
		C	IKMT-N/Indofood Kecap Manis PET 275 ml	17	0
	SP PURWOREJO	A	Susu Steril Indomilk Choco 190 ml	5656	87
		B	Bukrim Oxyklin Romantic Floral 800	120	2
		C	SUN BC SUSU BERAS MERAH KOTAK	16	0
	SP KRIAN	A	Susu Steril Indomilk Choco 190 ml	4201	65
		B	MINYAK GORENG BIMOLI 5LT JRG	185	3
		C	Bubur Bayi SUN BC Kacang Hijau Ekonomis	59	1
B	SP KENJERAN	A	Ichi Ocha Melati PET 350ml	7172	110
		B	Bubur Bayi SUN BC Beras Merah Ekonomis	130	2
		C	Susu UHT Indomilk Choco 190 ml	42	1
	SP BABAT	A	Krimer Kental Manis Kremer Plain 500g	442	7
		B	GARAM MEJA REFINA REF500GR BAL	111	2

ABC SP	Stock-point	ABC	Product	Total Demand last 13 Week	Average Demand (Day)
		C	Susu UHT Indomilk Vanila 190 ml	38	1
	SP SIDOARJO	A	Kental Manis Indomilk Putih Sachet 37g	1259	19
		B	RNG/Bumbu Racik Nasi Goreng 200x20gr	1711	26
		C	ID-T57 BASIC - SABUT STAINLESS	10	0
C	SP WARU	A	Susu UHT Indomilk Kids Choco 115 ml	1290	20
		B	PSPS/PL SAMBAL PEDAS SCH 960 x 8 gr	117	2
		C	Snack Chiki Ball CHO 10G	71	1
	SP BURNEH	A	Susu UHT Indomilk Kids Choco 115 ml	1113	17
		B	Bubur Bayi SUN BC Beras Merah Ekonomis	69	1
		C	Sun Marie Roll Kecil New	9	0

4.10.1 Input Parameter for Current Method

The calculation of input parameter will be done by using current company method, which follows the formula that has been provided on sub-chapter 2.7, which are formula 2.6 – 2.10. The calculation result is provided on table 4.27 below.

Table 4. 27 Min-Max of Current Method

ABC SP	Stock-point	ABC	Product	LT	Min	ROL	Max
A	SP BOJONEGORO	A	Ichi Ocha Melati PET 350ml	3	335	503	838
		B	Sun BC Susu Beras Merah Sachet	3	8	5	13
		C	SAPS-N/Sambal Pedas Sch 504 x 9 gr	3	4	1	5
	SP TUBAN	A	Susu Steril Indomilk Choco 190 ml	3	104	156	260
		B	Snack Qtela BBQ 60g	3	8	5	13
		C	ID-68 PEL KATUN KOTAK MEDIUM SET (12)	3	1	0	1
	SP PAMEKASAN	A	Krimer Kental Manis Kremer Plain 37g	3	106	159	264
		B	Genki Moko Moko Pants L1A	3	7	4	11
		C	IKMT-N/Indofood Kecap Manis PET 275 ml	3	3	1	4

ABC SP	Stock-point	ABC	Product	LT	Min	ROL	Max
	SP PURWOREJO	A	Susu Steril Indomilk Choco 190 ml	3	174	261	435
		B	Bukrim Oxyklin Romantic Floral 800	3	9	6	15
		C	SUN BC SUSU BERAS MERAH KOTAK	3	2	1	3
	SP KRIAN	A	Susu Steril Indomilk Choco 190 ml	3	129	194	323
		B	MINYAK GORENG BIMOLI 5LT JRG	3	14	9	23
		C	Bubur Bayi SUN BC Kacang Hijau Ekonomis	3	9	3	12
B	SP KENJERAN	A	Ichi Ocha Melati PET 350ml	3	221	331	552
		B	Bubur Bayi SUN BC Beras Merah Ekonomis	3	10	6	16
		C	Susu UHT Indomilk Choco 190 ml	3	6	2	8
	SP BABAT	A	Krimer Kental Manis Kremer Plain 500g	5	14	34	48
		B	GARAM MEJA REFINA REF500GR BAL	5	9	9	18

ABC SP	Stock-point	ABC	Product	LT	Min	ROL	Max
		C	Susu UHT Indomilk Vanila 190 ml	5	6	3	9
	SP SIDOARJO	A	Kental Manis Indomilk Putih Sachet 37g	5	39	97	136
		B	RNG/Bumbu Racik Nasi Goreng 200x20gr	5	132	132	264
		C	ID-T57 BASIC - SABUT STAINLESS	5	2	1	3
C	SP WARU	A	Susu UHT Indomilk Kids Choco 115 ml	5	40	99	139
		B	PSPS/PL SAMBAL PEDAS SCH 960 x 8 gr	5	9	9	18
		C	Snack Chiki Ball CHO 10G	5	11	5	16
	SP BURNEH	A	Susu UHT Indomilk Kids Choco 115 ml	5	34	86	120
		B	Bubur Bayi SUN BC Beras Merah Ekonomis	5	5	5	10
		C	Sun Marie Roll Kecil New	5	1	1	2

4.10.2 Input Parameter for Improvement Method

The calculation of input parameter will be done by using improvement method, which follows the formula that has been provided on sub-chapter 2.7,

which are formula 2.11 – 2.16. The calculation result is provided on table 4.28-4.29 below.

Table 4. 28 LT, St. Dev Demand, and SS of Improvement Method

ABC SP	Stock-point	ABC	Product	LT	St. Dev Demand	SS
A	SP BOJONEGORO	A	Ichi Ocha Melati PET 350ml	1	510.48	292.57
		B	Sun BC Susu Beras Merah Sachet	1	3.44	1.97
		C	SAPS-N/Sambal Pedas Sch 504 x 9 gr	1	2.08	1.19
	SP TUBAN	A	Susu Steril Indomilk Choco 190 ml	1	102.77	58.90
		B	Snack Qtela BBQ 60g	1	2.72	1.56
		C	ID-68 PEL KATUN KOTAK MEDIUM SET (12)	1	0.32	0.18
	SP PAMEKASAN	A	Krimer Kental Manis Kremer Plain 37g	1	126.49	72.49
		B	Genki Moko Moko Pants L1A	1	1.62	0.93
		C	IKMT-N/Indofood Kecap Manis PET 275 ml	1	0.47	0.27
	SP PURWOREJO	A	Susu Steril Indomilk Choco 190 ml	1	127.30	72.96
		B	Bukrim Oxyklin Romantic Floral 800	1	3.71	2.13
		C	SUN BC SUSU BERAS MERAH KOTAK	1	0.44	0.25
	SP KRIAN	A	Susu Steril Indomilk Choco 190 ml	1	108.35	62.10

ABC SP	Stock-point	ABC	Product	LT	St. Dev Demand	SS
		B	MINYAK GORENG BIMOLI 5LT JRG	1	3.78	2.17
		C	Bubur Bayi SUN BC Kacang Hijau Ekonomis	1	1.55	0.89
B	SP KENJERAN	A	Ichi Ocha Melati PET 350ml	2	410.26	332.52
		B	Bubur Bayi SUN BC Beras Merah Ekonomis	2	1.89	1.53
		C	Susu UHT Indomilk Choco 190 ml	2	1.01	0.82
	SP BABAT	A	Krimer Kental Manis Kremer Plain 500g	2	11.32	9.18
		B	GARAM MEJA REFINA REF500GR BAL	2	2.85	2.31
		C	Susu UHT Indomilk Vanila 190 ml	2	1.66	1.34
	SP SIDOARJO	A	Kental Manis Indomilk Putih Sachet 37g	2	18.34	14.87
		B	RNG/Bumbu Racik Nasi Goreng 200x20gr	2	31.60	25.61
		C	ID-T57 BASIC - SABUT STAINLESS	2	0.40	0.33
C	SP WARU	A	Susu UHT Indomilk Kids Choco 115 ml	2	15.50	12.56
		B	PSPS/PL SAMBAL PEDAS SCH 960 x 8 gr	2	2.75	2.23

ABC SP	Stock-point	ABC	Product	LT	St. Dev Demand	SS
		C	Snack Chiki Ball CHO 10G	2	2.20	1.78
	SP BURNEH	A	Susu UHT Indomilk Kids Choco 115 ml	3	12.81	12.72
		B	Bubur Bayi SUN BC Beras Merah Ekonomis	3	0.97	0.97
		C	Sun Marie Roll Kecil New	3	0.16	0.16

Table 4. 29 Min-Max of Improvement Method

ABC SP	Stock-point	ABC	Product	ROL	Q	Max
A	SP BOJONEGORO	A	Ichi Ocha Melati PET 350ml	628	167	795
		B	Sun BC Susu Beras Merah Sachet	10	2	12
		C	SAPS-N/Sambal Pedas Sch 504 x 9 gr	5	1	6
	SP TUBAN	A	Susu Steril Indomilk Choco 190 ml	163	52	215
		B	Snack Qtela BBQ 60g	9	2	11
		C	ID-68 PEL KATUN KOTAK MEDIUM SET (12)	1	1	2
	SP PAMEKASAN	A	Krimer Kental Manis Kremer Plain 37g	178	53	231
		B	Genki Moko Moko Pants L1A	8	1	9
		C	IKMT-N/Indofood Kecap Manis PET 275 ml	3	1	4

ABC SP	Stock-point	ABC	Product	ROL	Q	Max
	SP PURWOREJO	A	Susu Steril Indomilk Choco 190 ml	247	87	334
		B	Bukrim Oxyklin Romantic Floral 800	11	2	13
		C	SUN BC SUSU BERAS MERAH KOTAK	3	1	4
	SP KRIAN	A	Susu Steril Indomilk Choco 190 ml	191	65	256
		B	MINYAK GORENG BIMOLI 5LT JRG	16	3	19
		C	Bubur Bayi SUN BC Kacang Hijau Ekonomis	10	1	11
B	SP KENJERAN	A	Ichi Ocha Melati PET 350ml	553	221	774
		B	Bubur Bayi SUN BC Beras Merah Ekonomis	12	4	16
		C	Susu UHT Indomilk Choco 190 ml	7	1	8
	SP BABAT	A	Krimer Kental Manis Kremer Plain 500g	23	14	36
		B	GARAM MEJA REFINA REF500GR BAL	11	3	14
		C	Susu UHT Indomilk Vanila 190 ml	7	1	8
	SP SIDOARJO	A	Kental Manis Indomilk Putih Sachet 37g	54	39	92

ABC SP	Stock-point	ABC	Product	ROL	Q	Max
		B	RNG/Bumbu Racik Nasi Goreng 200x20gr	157	53	210
		C	ID-T57 BASIC - SABUT STAINLESS	2	1	3
C	SP WARU	A	Susu UHT Indomilk Kids Choco 115 ml	52	40	92
		B	PSPS/PL SAMBAL PEDAS SCH 960 x 8 gr	11	4	15
		C	Snack Chiki Ball CHO 10G	13	2	15
	SP BURNEH	A	Susu UHT Indomilk Kids Choco 115 ml	47	51	98
		B	Bubur Bayi SUN BC Beras Merah Ekonomis	6	3	9
		C	Sun Marie Roll Kecil New	2	1	3

4.10 Inventory Simulation

This subchapter will provide the explanation of the inventory simulation by using Monte Carlo Simulation. There are 2 condition that will be simulated. Which are current company method and improvement method condition that implement continuous review system (s, S).

4.10.1 Inventory Simulation for Current Method

We conduct inventory simulation for current method for 1 year with the total of 280 period (based on company working day). There are some elements of the simulation. They are:

1. Min

Minimum value for first cycle will be the initial input that provided on previous subchapter. Minimum value will be evaluated for every cycle (65

days). Minimum coefficient is based on the categorization of the product. A class is 2, B is 5, and C is 10. Based on the Minimum value for the first day (period) of each cycle will be calculated by using this formula:

$$Minimum\ Inventory =$$
$$Average\ Demand\ from\ previous\ cycle\ x\ Min.\ Coefficient \qquad (4.5)$$

2. Order Size (Q)

Order size will be based on the lead time for each stock point. The lead time of each stock point will be based on the contribution of the stock point. The lead time of each stock point will be following the equation 2.10. Q for 1st cycle will be using the initial input that has been provided on previous subchapter, and will be evaluated on the 1st day for each cycle. Here is the formula of the order size:

$$Q = Average\ Demand\ from\ previous\ cycle\ x\ Lead\ Time \qquad (4.6)$$

3. Max

Max value will be calculated by adding minimum and order size for each cycle, thus every cycle there will be changed. Here is the formula used to calculate max value:

$$Maximum\ Inventory = Minimum\ Inventory + Q \qquad (4.7)$$

4. Initial Inventory

Initial inventory on 1st period) assumed as the minimum inventory level that obtained by using formula for current method. Then, for the next period, the initial inventory will be the same as ending inventory of the previous period.

$$Initial\ Inventory_{(t=1)} = Max.\ inventory\ of\ current\ method \qquad (4.8)$$
$$Initial\ Inventory_{(t)} = Ending\ Inventory_{(t-1)} \qquad (4.9)$$

5. Order Received

Order received on the first period is assumed as 0, then on the next period will be depends on the current method of the company. The procurement team will be order product to the maximum stock. Number of products ordered will be closely relate to the product arrival period. We use *countif* function in excel so the product arrived can be added to the related period.

$$Order\ Recieved_{(t)} = Number\ of\ order\ arrived\ on\ (t) \qquad (4.10)$$

6. Available Inventory

Available inventory is the addition of initial inventory and order received. Number of available inventories will be used as demand fulfilling activity of the simulation.

$$Available\ Inventory_{(t)}$$
$$= Initial\ Inventory_{(t)} + Order\ Recieved_{(t)} \qquad (4.11)$$

7. Demand

Demand is obtained from the random number generation that follows the real distribution pattern of each product. This research used @Risk for Excel to generate random number that provided on the table 4.23.

8. Demand Fulfilled

Number of demands fulfilled for a period will be depend on the number of available inventory and demand for that period. If available inventory > demand, then all the demand will be fulfilled. Yet available inventory < demand, then demand fulfilled = available inventory. It can be concluded that number of demands fulfilled is the minimum value between available inventory and demand on that period.

$$Demand\ Fulfilled_{(t)} = Min\ (Avail.Inventory_{(t)},\ Demand_{(t)}) \quad (4.12)$$

9. Ending Inventory

Ending inventory obtained from the subtraction of available inventory and fulfilled demand. Ending inventory of this period will be the initial inventory for the next period. Ending inventory is calculated at the end of the period. Every product that has ending inventory, will have holding cost, depends on the number of ending inventory.

$$Ending\ Inventory_{(t)}$$
$$= Available\ Inventory_{(t)} - Demand\ Fulfilled_{(t)} \qquad (4.13)$$

10. Stockout

Stockout happens when the company cannot fulfill all the demand of certain period. If demand > demand fulfilled, the number of stockout will be the subtraction of demand and demand fulfilled. Stockout will signify value of

service level achieved by the company. Accumulation of stockout for simulation will be the parameter for decision making.

$$Stockout_{(t)} = Demand_{(t)} - Demand\ Fulfilled_{(t)} \qquad (4.14)$$

11. Order Decision

    Order decision will depend on the ending inventory level. If the number of ending inventory < ROP level, then order will be made. Notation that used for order decision is 1 if order is made for the period, and 0 if no order made for the period.

12. Lead Time

    Lead time of the product will depend on the categorization of the stock-point and the product. The data of lead time for each product is provided on table 4.25.

13. Product Arrival Period

    Product arrival period will depend on whether there is order made on that period or not. It also depending on the lead time of each product. If order decision is 1, then product arrival period will be that period + lead time.

    $$Product\ Arrival\ Period_{(t)} = Period_{(t)} - Lead\ Time_{(t)} \qquad (4.15)$$

14. Purchasing Cost

    Purchasing cost will be calculated by the amount of product that arrived on the period times the unit cost of the product.

    $$Purchasing\ Cost_{(t)} = Order\ Received_{(t)}\ x\ Unit\ Cost \qquad (4.16)$$

15. Holding Cost

    Holding cost is the cost that incurred from inventory holding activity. Value of holding cost for each product will be number of ending inventory for each period times the holding cost per period for the product.

    $$Holding\ Cost_{(t)}$$
    $$= Ending\ Inventory_{(t)}\ x\ Holding\ Cost\ (/unit/month) \qquad (4.17)$$

16. Ordering Cost

    Ordering cost is the cost that incurred from the ordering activity. The value of ordering cost will be different from one product to another, and will be calculated per unit of product. It is assumed that ordering cost will be incurred when the product arrived on the stock point.

$$Ordering\ Cost_{(t)} = Order\ Recieved_{(t)}\ x\ Order\ Cost\ (/unit) \qquad (4.18)$$

17. Total Cost

Total cost for each period will be the accumulation of all cost that incurred on that period.

$$Total\ Cost_{(t)} = Purchasing\ Cost_{(t)} + Holding\ Cost_{(t)}$$
$$+Ordering\ Cost_{(t)} \qquad (4.19)$$

18. Service Level

Service level will highly depend on the order fulfillment and stockout. The higher number of stockout occur, the lower service level will be achieved. Service level will be one of the parameters for decision taking.

$$Service\ Level_{(t)} = \frac{Number\ of\ Order\ Fulfilled_{(t)}}{Demand_{(t)}} x100\% \qquad (4.20)$$

Based on the simulation scheme, parameter used to measure the performance and evaluation is ending inventory, stockout, total cost, and service level as the base of decision making for each product inventory policy. We are running simulation for several times in order to get appropriate results. The simulation will be done by using Monte Carlo simulation method with @RISK for excel software. For initial testing, we use 500 iterations and 100 replications. In order to know the appropriate number of iterations and replications, we conduct an error testing by using formula … The calculation will be using α value of 5% error tolerance, with 95% confidence, with initial n = 100 replications. By using those α and n value, then the value of t-table is 1.984. We provide the data output for the simulation of product *SUN BC SUSU BERAS MERAH KOTAK* that belongs to Purworejo stock-point. In order to calculate the number of appropriate replications, we calculate the value of halfwidth (hw) by using unused inventory as the parameter. It is known that the average value of unused inventory from 100 replication simulation is 3.291 and standard deviation is 0.017491.

$$hw = 1.984\ x\ \sqrt{\frac{0.017491^2}{100}} = 0.003471$$

From the calculation, it is known that the value of hw 0.003471 or around 0.1055% of the average of unused inventory. By having those error value, it is concluded that the number of replications is sufficient. In order to test the validity

of the simulation model, we conduct t-test for product *SUN BC SUSU BERAS MERAH KOTAK* of Purworejo stock-point. The recapitulation of existing condition and simulation results is provided on table 4.30 below

Table 4. 30 Comparison of Real System and Simulation Result Data for product SUN BC SUSU BERAS MERAH of SP Purworejo

No	Real System	No	Simulation Result
1	4	1	4
2	4	2	4
3	4	3	3
4	4	4	3
5	4	5	3
6	4	6	4
7	4	7	4
8	4	8	2
9	2	9	2
10	2	10	3
…		…	
150	4	100	4

Then, we conduct t-test by using data analysis of Microsoft Excel software. The t-test result is provided on figure 4.7. The result shows that t table < t stat < t table, which means that simulation result is acceptable. It is concluded that there are no differences between real system and simulation system. After calculating error value and conducting t-test, next we conduct inventory simulation for 260 days for 30 product samples that has been chosen.

	Variable 1	Variable 2
Mean	3.291112748	3.387326667
Variance	0.000305956	0.686244463
Observations	100	150
Pooled Variance	0.412422236	
Hypothesized Mean Difference	0	
df	248	
t Stat	-1.160492908	
P(T<=t) one-tail	0.123482039	
t Critical one-tail	1.651021013	
P(T<=t) two-tail	0.246964078	
t Critical two-tail	1.969575654	

Figure 4. 6 t-test Result

After the simulation model has been validated, next we do the simulation for current company method. Simulation conducted with @RISK for Excel application. The simulation model preview will be provided on table 4.31 and the examples for simulation result graph for product Ichi Ocha 350 ml of SP Bojonegoro will be provided on figure 4.7 - 4.8.
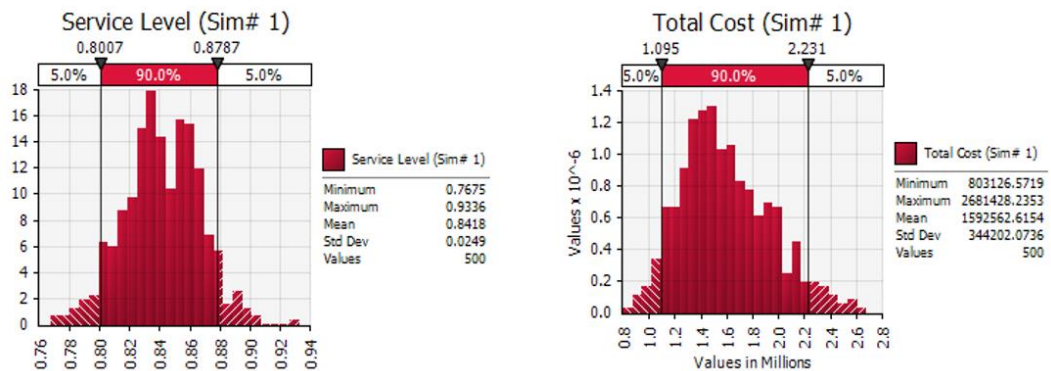
Figure 4. 7 Service Level and Total Cost Results for 1st Replication of product Ichi Ocha 350 ml on SP Bojonegoro
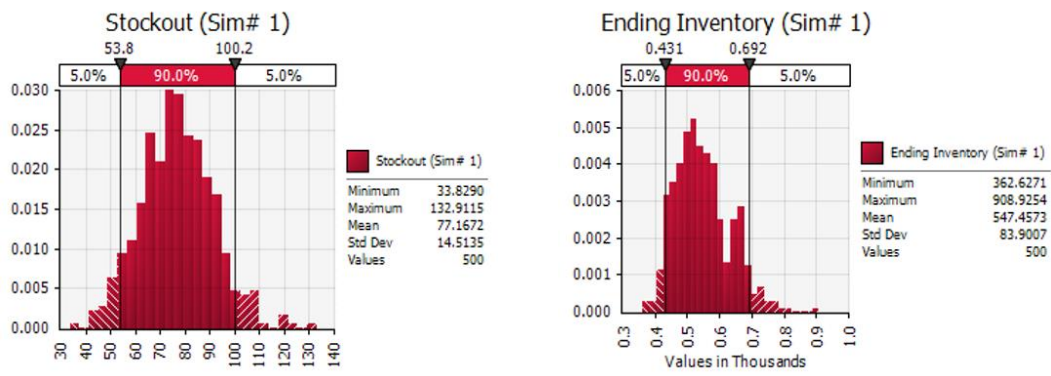
Figure 4. 8 Stockout and Ending Inventory Results for 1st Replication of product Ichi Ocha 350 ml on SP Bojonegoro

Table 4. 31 Existing Simulation Model Preview for Ichi Ocha 350 ml on SP Bojonegoro

Period	Initial Inventory	Order Received	Available Inventory	Demand	Demand Fulfilled	Ending Inventory	Stockout`	Order Decision	Arrival Period
1	838	0	838	22	22	816	0	0	0
2	816	0	816	0	0	816	0	0	0
3	816	0	816	22	22	794	0	0	0
4	794	0	794	628	628	166	0	1	7
5	166	0	166	1	1	165	0	1	8
6	165	0	165	16	16	149	0	0	0
7	149	672	820	40	40	780	0	0	0
8	780	673	1453	20	20	1433	0	0	0
9	1433	0	1433	29	29	1404	0	0	0
10	1404	0	1404	1440	1404	0	36	1	13
11	0	0	0	29	0	0	29	0	0
12	0	0	0	4	0	0	4	0	0
13	0	838	838	1460	838	0	622	0	0
14	0	0	0	23	0	0	23	1	17
15	0	0	0	33	0	0	33	0	0
16	0	0	0	0	0	0	0	0	0
17	0	838	838	35	35	803	0	0	0
18	803	0	803	1015	803	0	212	1	21
19	0	0	0	60	0	0	60	0	0
20	0	0	0	0	0	0	0	0	0
…	…	…	…	…	…	…		…	…
260	14	0	14	0	0	14	0	0	0
						511.368	69.7754658		

Table 4.31 Simulation Model Preview for Ichi Ocha 350 ml on SP Bojonegoro (Cont.)

Period	Purchasing Cost (Rp.)	Holding Cost (Rp.)	Order Cost (Rp.)	Total Cost (Rp.)	Service Level
1	-	20,877.08	-	20,877.08	1
2	-	20,877.08	-	20,877.08	1
3	-	20,325.22	-	20,325.22	1
4	-	4,261.17	-	4,261.17	1
5	-	4,227.15	-	4,227.15	1
6	-	3,807.24	-	3,807.24	1
7	13,916,938.15	19,961.47	139,278.70	14,076,178.33	1
8	13,944,485.77	36,670.66	139,278.70	14,120,435.13	1
9	-	35,927.93	-	35,927.93	1
10	-	-	-	-	0.975
11	-	-	-	-	0
12	-	-	-	-	0
13	17,366,712.00	-	139,278.70	17,505,990.70	0.574
14	-	-	-	-	0
15	-	-	-	-	0
16	-	-	-	-	1
17	17,366,712.00	20,552.34	139,278.70	17,526,543.04	1
18	-	-	-	-	0.791
19	-	-	-	-	0
20	-	-	-	-	1
…	…	…	…	…	…
260	-	369.73	-	369.73	1
				1,693,275.89	**85%**

The recapitulation of simulation results for all product sample is provided on table 4.32.

Table 4. 32 Recapitulation of Simulation Results for All Product Sample

Stock Point	Product Class	Product Name	Ending Inventory	Stockout	Total Cost	Service Level
SP BOJONEGORO	A	Ichi Ocha Melati PET 350ml	549	77.535	1,598,217.48	84.20%
	B	Sun BC Susu Beras Merah Sachet	10	0.042	131,544.82	98.56%
	C	SAPS-N/Sambal Pedas Sch 504 x 9 gr	5	0.048	36,779.20	98.84%
SP TUBAN	A	Susu Steril Indomilk Choco 190 ml	175	17.864	2,121,913.29	86.09%
	B	Snack Qtela BBQ 60g	6	0.128	55,273.75	96.39%
	C	ID-68 PEL KATUN KOTAK MEDIUM SET (12)	14	0.971	222,280.71	96.24%
SP PAMEKASAN	A	Krimer Kental Manis Kremer Plain 37g	126	6.361	2,150,598.52	91.78%
	B	Genki Moko Moko Pants L1	9	0.060	218,649.73	98.19%

Stock Point	Product Class	Product Name	Ending Inventory	Stockout	Total Cost	Service Level
	C	IKMT-N/Indofood Kecap Manis PET 275 ml	3	0.014	50,571.62	98.90%
SP PURWOREJO	A	Susu Steril Indomilk Choco 190 ml	262	19.987	3,165,261.44	87.94%
	B	Bukrim Oxyklin Romantic Floral 800	9	0.187	85,729.80	97.22%
	C	SUN BC SUSU BERAS MERAH KOTAK	3	0.004	49,740.34	99.65%
SP KRIAN	A	Susu Steril Indomilk Choco 190 ml	243	23.020	3,429,966.21	85.56%
	B	MINYAK GORENG BIMOLI 5LT JRG	194	15.889	4,771,574.47	85.24%
	C	Bubur Bayi SUN BC Kacang Hijau Ekonomis	11	0.006	122,821.94	99.78%
SP KENJERAN	A	Ichi Ocha Melati PET 350ml	217	10.116	376,654.25	92.85%

Stock Point	Product Class	Product Name	Ending Inventory	Stockout	Total Cost	Service Level
	B	Bubur Bayi SUN BC Beras Merah Ekonomis	12	0.016	232,871.78	99.57%
	C	Susu UHT Indomilk Choco 190 ml	8	0.002	78,903.38	99.94%
SP BABAT	A	Krimer Kental Manis Kremer Plain 500g	25	1.067	1,341,340.32	87.01%
	B	GARAM MEJA REFINA REF500GR BAL	15	0.265	185,250.95	94.97%
	C	Susu UHT Indomilk Vanila 190 ml	20	0.888	40,383.76	94.74%
SP SIDOARJO	A	Kental Manis Indomilk Putih Sachet 37g	91	7.740	1,862,387.40	83.57%
	B	RNG/Bumbu Racik Nasi Goreng 200x20gr	181	2.077	5,415,159.84	95.38%
	C	ID-T57 BASIC - SABUT STAINLESS	2	0.012	31,509.78	98.63%

Stock Point	Product Class	Product Name	Ending Inventory	Stockout	Total Cost	Service Level
SP WARU	A	Susu UHT Indomilk Kids Choco 115 ml	86	3.997	1,175,091.07	83.46%
	B	PSPS/PL SAMBAL PEDAS SCH 960 x 8 gr	9	0.047	122,562.16	97.85%
	C	Snack Chiki Ball CHO 10G	14	0.090	26,283.52	98.83%
SP BURNEH	A	Susu UHT Indomilk Kids Choco 115 ml	68	2.865	839,024.57	84.82%
	B	Bubur Bayi SUN BC Beras Merah Ekonomis	11	0.188	158,865.09	94.25%
	C	Sun Marie Roll Kecil New	2	0.011	41,571.48	98.88%

4.10.2 Inventory Simulation for Improvement Method

In the improvement method, there are several elements that different formula compared to the current method. The lead time of each category of stock point will be following the real lead time as shown on formula 2.15. There are differences in the calculation of minimum value which use safety stock equation (ss) and reorder level (ROL) as the elements of minimum value. Here are the elements that have different formula compared to the current method simulation:

1. Safety Stock (SS)

   Safety stock is the extra stock that maintained by the company to mitigate risk of stockouts caused by uncertainties of supply and demand. Safety stock will be evaluated for every cycle on the first period. The calculation of safety stock in the improvement method will be following this formula:

   $$SS = \text{Z-value of SL Target} \times \sqrt{LT} \qquad (4.21)$$

2. Reorder Level (ROL)

   Reorder level is the inventory level at which company would place a new order. The reorder level for improvement method will follows the classification of the products, and will be following the minimum coefficient that used on the minimum value on the current method. Reorder level will be evaluated on the start of every cycle. Here is the formula of reorder level:

   $$ROL = Avg. Demand\ from\ previous\ cycle\ x\ Min. Coefficient \quad (4.22)$$

3. Order Quantity (Q)

   Order quantity for improvement method will be based on the lead time, which got from the schedule of delivery for each stock points. Different with the current method, improvement method used real lead time – with no adjustment. Differences between lead time for each stock point is provided on formula 2.15. The formula used to calculate order quantity for improvement method is identical with the current method (formula 4.6).

   For improvement method, the service level target is set on 90%, which have z-value of 1.28152. Here is the example of preview of simulation for improvement method for product Ichi Ocha Melati 350 ml on SP Bojonegoro.

Table 4. 33 Improvement Simulation Model Preview for product Ichi Ocha Melati 350 ml on SP Bojonegoro

Period	Initial Inventory	Order Received	Available Inventory	Demand	Demand Fulfilled	Ending Inventory	Stockout`	Order Decision	Arrival Period
1	795	0	795	61	61	734	0	0	0
2	734	0	734	531	531	203	0	1	3
3	203	592	795	0	0	795	0	0	0
4	795	0	795	1	1	794	0	0	0
5	794	0	794	0	0	794	0	0	0
6	794	0	794	0	0	794	0	0	0
7	794	0	794	36	36	758	0	0	0
8	758	0	758	48	48	711	0	0	0
9	711	0	711	48	48	662	0	0	0
10	662	0	662	12	12	651	0	0	0
11	651	0	651	64	64	586	0	1	12
12	586	209	795	10	10	785	0	0	0
13	785	0	785	68	68	717	0	0	0
14	717	0	717	19	19	698	0	0	0
15	698	0	698	0	0	698	0	0	0
16	698	0	698	0	0	698	0	0	0
17	698	0	698	0	0	698	0	0	0
18	698	0	698	0	0	698	0	0	0
19	698	0	698	0	0	698	0	0	0
20	698	0	698	53	53	645	0	0	0
…	…	…	…	…	…	…		…	…
260	1913	821	2735	919	919	1816	0	1	261
						1326.29	21.98		

Table 4.33 Improvement Simulation Model Preview for product Ichi OchaMelati 350 ml on SP Bojonegoro (Cont.)

Period	Purchasing Cost (Rp.)	Holding Cost (Rp.)	Order Cost (Rp.)	Total Cost (Rp.)	Service Level
1	-	18,800.05	-	18,800.05	1
2	-	5,200.43	-	5,200.43	1
3	2,265,399.01	20,350.70	139,278.70	12,425,028.42	1
4	-	20,336.74	-	20,336.74	1
5	-	20,336.74	-	20,336.74	1
6	-	20,336.74	-	20,336.74	1
7	-	19,415.04	-	19,415.04	1
8	-	18,191.43	-	18,191.43	1
9	-	16,957.58	-	16,957.58	1
10	-	16,655.21	-	16,655.21	1
11	-	15,010.68	-	15,010.68	1
12	4,323,189.39	20,105.73	139,278.70	4,482,573.83	1
13	-	18,358.29	-	18,358.29	1
14	-	17,861.77	-	17,861.77	1
15	-	17,861.77	-	17,861.77	1
16	-	17,861.77	-	17,861.77	1
17	-	17,861.77	-	17,861.77	1
18	-	17,861.77	-	17,861.77	1
19	-	17,861.77	-	17,861.77	1
20	-	16,517.36	-	16,517.36	1
…	…	…	…	…	…
260	-	76,994.16	-	76,994.16	1
				3947887.79	**99%**

The simulation is conducted by using @Risk for Excel application with 100 replications and 5000 iterations. On Figure 4.10 and 4.11 shown the example of output for simulation for product Ichi Ocha 350 ml on Bojonegoro stock-point for 1st replication.
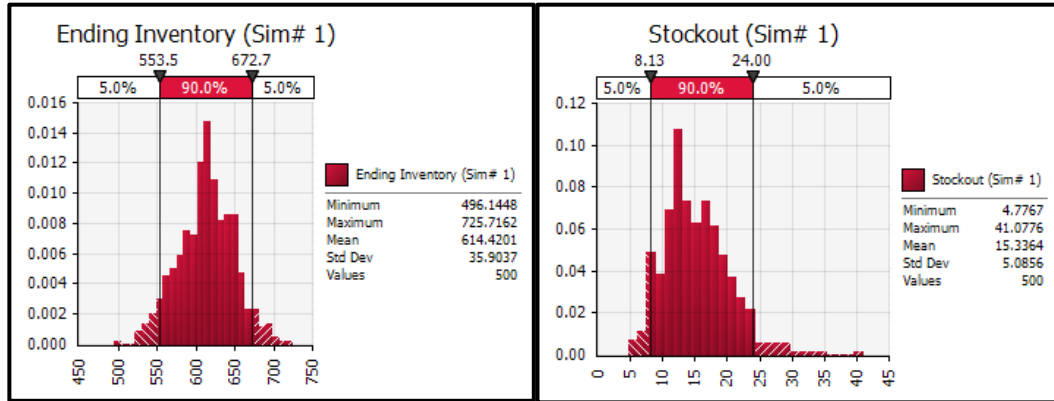
Figure 4. 9 Ending Inventory and Stockout Output of Improvement Method for Ichi Ocha 350 ml on Bojonegoro Stock point (Replication 1)
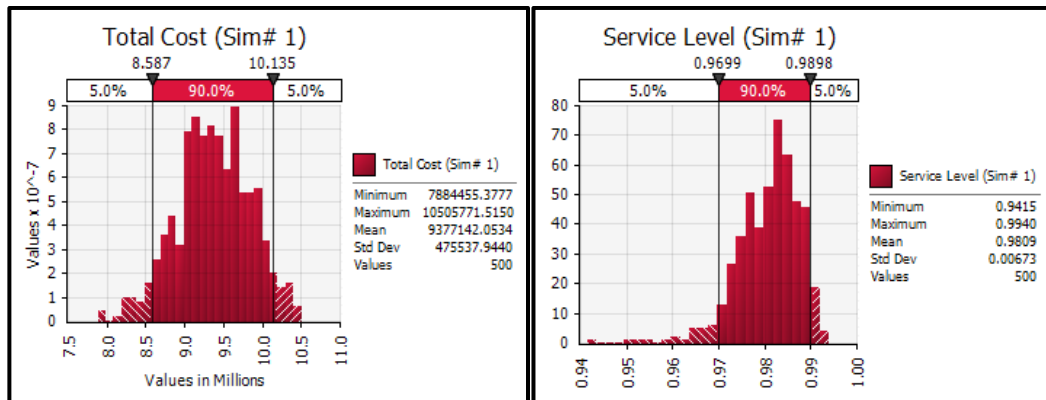
Figure 4. 10 Total Cost and Service Level Output of Improvement Method for Ichi Ocha 350 ml on Bojonegoro Stock point (Replication 1)

The recapitulation of simulation output for improvement method is provided on table 4.34 on the next page.

Table 4. 34 Recapitulation of Improvement Simulation Output

Stock Point	Product Class	Product Name	Ending Inventory	Stockout	Total Cost	Service Level
SP BOJONEGORO	A	Ichi Ocha Melati PET 350ml	783	55.465	2,548,232.73	95.90%
	B	Sun BC Susu Beras Merah Sachet	10	0.004	194,979.26	99.96%
	C	SAPS-N/Sambal Pedas Sch 504 x 9 gr	6	0.019	42,283.73	99.73%
SP TUBAN	A	Susu Steril Indomilk Choco 190 ml	204	11.576	2,508,929.11	97.24%
	B	Snack Qtela BBQ 60g	6	0.046	72,186.04	99.22%
	C	ID-68 PEL KATUN KOTAK MEDIUM SET (12)	18	1.047	279,025.65	96.67%
SP PAMEKASAN	A	Krimer Kental Manis Kremer Plain 37g	123	3.235	2,464,505.43	98.38%
	B	Genki Moko Moko Pants L1	9	0.005	253,433.27	99.92%
	C	IKMT-N/Indofood Kecap Manis PET 275 ml	3	0.004	55,564.91	99.84%

Stock Point	Product Class	Product Name	Ending Inventory	Stockout	Total Cost	Service Level
SP PURWOREJO	A	Susu Steril Indomilk Choco 190 ml	270	10.244	3,807,360.57	97.56%
	B	Bukrim Oxyklin Romantic Floral 800	10	0.067	106,448.62	99.37%
	C	SUN BC SUSU BERAS MERAH KOTAK	4	0.000	53,886.43	100.00%
SP KRIAN	A	Susu Steril Indomilk Choco 190 ml	259	12.523	4,119,891.42	96.89%
	B	MINYAK GORENG BIMOLI 5LT JRG	219	13.184	5,442,747.62	90.51%
	C	Bubur Bayi SUN BC Kacang Hijau Ekonomis	11	0.000	149,311.52	100.00%
SP KENJERAN	A	Ichi Ocha Melati PET 350ml	319	7.074	465,319.24	96.72%
	B	Bubur Bayi SUN BC Beras Merah Ekonomis	12	0.001	267,430.18	99.99%
	C	Susu UHT Indomilk Choco 190 ml	9	0.000	105,492.10	100.00%

Stock Point	Product Class	Product Name	Ending Inventory	Stockout	Total Cost	Service Level
SP BABAT	A	Krimer Kental Manis Kremer Plain 500g	21	0.372	1,645,841.55	97.46%
	B	GARAM MEJA REFINA REF500GR BAL	14	0.077	233,993.81	99.05%
	C	Susu UHT Indomilk Vanila 190 ml	19	0.821	49,877.92	96.09%
SP SIDOARJO	A	Kental Manis Indomilk Putih Sachet 37g	74	3.704	2,333,368.53	94.94%
	B	RNG/Bumbu Racik Nasi Goreng 200x20gr	162	0.236	5,895,422.46	99.74%
	C	ID-T57 BASIC - SABUT STAINLESS	2	0.009	35,603.57	99.46%
SP WARU	A	Susu UHT Indomilk Kids Choco 115 ml	46	0.311	1,483,648.46	99.11%
	B	PSPS/PL SAMBAL PEDAS SCH 960 x 8 gr	9	0.002	154,090.59	99.93%

Stock Point	Product Class	Product Name	Ending Inventory	Stockout	Total Cost	Service Level
	C	Snack Chiki Ball CHO 10G	15	0.071	35,697.63	99.54%
SP BURNEH	A	Susu UHT Indomilk Kids Choco 115 ml	44	0.702	1,035,963.45	97.18%
	B	Bubur Bayi SUN BC Beras Merah Ekonomis	11	0.132	196,451.49	97.03%
	C	Sun Marie Roll Kecil New	3	0.002	52,256.91	99.85%

4.10.3 Comparison of Current and Improvement Method Simulation Output

There are 4 parameter that used as the factor of decision making for the company. Those parameters are unused inventory, stockout number, total cost, and service level. On the figure 4.11 is shown the output parameter comparison between current company method and improvement method regarding the unused inventory, with the horizontal line as the product number (refer to table 4.XX). Product 1, Ichi Ocha Melati 350 ml from SP Bojonegoro has the highest ending inventory on both current method and improvement method, with the average of 644.60 carton on current method and 782.83 carton on improvement method. Ichi Ocha Melati 350 ml from SP Bojonegoro also has the highest ending inventory changes, with the escalation of 138.24 carton between current method and improvement method. In the other hand, there are 16 product that has lower average ending inventory on improvement method compared to current method, and product that has highest reduction is Product 25, Susu UHT Indomilk Kids Choco 115 ml from SP Kenjeran with the reduction of 40.33 carton, from 86.42 carton to 46.09 carton.
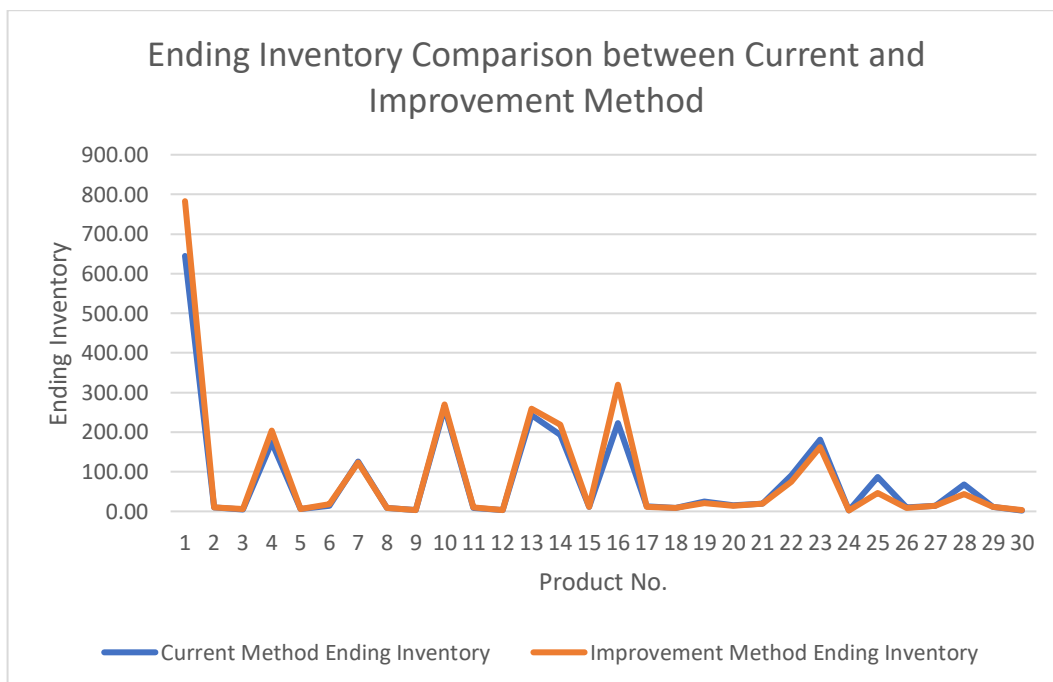
Figure 4. 11 Ending Inventory Comparison between Current and Improvement Method

The next output indicator is stockout. Product that has highest number of stockout is product 1, Ichi Ocha Melati PET 350 ml from SP Bojonegoro, with current method stockout is 84.57 carton and improvement method stockout is 54.465 carton. The highest reduction also comes from that product with the reduction of 28.793 cartons of stockout number. The lowest number of stockout come from product 25, Susu UHT Indomilk Choco 190 ml from SP Kenjeran with 0.002 on current method and 0.00007 on improvement method. There is 1 product that has increasing number of stockout on improvement method, which is product 6, ID-68 PEL KATON KOTAK MEDIUM SET from SP Tuban with the increase of 0.075 carton, from 0.971 to 1.047 carton. On the figure 4.12 is shown the comparison between method on stock point output.
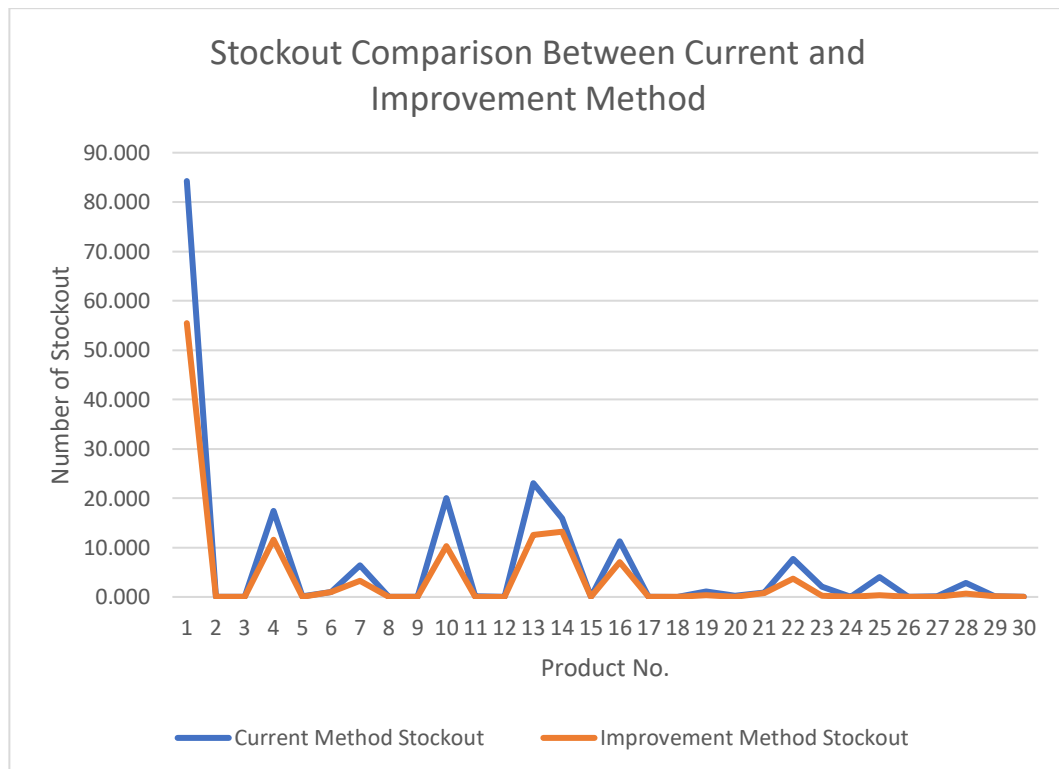
Figure 4. 12 Stockout Comparison between Current and Improvement Method

The improvement method has offer higher service level in general, with the highest service level achieved by a product is 100%, which is product 18, Susu UHT Indomilk Choco 190 ml with the increase of 0.06% of service level. The lowest service level of the simulation of current method is comes from product 18,

Susu UHT Indomilk Kids Choco 115 ml, with 83.46% service level, which also have the highest increase with 15.65% increase of service level, that escalate the service level to 99.11% on the improvement method. The lowest service level for improvement method comes from product 14, MINYAK GORENG BIMOLI 5LT JRG with 90.51%. Figure 4.13 shown the comparison of service level between current method and improvement method.
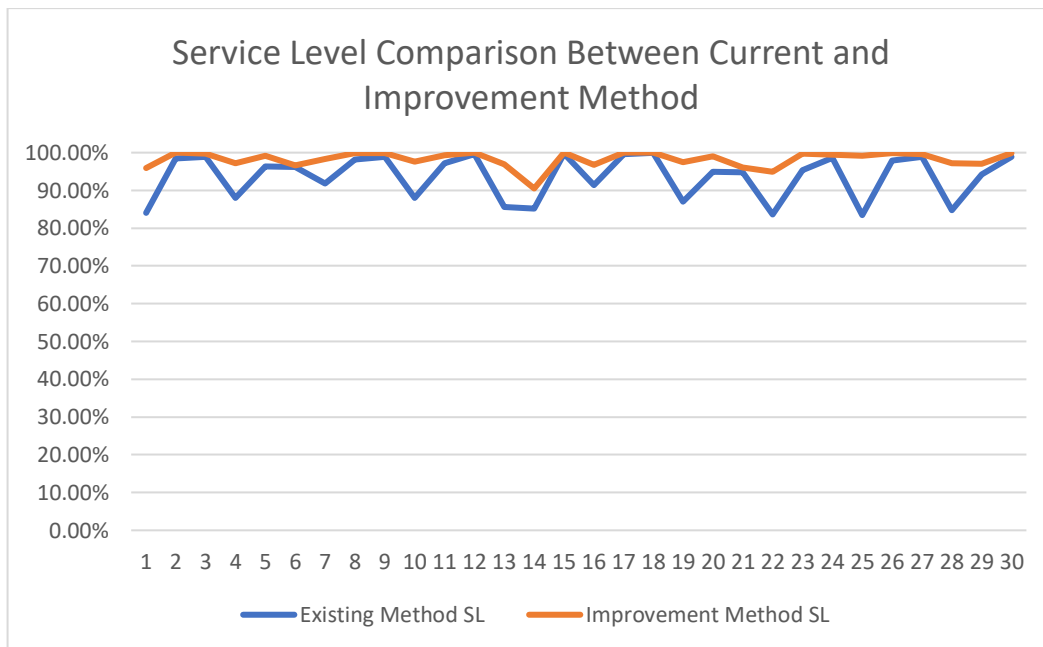
Figure 4. 13 Service Level Comparison between Current and Improvement Method

The increasing number of service level is causing an increase on total cost of the product. Highest total cost for both methods is come from product 23, RNG/Bumbu Racik Nasi Goreng 200x20gr from SP Sidoarjo with Rp. 5,415,159.84 on current method and 5,895,422.46 on improvement method, which has the increase of Rp. 480,262.62. The highest increase is come from product 13, Susu Steril Indomilk Choco 190 ml from SP Krian with Rp. 689,625.21, or equivalent with 20% increase on total cost. The highest increase by percentage come from product 2, Sun BC Susu Beras Merah Sachet from SP Bojonegoro, with 38% total cost increase. The lowest increase by percentage is come from product 12, SUN BC SUSU BERAS MERAH KOTAK, with 8% of increase. Figure 4.14 shown the comparison of total cost between current and improvement method.
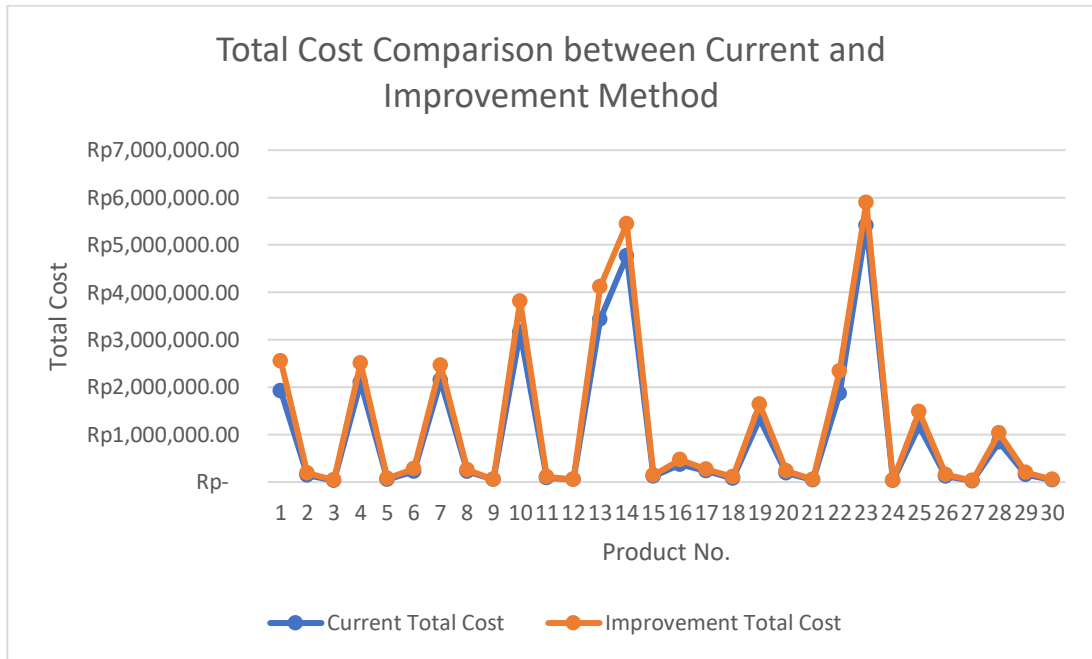
Figure 4. 14 Total Cost Comparison between Current and Improvement Method

4.11 Scenario Building

After simulation of existing and improvement method, we want to know that if the method is can be improved based on parameter that can be changed by the company, which is service level target, to increase the performance of the method. By tweaking service level target, the improvement method will have different minimum value and will changes the total cost and actual service level output of the simulation. It also will change stockout and unused inventory value. Therefore, we will adjust service level target for the scenario building. There are 6 service level targets value will be used on the scenario building, which are 90% (current company target), 92%, 94%, 96%, 98%, and 99.99%, and there are 4 output to be analyzed later which are unused inventory, stockout, total cost, and actual service level. The results of scenario building will be provided on table 4.35 for 30 products sample.

Table 4. 35 Recapitulation of Scenario Output

Stock Point	Product Name	SL Target	Ending Inventory	Stock out	Total Cost	Service Level
SP BOJONEGORO	Ichi Ocha Melati PET 350ml	90.00%	783	55.465	2,548,232.73	95.90%
		92.00%	816	52.536	2,616,021.37	96.14%
		94.00%	856	49.328	2,687,697.25	96.40%
		96.00%	908	45.239	2,784,386.70	96.72%
		98.00%	991	39.598	2,915,139.66	97.16%
		99.99%	1457	20.289	3,394,679.80	98.57%
	Sun BC Susu Beras Merah Sachet	90.00%	10	0.004	194,979.26	99.96%
		92.00%	10	0.004	195,206.75	99.96%
		94.00%	11	0.003	195,256.84	99.96%
		96.00%	11	0.003	195,456.26	99.97%
		98.00%	11	0.003	195,814.30	99.97%
		99.99%	14	0.002	197,116.71	99.98%
	SAPS-N/Sambal Pedas Sch 504 x 9 gr	90.00%	6	0.019	42,283.73	99.73%
		92.00%	6	0.018	42,558.64	99.74%
		94.00%	6	0.017	42,635.90	99.76%
		96.00%	6	0.016	42,866.47	99.77%
		98.00%	7	0.015	43,059.00	99.79%
		99.99%	8	0.011	44,215.39	99.86%
SP TUBAN	Susu Steril Indomilk Choco 190 ml	90.00%	204	11.576	2,508,929.11	97.24%
		92.00%	212	11.094	2,538,955.77	97.38%
		94.00%	223	10.556	2,577,073.90	97.53%
		96.00%	237	9.896	2,618,822.23	97.70%
		98.00%	259	8.989	2,681,135.65	97.94%
		99.99%	381	6.046	2,900,173.47	98.65%
	Snack Qtela BBQ 60g	90.00%	6	0.046	72,186.04	99.22%
		92.00%	6	0.042	72,571.64	99.28%
		94.00%	7	0.038	73,124.40	99.37%
		96.00%	7	0.033	73,772.20	99.46%
		98.00%	7	0.026	74,627.31	99.57%
		99.99%	9	0.008	77,521.25	99.87%
	ID-68 PEL KATUN KOTAK	90.00%	18	1.047	279,025.65	96.67%
		92.00%	19	1.051	285,125.24	96.66%
		94.00%	19	1.047	290,691.69	96.66%

Stock Point	Product Name	SL Target	Ending Inventory	Stock out	Total Cost	Service Level
	MEDIUM SET (12)	96.00%	20	1.039	304,221.58	96.76%
		98.00%	21	1.045	318,195.29	96.76%
		99.99%	27	1.035	395,289.24	96.88%
SP PAMEKASAN	Krimer Kental Manis Kremer Plain 37g	90.00%	123	3.235	2,464,505.43	98.38%
		92.00%	127	3.057	2,480,645.61	98.49%
		94.00%	131	2.858	2,498,375.10	98.61%
		96.00%	137	2.608	2,527,367.39	98.76%
		98.00%	145	2.249	2,557,351.70	98.96%
		99.99%	195	1.053	2,682,689.45	99.57%
	Genki Moko Moko Pants L1	90.00%	9	0.005	253,433.27	99.92%
		92.00%	9	0.004	253,793.35	99.93%
		94.00%	9	0.004	253,977.89	99.94%
		96.00%	9	0.003	254,364.31	99.95%
		98.00%	10	0.002	255,038.47	99.96%
		99.99%	12	0.001	257,617.97	99.98%
	IKMT-N/Indofood Kecap Manis PET 275 ml	90.00%	3	0.004	55,564.91	99.84%
		92.00%	3	0.004	55,791.24	99.85%
		94.00%	3	0.004	55,868.81	99.86%
		96.00%	3	0.003	55,938.99	99.87%
		98.00%	4	0.003	56,173.62	99.89%
		99.99%	4	0.002	56,988.43	99.94%
SP PURWOREJO	Susu Steril Indomilk Choco 190 ml	90.00%	270	10.244	3,807,360.57	97.56%
		92.00%	280	9.553	3,859,658.70	97.75%
		94.00%	293	8.793	3,909,287.96	97.95%
		96.00%	311	7.915	3,968,498.22	98.18%
		98.00%	338	6.815	4,049,326.97	98.46%
		99.99%	489	3.753	4,293,988.04	99.15%
	Bukrim Oxyklin Romantic Floral 800	90.00%	10	0.067	106,448.62	99.37%
		92.00%	10	0.061	107,131.64	99.43%
		94.00%	10	0.055	108,027.96	99.50%
		96.00%	11	0.047	108,915.99	99.57%
		98.00%	11	0.038	109,898.22	99.66%
		99.99%	14	0.012	114,370.88	99.90%
	SUN BC SUSU	90.00%	4	0.000	53,886.43	100.00%
		92.00%	4	0.000	53,834.65	100.00%

Stock Point	Product Name	SL Target	Ending Inventory	Stock out	Total Cost	Service Level
	BERAS MERAH KOTAK	94.00%	4	0.000	53,930.49	100.00%
		96.00%	4	0.000	53,988.32	100.00%
		98.00%	4	0.000	54,086.73	100.00%
		99.99%	5	0.000	54,614.65	100.00%
SP KRIAN	Susu Steril Indomilk Choco 190 ml	90.00%	259	12.523	4,119,891.42	96.89%
		92.00%	270	11.876	4,163,099.72	97.06%
		94.00%	284	11.196	4,212,951.76	97.24%
		96.00%	301	10.376	4,265,413.04	97.45%
		98.00%	329	9.361	4,335,871.24	97.69%
		99.99%	483	6.463	4,575,015.82	98.32%
	MINYAK GORENG BIMOLI 5LT JRG	90.00%	219	13.184	5,442,747.62	90.51%
		92.00%	227	13.020	5,498,490.05	90.55%
		94.00%	236	12.834	5,555,461.97	90.61%
		96.00%	248	12.633	5,623,626.26	90.65%
		98.00%	267	12.312	5,726,165.59	90.74%
		99.99%	370	11.016	6,184,535.51	91.08%
	Bubur Bayi SUN BC Kacang Hijau Ekonomis	90.00%	11	0.000	149,311.52	100.00%
		92.00%	11	0.000	149,321.92	100.00%
		94.00%	11	0.000	149,418.35	100.00%
		96.00%	11	0.000	149,530.31	100.00%
		98.00%	11	0.000	149,693.44	100.00%
		99.99%	13	0.000	150,632.27	100.00%
SP KENJERAN	Ichi Ocha Melati PET 350ml	90.00%	319	7.074	465,319.24	96.72%
		92.00%	327	6.780	473,047.56	96.89%
		94.00%	337	6.375	482,148.29	97.08%
		96.00%	350	5.934	492,815.41	97.31%
		98.00%	369	5.310	507,500.35	97.60%
		99.99%	482	2.758	573,331.20	98.74%
	Bubur Bayi SUN BC Beras Merah Ekonomis	90.00%	12	0.001	267,430.18	99.99%
		92.00%	12	0.000	267,699.75	99.99%
		94.00%	13	0.000	267,845.92	99.99%
		96.00%	13	0.000	268,135.05	100.00%
		98.00%	13	0.000	268,483.62	100.00%
		99.99%	17	0.000	270,493.56	100.00%
		90.00%	9	0.000	105,492.10	100.00%

Stock Point	Product Name	SL Target	Ending Inventory	Stock out	Total Cost	Service Level
	Susu UHT Indomilk Choco 190 ml	92.00%	9	0.000	105,581.18	100.00%
		94.00%	9	0.000	105,683.64	100.00%
		96.00%	9	0.000	105,691.29	100.00%
		98.00%	9	0.000	105,800.52	100.00%
		99.99%	11	0.000	106,569.09	100.00%
SP BABAT	Krimer Kental Manis Kremer Plain 500g	90.00%	21	0.372	1,645,841.55	97.46%
		92.00%	22	0.338	1,659,758.40	97.73%
		94.00%	23	0.302	1,674,593.86	98.00%
		96.00%	24	0.262	1,692,558.99	98.30%
		98.00%	26	0.209	1,716,581.33	98.68%
		99.99%	37	0.077	1,789,693.64	99.54%
	GARAM MEJA REFINA REF500GR BAL	90.00%	14	0.077	233,993.81	99.05%
		92.00%	15	0.073	234,277.81	99.10%
		94.00%	15	0.069	235,088.77	99.15%
		96.00%	16	0.064	235,777.46	99.21%
		98.00%	17	0.058	236,868.62	99.28%
		99.99%	23	0.045	241,403.55	99.41%
	Susu UHT Indomilk Vanila 190 ml	90.00%	19	0.821	49,877.92	96.09%
		92.00%	19	0.818	50,522.39	96.12%
		94.00%	20	0.812	51,319.47	96.15%
		96.00%	21	0.807	52,404.60	96.19%
		98.00%	22	0.799	54,136.00	96.26%
		99.99%	28	0.746	63,025.80	96.61%
SP SIDOARJO	Kental Manis Indomilk Putih Sachet 37g	90.00%	74	3.704	2,333,368.53	94.94%
		92.00%	78	3.480	2,358,102.51	95.26%
		94.00%	82	3.238	2,387,260.32	95.62%
		96.00%	87	2.951	2,418,614.97	96.03%
		98.00%	95	2.559	2,463,983.39	96.58%
		99.99%	143	1.236	2,628,993.47	98.31%
	RNG/Bumbu Racik Nasi Goreng 200x20gr	90.00%	162	0.236	5,895,422.46	99.74%
		92.00%	166	0.222	5,897,245.14	99.76%
		94.00%	171	0.204	5,905,931.00	99.78%
		96.00%	177	0.188	5,918,359.11	99.80%
		98.00%	186	0.168	5,934,727.10	99.82%
		99.99%	237	0.126	6,000,496.63	99.86%

Stock Point	Product Name	SL Target	Ending Inventory	Stock out	Total Cost	Service Level
	ID-T57 BASIC - SABUT STAINLESS	90.00%	2	0.009	35,603.57	99.46%
		92.00%	2	0.008	35,763.61	99.47%
		94.00%	2	0.008	36,010.74	99.48%
		96.00%	2	0.008	36,260.43	99.52%
		98.00%	3	0.007	36,716.51	99.56%
		99.99%	3	0.006	37,958.29	99.62%
SP WARU	Susu UHT Indomilk Kids Choco 115 ml	90.00%	46	0.311	1,483,648.46	99.11%
		92.00%	48	0.270	1,486,539.96	99.23%
		94.00%	49	0.232	1,490,291.15	99.34%
		96.00%	52	0.192	1,493,683.98	99.45%
		98.00%	56	0.152	1,498,304.70	99.56%
		99.99%	77	0.105	1,509,948.55	99.68%
	PSPS/PL SAMBAL PEDAS SCH 960 x 8 gr	90.00%	9	0.002	154,090.59	99.93%
		92.00%	9	0.002	154,330.80	99.95%
		94.00%	9	0.002	154,692.11	99.96%
		96.00%	9	0.001	154,891.09	99.97%
		98.00%	10	0.001	155,418.89	99.98%
		99.99%	12	0.000	157,412.53	100.00%
	Snack Chiki Ball CHO 10G	90.00%	15	0.071	35,697.63	99.54%
		92.00%	15	0.070	35,730.75	99.55%
		94.00%	16	0.069	35,811.59	99.56%
		96.00%	16	0.068	35,935.89	99.57%
		98.00%	17	0.067	36,120.32	99.58%
		99.99%	23	0.061	37,285.73	99.62%
SP BURNEH	Susu UHT Indomilk Kids Choco 115 ml	90.00%	44	0.702	1,035,963.45	97.18%
		92.00%	45	0.621	1,041,849.28	97.52%
		94.00%	47	0.540	1,048,492.70	97.86%
		96.00%	49	0.443	1,056,047.36	98.25%
		98.00%	53	0.333	1,065,886.92	98.69%
		99.99%	76	0.116	1,089,359.15	99.49%
	Bubur Bayi SUN BC Beras Merah Ekonomis	90.00%	11	0.132	196,451.49	97.03%
		92.00%	11	0.130	196,708.21	97.06%
		94.00%	12	0.129	196,767.45	97.08%
		96.00%	12	0.128	197,001.58	97.10%
		98.00%	13	0.128	197,304.53	97.10%

Stock Point	Product Name	SL Target	Ending Inventory	Stock out	Total Cost	Service Level
		99.99%	18	0.126	197,772.19	97.14%
	Sun Marie Roll Kecil New	90.00%	3	0.002	52,256.91	99.85%
		92.00%	3	0.002	52,219.33	99.86%
		94.00%	3	0.002	52,197.87	99.87%
		96.00%	3	0.002	52,221.11	99.87%
		98.00%	3	0.002	52,213.52	99.88%
		99.99%	4	0.001	52,413.78	99.91%

4.12 Sensitivity

Demand is a huge factor of the performances of the company inventory management; therefore, we conduct sensitivity analysis on the demand of product for improvement method. Service level target that will be used for the sensitivity analysis is based on the company current service level target which are 90%. There are 6 demand level for this sensitivity analysis, which are 50%, 75% ,100%, 150%, 200%, 300% of current demand. The examples of results of sensitivity test of product 1, Ichi Ocha Melati 350 ml on SP Bojonegoro is shown on table 4.xx below.

Table 4. 36 Sensitivity Test Output of Ichi Ocha Melati 350 ml on SP Bojonegoro

Demand Percentage	Ending Inventory	Stockout	Total Cost	Service Level
50%	490.04	23.381	1,349,382.88	96.56%
75%	633.92	39.004	1,958,347.04	96.18%
100%	782.56	55.406	2,547,335.36	95.90%
150%	1084.84	88.979	3,711,253.35	95.55%
200%	1388.72	123.282	4,864,961.30	95.32%
300%	1998.90	192.141	7,182,981.40	95.05%

Next, table 4.37 and figure 4.16 – 4.18 are showing how the changes of demand affect the output of the simulation, which are service level, number of stockout, number of ending inventory, and total cost. As the demand increasing, the service level of the product is decreasing, but still achieve the target service level that set by the company. The decrease of service level also not too high.

Table 4. 37 Demand Changes Effect on Service Level

No.	Product	50%	75%	100%	150%	200%	300%
1	Ichi Ocha Melati PET 350ml	96.56%	96.18%	95.90%	95.55%	95.32%	95.05%
2	Sun BC Susu Beras Merah Sachet	99.93%	99.85%	99.73%	99.45%	99.19%	98.82%
3	SAPS-N/Sambal Pedas Sch 504 x 9 gr	99.98%	99.97%	99.96%	99.72%	99.43%	98.70%
4	Susu Steril Indomilk Choco 190 ml	97.97%	97.54%	97.24%	96.91%	96.71%	96.22%
5	Snack Qtela BBQ 60g	99.71%	99.44%	99.22%	98.92%	98.70%	98.24%
6	ID-68 PEL KATUN KOTAK MEDIUM SET (12)	97.40%	96.92%	96.67%	96.40%	96.21%	95.71%
7	Krimer Kental Manis Kremer Plain 37g	98.53%	98.46%	98.38%	98.17%	97.98%	97.40%
8	Genki Moko Moko Pants L1	99.98%	99.96%	99.92%	99.70%	99.26%	98.29%
9	IKMT-N/Indofood Kecap Manis PET 275 ml	99.98%	99.89%	99.84%	99.72%	99.60%	99.38%
10	Susu Steril Indomilk Choco 190 ml	98.24%	97.99%	97.56%	97.58%	96.03%	95.11%
11	Bukrim Oxyklin Romantic Floral 800	99.66%	99.48%	99.37%	99.15%	98.86%	98.29%

No.	Product	50%	75%	100%	150%	200%	300%
12	SUN BC SUSU BERAS MERAH KOTAK	100%	100%	100%	99.99%	99.95%	99.77%
13	Susu Steril Indomilk Choco 190 ml	98.23%	97.60%	96.89%	95.84%	95.16%	94.06%
14	MINYAK GORENG BIMOLI 5LT JRG	94.59%	92.19%	90.52%	88.46%	87.27%	85.90%
15	Bubur Bayi SUN BC Kacang Hijau Ekonomis	100%	100%	100%	99.98%	99.88%	99.24%
16	Ichi Ocha Melati PET 350ml	97.16%	96.87%	96.72%	96.54%	96.21%	95.67%
17	Bubur Bayi SUN BC Beras Merah Ekonomis	100%	99.99%	99.99%	99.72%	98.71%	95.93%
18	Susu UHT Indomilk Choco 190 ml	100%	100%	100%	99.97%	99.74%	98.62%
19	Krimer Kental Manis Kremer Plain 500g	98.00%	97.77%	97.46%	96.48%	95.60%	94.26%
20	GARAM MEJA REFINA REF500GR BAL	99.70%	99.51%	99.05%	97.75%	96.61%	95.07%
21	Susu UHT Indomilk Vanila 190 ml	96.51%	96.24%	96.09%	95.89%	95.73%	95.46%

No.	Product	50%	75%	100%	150%	200%	300%
22	Kental Manis Indomilk Putih Sachet 37g	95.86%	95.47%	94.95%	93.90%	92.97%	91.33%
23	RNG/Bumbu Racik Nasi Goreng 200x20gr	99.88%	99.86%	99.74%	98.87%	97.75%	95.53%
24	ID-T57 BASIC - SABUT STAINLESS	99.88%	99.67%	99.46%	99.25%	99.07%	98.90%
25	Susu UHT Indomilk Kids Choco 115 ml	99.49%	99.45%	99.11%	96.17%	92.91%	88.35%
26	PSPS/PL SAMBAL PEDAS SCH 960 x 8 gr	99.97%	99.95%	99.93%	99.89%	99.72%	98.89%
27	Snack Chiki Ball CHO 10G	99.85%	99.67%	99.54%	99.36%	99.25%	98.97%
28	Susu UHT Indomilk Kids Choco 115 ml	97.80%	97.59%	97.18%	95.48%	93.19%	89.29%

This low decrease of service level is mainly caused by how the improvement method maintain the performance of the system by adjusting the min-max, which will affect the number of unused inventory and stockout of the system. The number of unused inventory and stockout is increasing as the demand goes higher.
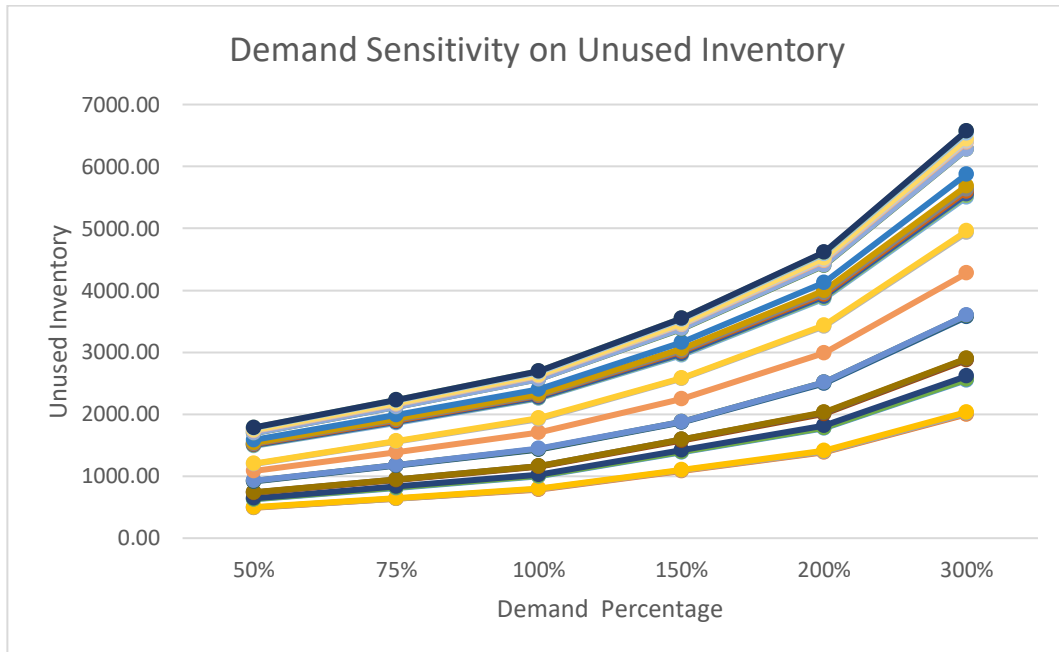
Figure 4. 15 Demand Changes Effect on Unused Inventory
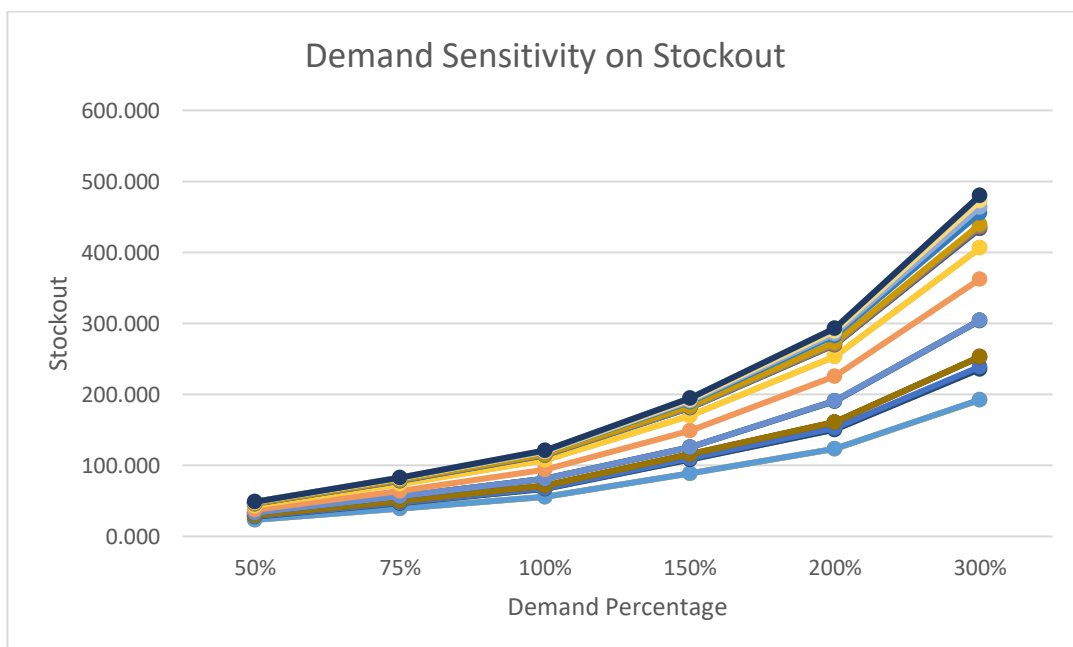
Figure 4. 16 Demand Changes Effect on Stockout

By having higher number of unused inventory and stockout will directly affect the cost spend to do the inventory management. As the demand increase, the total cost of the system is increasing as shown on figure 4.18 below.
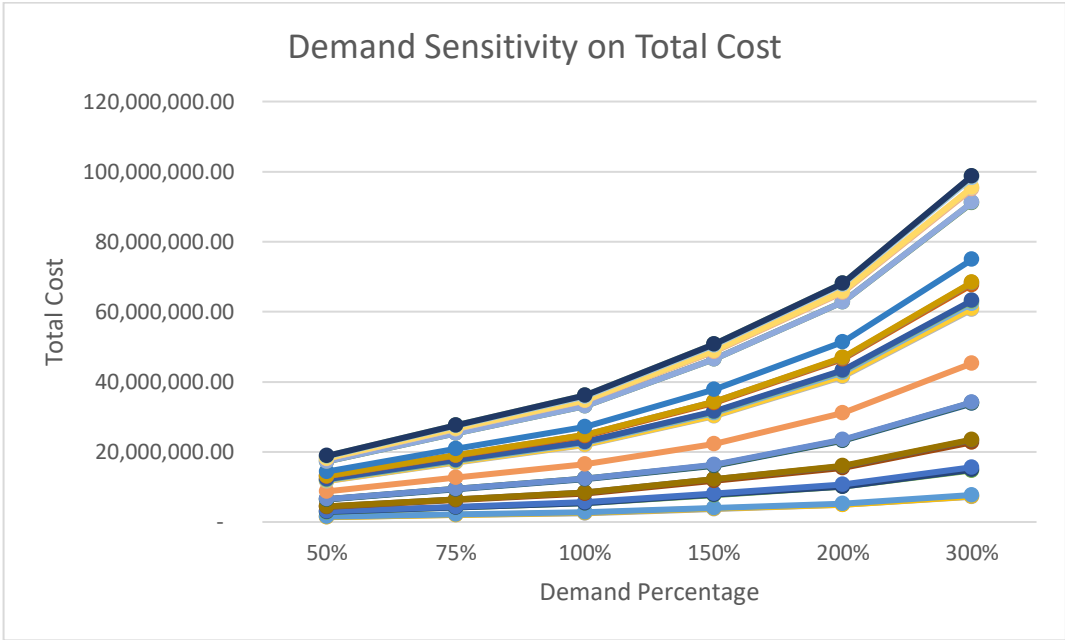
Figure 4. 17 Demand Changes Effect on Total Cost

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CHAPTER V

ANALYSIS AND INTERPRETATION

This chapter provide analysis and interpretation of the output that has been earned from previous chapter. This chapter consist of 6 sub-chapter, which are analysis of stock-point contribution, analysis of product classification, analysis of comparison between current company method and improvement method, analysis of scenario building for improvement method, and sensitivity analysis.

5.1   Analysis of Stock point and Product Classification

Product classification is important in order to know the contribution of each stock point and product, in which will help the company to choose the best inventory management method. For the purpose of this research, ABC Classification is used to conduct product classification on the company stock point and product. Stock point ABC classification is conducted based on the net sales of each stock point and service level. From the total of 144 stock points, there are 23 stock points that classified as A class, 35 stock points as B class, and 58 stock point as C class. Since there are 2 aspect to be considered on the classification, we conduct weighting for each the service level and net sales of the stock point. Since we want to find the most contributive, yet most underperform stock point, we weight the net sales as the biggest net sales as 1, and the lowest as 0. In the other hand, the service level weighting follows a different rule, with the lowest service level as 1 and highest service level as 0. The weighting follows 50:50 rules, which might have different output if the weighting follows other rules based on the company wish, whether they want to focus on achieving service level, they can increase the weighting of the service level, vice versa. We choose 5 A class stock points, 3 B class stock points, and 2 C class stock points as our sample, since we want to know the characteristic of each stock point, but still fix the most underperform yet contributive stock point for the company. The company use stock point classification as the base of delivery frequency, which affect the Q value of each stock point. The classification will affect the number of max inventory level of the company, which C class will have highest coefficient of max inventory

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compared to B and A class stock point. Table 5.1 shown the Q of each stock point of the company current method.

Table 5. 1 Delivery Frequency of DC to Stock point on Q Decision

Delivery Frequency	Q
1 Day 1 Delivery	3
2-3 Day 1 Delivery	5
4-5 Day 1 Delivery	8
>5 Day 1 Delivery	N+4

Higher Q will directly affect the number of maximum inventory capacity, in which will affect the number of available inventories for the stock point. This condition can drive a huge number of unused inventories, which will reduce the performance level of the stock point supply chain. If this condition combined with bad warehouse management, the product that stored may have a bad inventory circulation, which means that the used of FIFO rules is not effective, and in the end, there will be a lot of products that need to be destroyed because of expired, obsolete, or broken. Therefore, the company should be very careful on this condition, since this might be the driver of the huge number of product destruction problem that also faced by the company.

After choosing stock point as samples, next we move to the product chosen for each stock point. The product chosen for each stock point also follow ABC rules, based on the net sales for each product only, since the company does not have service level data for each product of each stock point. There are 3 products chosen for each stock point, that categorized on each A, B, and C category. We decide to choose each A, B, and C product for each stock point since we want to know whether there is an effect of stock point classification on product that have the same class. On the company current method, product classification is the base of minimum inventory level decision. Table 5.2 show the decision of minimum coefficient for each class.

Table 5. 2 Product Classification on Minimum Coefficient Decision

Product Class	Minimum Coefficient
A	2
B	5
C	10

Minimum coefficient will highly affect the performance of the inventory management, especially it has the contribution on min-max decision. With higher minimum value, the maximum value will be higher, and it will drive higher number of stock and unused inventory. The combination of both stock point classification and product classification will have the output of minimum and maximum value for each product. Product that categorized as C class and appear on stock point that has big interval of delivery will has a very high number of max coefficients, and also drive a high number of stocks. Therefore, we decide to adjust the number of Q and minimum coefficient on the improvement method. The improvement method adds an additional safety stock as one factor of the minimum value calculation. The comparison of current and improvement method will be delivered on the next sub-chapter.

5.2   Analysis of Comparison between Current and Improvement Method

The company has some problem on achieving the targeted service level, especially for product categorized on A class. This could be happening because of fast product moving pace on A class, that contribute high income for the company. By having lower service level than the service level target, it may reduce the income of the company, especially when the loss of sales happens. Loss of sales is most likely happened on retail business, especially for FMCG product that has been the most commodities that the company sell to the customer. Customer tend to change to another product if the company cannot fulfill the demand that measured as a service level. Therefore, service level is so important for the business, especially for stock point which considered as the closest entities of the business to the customer.

To solve their service level problem, we decide to analyze their inventory management method, which they use special min-max method that implement some

coefficient that has been explained on previous sub-chapter. We try to formulate new formula of inventory management method, by following continuous review system (s, S), by adjusting the lead time of product by matching it to the real condition lead time. We also elaborate the minimum indicator by using SS and ROL rules, so the system can adapt when the demand changing. After conducting simulation, we found that the improvement method boosts the service level for all product, especially for product that classified as A class product. In general, A class product has a boost of 10% on service level, from 87% to 97%, while the improvement method has lesser effect on product that belongs to category B and C, with 3% and 1% boost respectively. The comparison of service level for improvement and current company method based on product class can be seen on table 5.3.

Table 5. 3 Service Level Comparison between Current and Improvement Method based on Product Class

	Current Company Method	Improvement Method	Changes
A	87%	97%	+10%
B	96%	98%	+3%
C	98%	99%	+1%

One of the reasons of the service level boost is the stock availability. Since the lead time has been adjusted, it will reduce the maximum value of inventory of the system. By having a reduce in maximum value, it directly drives the system to generate more order frequency, which still acceptable as long as it follows the real delivery frequency for each stock point. The system will keep more product as inventory for each period. Class A product has an average of 20.04 cartons increase of product, which less than 1 pallet of product. Class B and C has an increase of 0.44 and 0.51 carton respectively. The increasing number of unused inventories is acceptable, especially for product B, since the changes of unused inventory only 1% of the current company method, which if compared to the service level changes, which are +3%. For A class product, it considered as acceptable since the changes of unused inventory around 10% of the current company method, which has the same value with the changes of service level. For class C product, the changes of unused inventory are reflecting an incompatibility, with an increase around 6%,

compared to service level changes that only 1%. The comparison of unused inventory between current and improvement method based on product class can be seen on table 5.4 below.

Table 5. 4 Unused Inventory Comparison between Current and Improvement Method based on Product Class

Product Class	Current Company Method	Improvement Method	Changes
A	194.28	214.31	+20.04
B	45.78	46.22	+0.44
C	8.43	8.94	+0.51

By having more inventory on hand, it would reduce the number of stockout on the company. By looking on table 5.5, we can see that stockout condition is reduced for all product class, with A class product has the biggest changes, which reduce around 45%, from 17.80 cartons to 10.52 cartons. Followed by B class product reducing around 25% from 1.89 cartons to 1.38 cartons, and C class product that reducing around 5%, from 0.20 to 0.19. This might be the driver of a huge boost of service level on class A product. By having a low level of stockout, it would help the business to maintain the performance of their supply chain. Maintaining number of stockout could be achieved by having more stock, that also corelated to previous table. By having around 10% more product as stock, the company can reduce 45% stockout condition for product A. This is very important since class A product share the biggest net value compared to other class, and need to have good performance on supply chain to boost the profit of the company.

Table 5. 5 Stockout Comparison between Current and Improvement Method based on Product Class

Product Class	Current Company Method	Improvement Method	Changes
A	17.80	10.52	-7.28
B	1.89	1.38	-0.52
C	0.20	0.19	-0.01

Having more inventory means that there will be more cost that need to be spend to control those inventories. Cost that spend by the company comes from 3 main component, which are purchasing cost, that used to purchase the product, order cost, and holding cost that used on managing the product when they become

the stock point inventory. The sum of those cost called as total cost. There are an increase of cost on improvement method compared to the current company method, with the highest increase comes from C class product, with around 23% increase of total cost, followed by A class product that has increase around 22% on total cost, and the last is B class product with around 13% of total cost. The data of total cost comparison between current and improvement method based on product class can be seen on table 5.6.

Table 5. 6 Total Cost Comparison between Current and Improvement Method based on Product Class

Product Class	Current Company Method (Rp.)	Improvement Method (Rp.)	Changes (Rp.)	Changes in %
A	1,836,924.44	2,241,306.05	404,381.61	22%
B	1,138,767.33	1,281,718.33	142,951.01	13%
C	70,084.57	85,900.04	15,815.46	23%

After finding out the effect of improvement method on all output of simulation, next we compare both method (existing and improvement) in order to choose which method that suit each product class. For product that belongs on class A, there are 10% changes in SL, which considerably as huge changes, since at the current company method, in average A class product does not achieve the service level target set by the company. By the increase of 22% of total cost, it considerably acceptable, since the product is categorized as fast-moving product, and the stock point should fulfill the demand of the customer or they will have lost sales and lost their potential customer. In the other hand, for both class B and C product has achieved the intended service level with current company method, but there is a potential of improvement on class B, with the increase of 3% SL by applying improvement method, and there will be a boost of 13% total cost to achieve those value. To have better performance, especially generate more profit by having more service level. This also good to generate new customer, since by having more SL, the company will be providing more certainty to fulfill the customer demand, and will be one of the selling points that could attract new customer. There is not much improvement for C class product, since they have a huge initial service level, which are 98%. The biggest factor that contribute to those high service levels is the setting

of minimum coefficient (10 x Demand for C class) that set by the company. By having 10X Demand as minimum value, there will be a hidden stock point, that lead to huge number of inventories, and higher service level. By only having 1% boost on service level from current to improvement method and 23% more cost, we think the company should stick to the current method. The data of decision on method to be implemented for each product class is provided on table 5.7.

Table 5. 7 Decision on Method to be Implemented for each Product Class

Product Class	Current Company Method SL	Improvement Method SL	Changes in SL	Changes in Total Cost
A	87%	97%	+10%	+22%
B	96%	98%	+3%	+13%
C	98%	99%	+1%	+23%

■ Implement Improvement Method
■ Implement Current Company Method

Table 5.7 also showing that the increase of 1% service level will have different percentage of cost based on the initial service level. For example, let's look on class A and C. For class A product, they need an increase of 22% total cost need to boost SL from 87% to 97%, and for class C product, they need an increase of 23% total cost to boost SL from 98% to 99%. By having this condition, the company need to be very selective to set their service level target, so they can have not only good service level that will generate more income, but also manageable total cost that can generate biggest profit. To know the effect of service level target to the total cost and service level, we conduct the scenario that will be explained on the next subchapter.

5.3 Analysis of Scenario Building of Improvement Method

One of the superiorities of the improvement method is on how service level target is contributive to the system. Service level target is used on the calculation of safety stock, that directly contribute on the setting of minimum value for the inventory system. We believe that the company would want to achieve higher service level on the next future, therefore we try to find a connection on how service level target affects the actual service level of the product. We conduct the test by

having 6 scenario of service level target, which are 90%, 92%, 94%, 96%, 98%, and 99.99% service level target. After conducting scenario building, we found that the number of actual service level will increase when we increase the service level target, but the increment is lower than expected. There are several reasons regarding this condition. The first one is the component of minimum inventory level was not only safety stock. We also have ROL that play a big part on the setting of minimum inventory level. The ROL need to be updated by the increase of service level target, and we believe that this could be continued as a new research on the ROL of the company. The next one is minimum inventory is not the only aspect that affect the service level of the company. Maximum inventory capacity seems play a bigger role than the minimum inventory capacity, since the system are placing an order when the product is below maximum inventory level automatically, and if the maximum inventory level could have bigger value, the service level could be higher. We believe that each product needs to have different service level target, based on the classification of the product. For example, if the company would want to achieve 98% service level for all product, they need to set 98% service level target on class A product, and 90% on class B and C product. The data of average service level achievement for each product class can be seen on table 5.8.

Table 5. 8 Service Level Target on the Average Service Level Achievement Based on ABC Classification

Product Class	Service Level Target					
	90.0%	92.0%	94.0%	96.0%	98.0%	99.99%
A	97.1%	97.3%	97.6%	97.8%	98.1%	99.0%
B	98.5%	98.5%	98.5%	98.6%	98.6%	98.7%
C	99.1%	99.1%	99.1%	99.2%	99.2%	99.2%

The increase of service level target would also affect the total cost of the system. As the service level target increased, the total cost of the system would also be increasing. The biggest increases of total cost are coming from A class product, with in average around 1.5% total cost increase for 2% service level target increase for 90% to 98%, and the total cost boosted heavily on 98-99.99% with 6.30% increase of total cost. The lowest increases surprisingly come from class B product, with around 0.4% increase in average for 90-98% service level target and 2.29%

for 98-99.99%. The data of average increase for each increase of service level target for each product class is provided on table 5.9.

Table 5. 9 Service Level Target on the Average Increase of Total Cost based on ABC Classification

Product Class	Service Level Range (in%)				
	90-92	92-94	94-96	96-98	98-99.99
A	1.13%	1.24%	1.47%	1.95%	6.80%
B	0.30%	0.35%	0.40%	0.57%	2.29%
C	0.50%	0.51%	0.87%	1.09%	5.41%

In order to know the comparison between service level target setting to the increase of total cost and service level, we provide graph 5.1-5.3 that contains the information about total cost and service level for each service level target for each class A, B, and C.
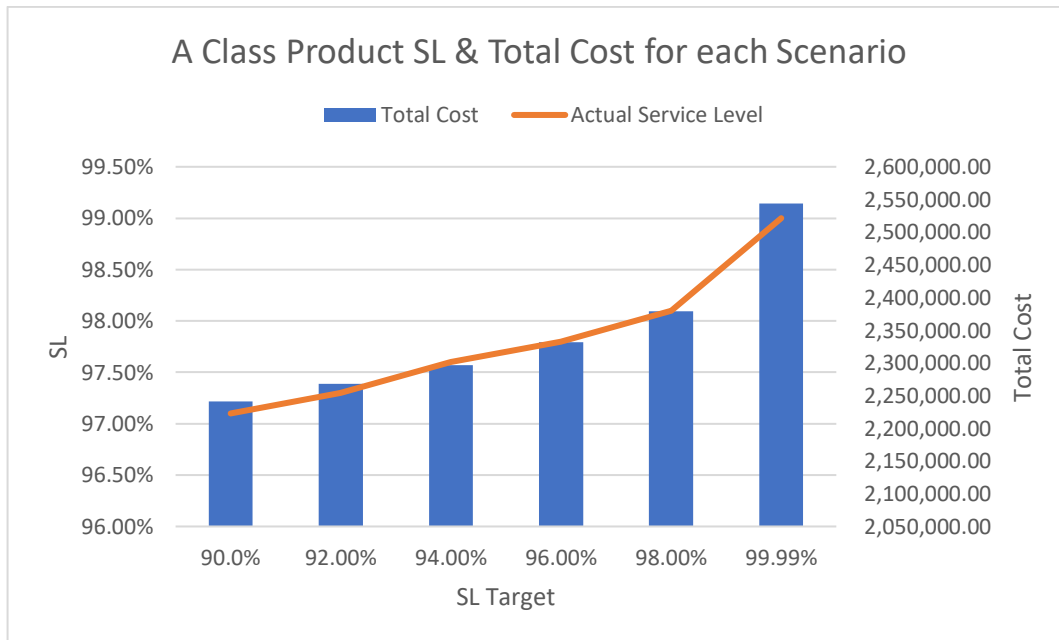
Figure 5. 1 A Class Product SL & Total Cost for each Scenario
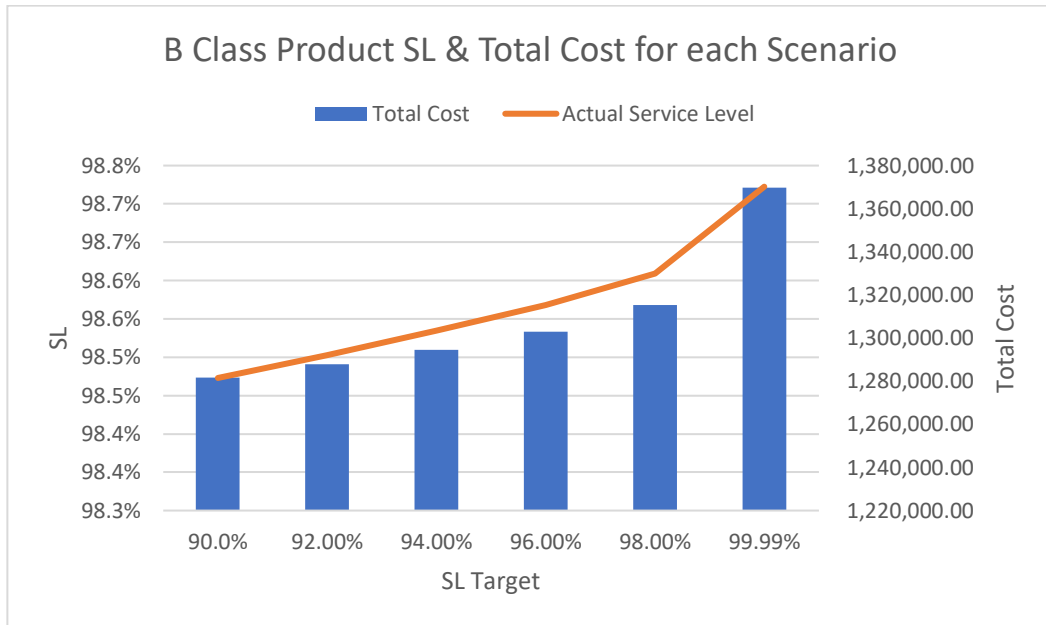
Figure 5. 2 B Class Product SL & Total Cost for each Scenario
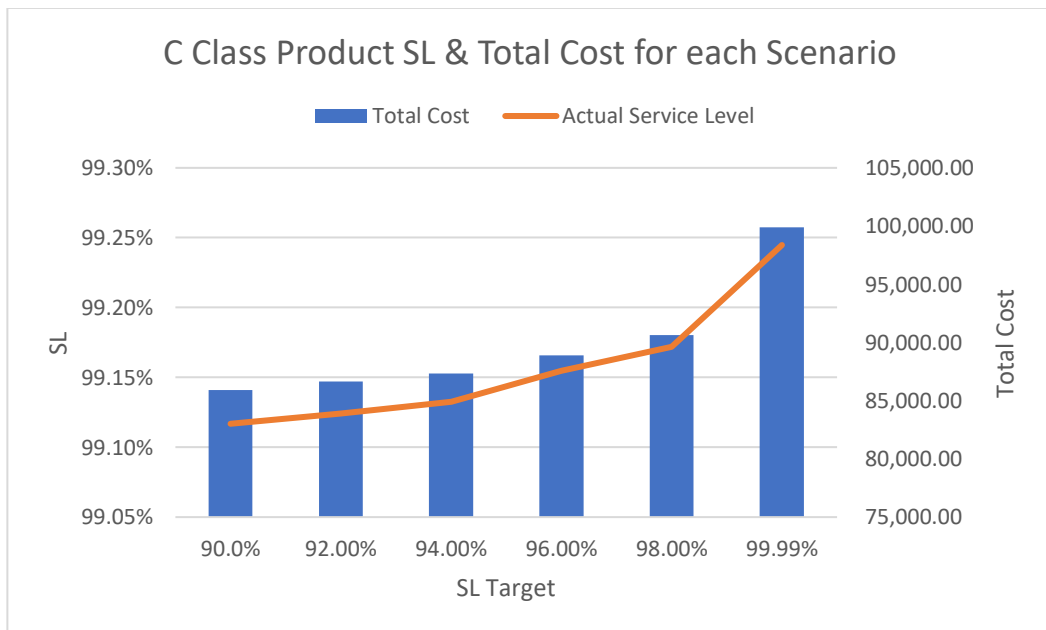
Figure 5. 3 C Class Product SL & Total Cost for each Scenario

As we can see from figure 5.1-5.3, as the service level target is set higher by the company, there will be some boost on actual service level that achieved, but the condition would also trigger high number of total costs. The highest increase of both total cost and service level is occur between 98% and 99.99% SL target. This

validate the previous subchapter analysis on how the connection between service level and total cost on inventory management improvement.

For current condition, we are sure that the company does not need to increase their service level target, since the improvement method has offered a minimum of 97% service level. But, if in the future, the company want to have higher service level, adjusting the service level can be one of the ways to achieve the goals, beside adjusting ROL, delivery frequency (Q), or building a whole new inventory management method.

5.4   Sensitivity Analysis

Demand, as the only uncertain factor in this inventory management method, has need to be fulfilled as much as possible by the company. Demand is important to generate more income, and ends up with more profit for the company. We believe that the demand for each product will be vary as time goes by. Therefore, we conduct sensitivity analysis, in order to know how the inventory management method, perform when the demand is changing, whether when the demand is decreasing and increasing. Demand percentage used for the sensitivity analysis are 50%, 75%, 100%, 150%, 200%, and 300%. Figure 5.4 below shown the demand sensitivity effect on service level for each product class.

Demand sensitivity has a less effect on class C, following with class B and class A. This could be happening because of the determination of ROL that follows product class, which affect the minimum inventory level of the product. Class C product has the highest coefficient (10) on ROL compared to other product, which make the class C product have more stability on the service level. Although there are decline on service level, at the highest percentage of demand (300%), in average, all product still maintains their service level more than 90%.
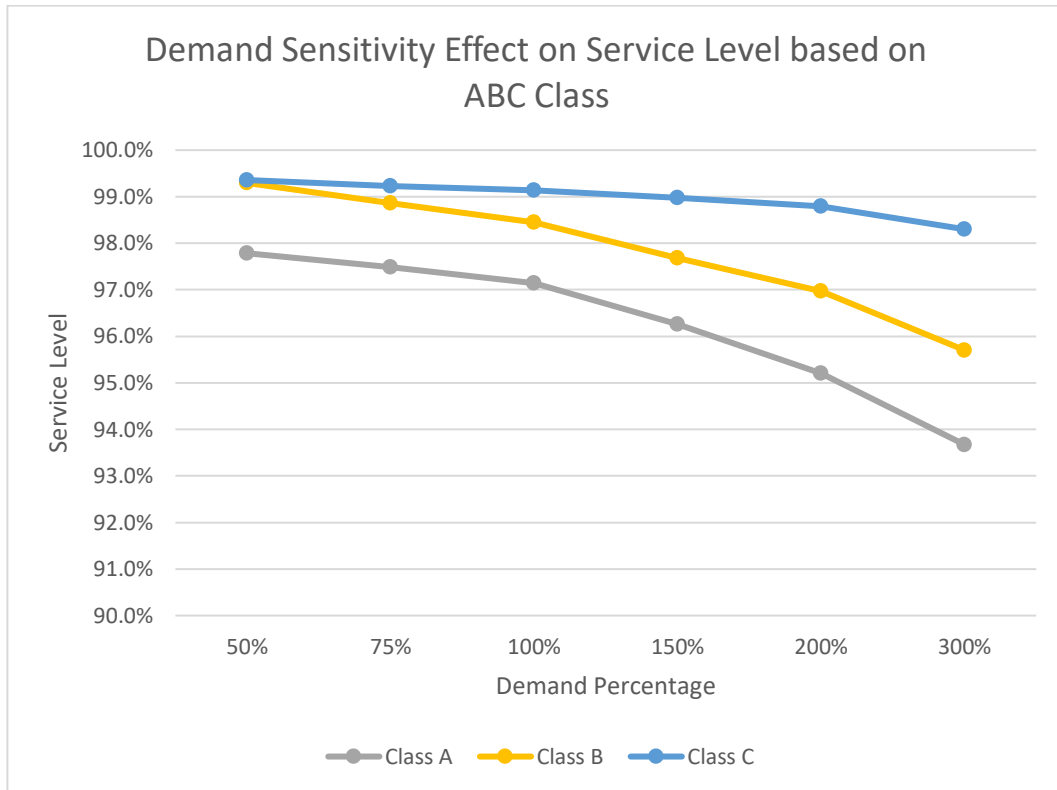
Figure 5. 4 Demand Sensitivity Effect on Service Level based on ABC Class

There are several products that has unique output on the sensitivity test, which are SUN BC SUSU BERAS MERAH KOTAK from SP Bojonegoro, Susu UHT Indomilk Kids Choco 115 ml from SP Waru and MINYAK GORENG BIMOLI 5 LT JRG from SP Krian. SUN BC SUSU BERAS MERAH KOTAK has the most stable service level with straight 100% up to 150% demand, and decrease by only around 0.05% on 300% demand. The next one is Susu UHT Indomilk Kids Choco 115 ml that has the most decline, from 99.5% SL on 50% of demand, to 88.4% SL on 300% demand, and MINYAK GORENG BIMOLI 5 LT JRG that has the lowest service level for the sensitivity analysis, with 85.9% SL on 300% demand.

There are some products that has not achieved the service level target (90%) after the sensitivity analysis, which are MINYAK GORENG BIMOLI 5LT JRG from SP Krian, Susu UHT Indomilk Kids Choco 115 ml from SP Waru, and Susu UHT Indomilk Kids Choco 115 ml from SP Burneh. MINYAK GORENG BIMOLI 5 LT JRG failed to achieve SL target on 150% demand, when the rest failed on 300% demand. By having this information, the company should increase their

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awareness on those 3 products, especially MINYAK GORENG BIMOLI 5LT JRG, since by only changes of 150% demand, it would fail to achieve the SL target.

We found that demand distribution has some contribution on how this could be happening. Different demand distribution should be approached by different method, or at least different maximum and minimum inventory level coefficient. Classifying product into ABC classification is not enough. The company needs to do further research on the method scheme for each product, since each product have different character, and different character need to be treated differently.

It also might be affected by the setting of minimum coefficient that set by the company (2 x demand for A class, 5 for B class, 10 for C class) that affecting different service level for each class, and it has different pattern when the demand is changing. Class C product have more stability in service level, in regards on the 10 X demand coefficient that make the inventory system more adaptive to the changes of demand. The company need to consider changing the minimum coefficient for class A and B product, especially when the demand changes. The company need to find a certain way to make a system that can adapt to demand changes, whether by changing minimum coefficient with certain trigger, or finding another method.

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CHAPTER VI

CONCLUSION AND RECOMMENDATION

This chapter provide the conclusion of this research and recommendation for this research

6.1   Conclusion

There are 5 conclusions of this research, which are:

1. Current company method has lower output value compared to the improvement method, especially for A class product. This driven by the lead time setting that adjusted by the company, and the minimum coefficient setting that does not consider safety stock.

2. Improvement method is chosen for A and B class product, since improvement method provide A class 97% service level product, that only achieve 87% service level with current company method that has not achieve service level target of the company. B class product earn 3% service level boost with the improvement method with only 13% increase on total cost. Class C product can stay using current company method since there are no big impact on the use of improvement method.

3. After scenario building, it is known that the changes of service level target will increase the actual service level and total cost. With a similar service level increase, total cost will be having a bigger increase when the initial service level is higher compared to lower initial service level.

4. Increase in demand has an impact which will decrease the service level of product, increase on total cost, decrease on number of stockout and increasing number of unused inventories. There are 3 product that has not achieve the service level target when there are 300% demand, which are MINYAK GORENG BIMOLI 5LT JRG from SP Krian, Susu UHT Indomilk Kids Choco 115 ml from SP Waru, and Susu UHT Indomilk Kids Choco 115 ml from SP Burneh.

6.2   Recommendation

There are several suggestions for further research, which are:

1. Building a whole new model of inventory management that can boost the performance of the company inventory management even better.

2. Considering the warehouse capacity and delivery capacity for each stock point, as well as lead time for each product from the factory to the DC as one of the uncertainties for the system.

3. Considering the effect on promotional event, such as discount and feast day for product that affected into it.

4. Considering the effect of delivery frequency changes to the lead time changes and order level.

REFERENCES

Amadeo, K. (2018). The Retail Industry and Its Impact on the Economy. [online] The Balance. Available at: https://www.thebalance.com/what-is-retailing-why-it-s-important-to-the-economy-3305718 [Accessed 4 Apr. 2019].

Courses.lumenlearning.com. (2019). Understanding Inventory | Boundless Accounting. [online] Available at: https://courses.lumenlearning.com/boundless-accounting/chapter/understanding-inventory/ [Accessed 4 Apr. 2019].

Databoks.katadata.co.id. (2017). Alfa dan Indomaret Terus Tambah Gerai | Databoks. [online] Available at: https://databoks.katadata.co.id/datapublish/2017/07/12/alfa-dan-indomaret-terus-tambah-gerai [Accessed 4 Apr. 2019].

Databoks.katadata.co.id. (2017). Berapa Nilai Penjualan Ritel Indonesia? | Databoks. [online] Available at: https://databoks.katadata.co.id/datapublish/2017/06/06/berapa-nilai-penjualan-ritel-indonesia [Accessed 4 Apr. 2019].

Databoks.katadata.co.id. (2018). Gerai Alfamart dan Indomaret Masih Ekspansi | Databoks. [online] Available at: https://databoks.katadata.co.id/datapublish/2018/10/05/gerai-alfamart-dan-indomaret-masih-ekspansi [Accessed 4 Apr. 2019].

Databoks.katadata.co.id. (2017). Indonesia Masuk Daftar 10 Pasar Ritel Teratraktif | Databoks. [online] Available at: https://databoks.katadata.co.id/datapublish/2017/06/06/indonesia-masuk-daftar-10-pasar-ritel-teratraktif [Accessed 4 Apr. 2019].

Data.worldbank.org. (2018). Households and NPISHs Final consumption expenditure (current US$) | Data. [online] Available at: https://data.worldbank.org/indicator/NE.CON.PRVT.CD?year_high_desc=true [Accessed 4 Apr. 2019].

Fritsch, D. (2014). Advanced ABC Classification for Inventory Management. [online] EazyStock. Available at: https://www.eazystock.com/blog/2014/12/01/how-to-use-abc-classification-for-inventory-management/ [Accessed 4 Apr. 2019].

Hcltech.com. (2019). What is retail supply chain management? | HCL Technologies. [online] Available at: https://www.hcltech.com/technology-qa/what-is-retail-supply-chain-management [Accessed 4 Apr. 2019].

Juneja, P. (2019). Inventory Costs - Ordering Cost, Carrying Cost and Stock Out Cost. [online] Managementstudyguide.com. Available at: https://www.managementstudyguide.com/inventory-costs.htm [Accessed 4 Apr. 2019].

Liu, Shuguang. (2016). Managing Facilitating Goods. Available at: http://www2.newpaltz.edu/~liush/OM/inventory.pdf [Accesed 4 Apr. 2019]

Monte Carlo Simulation: What Is It and How Does It Work? - Palisade. (2019). What is Monte Carlo Simulation? [online] Available at: https://www.palisade.com/risk/monte_carlo_simulation.asp [Accessed 4 Apr. 2019].

Pease, C. (2018). An Overview of Monte Carlo Methods. [online] Towards Data Science. Available at: https://towardsdatascience.com/an-overview-of-monte-carlo-methods-675384eb1694 [Accessed 4 Apr. 2019].

Pujawan, I. N. (2017) Supply Chain Management. 3rd edn. Yogyakarta: Andi.

Silver, E. A., Pyke D.F., and Peterson R. (1998) Inventory Management and Production Planning and Scheduling. 3rd edn. New York: John Wiley & Sons.

Singh, R. K. (2013). Analyzing the Factors for VMI Implementation: A Framework. Global Business Review 14, 169-186.

Singh. K. (2016). A Summary of Commonly Used Inventory Policies. Available at: https://supplychain-analysis.com/2016/08/01/a-summary-of-commonly-used-inventory-polices/, [Accesed 4 Apr. 2019]

Supply Chain Minded. (2019). Safety Stock. [online] Available at: https://supplychainminded.com/safety-stock/ [Accessed 4 Apr. 2019].

Supplychainindonesia.com. (2017). Biaya Logistik Agregat -. [online] Available at: http://supplychainindonesia.com/new/biaya-logistik-agregat/ [Accessed 4 Apr. 2019].

Tersine, R. J. (1994) Principles of Inventory and Materials Management. 4th edn. United States: Prentice – Hall International.

Ramalingga Karteek, P. and Jyoti, K. (2014). Deterministic and Probabilistic models in Inventory Control. IJEDR 2014, 2(3).

Wahyono, B. (2019). Tipe Bisnis Retail. [online] Pendidikanekonomi.com. Available at: http://www.pendidikanekonomi.com/2014/01/tipe-bisnis-retail.html [Accessed 4 Apr. 2019].

APPENDIX

APPENDIX A PRODUCT AVERAGE NET SALES OF EACH STOCKPOINT

Product Average Net Sales of Tuban Stock-point

No.	Material No.	Product	Net Sales per Cycle (Rp.)			Average Net Sales
			Cycle 2	Cycle 3	Cycle 4	
1	100488	Mi Instan Ind. Ayam Bawang	13,170,499	14,767,927	10,399,475	12,779,300
2	100489	Mi Instan Ind. Ayam Special	6,258,852	6,067,474	3,694,773	5,340,366
3	100491	Mi Instan Ind. Goreng Pedas	6,391,750	7,606,430	6,858,192	6,952,124
4	100493	Mi Instan Ind. Goreng Special Plus	69,234,232	99,303,549	125,170,485	97,902,755
5	100496	Mi Instan Ind. Gr Ayam Panggang Jumbo	7,396,956	2,126,024	3,463,144	4,328,708
6	100497	Mi Instan Ind. Goreng Spesial Jumbo	5,412,668	9,921,441	7,586,825	7,640,311
7	100506	Mi Instan Ind. Soto Mi	8,861,428	11,619,102	9,363,252	9,947,927
8	100507	Mi Telor Kuning	1,477,982	3,419,145	2,973,442	2,623,523
9	100508	Mi Telor Merah	2,374,427	5,173,910	4,008,223	3,852,187
10	100766	Mi Instan Sar. Grg Ayam Kecap Dua	8,430,429	9,192,970	5,418,766	7,680,722
…	…	…	…	…	…	…
…	…	…	…	…	…	…
555	199914	QUAKER 3IN1 SIC COKLAT RENCENG 29GR-P	-34,856			-34,856
Total			1,532,212,427	1,767,939,849	2,137,444,453	1,901,974,557

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Product Average Net Sales of Pamekasan Stock-point

No.	Material No.	Product	Net Sales per Cycle (Rp.)			Average Net Sales
			Cycle 2	Cycle 3	Cycle 4	
1	100488	Mi Instan Ind. Ayam Bawang	1,830,231	2,924,739	3,534,711	2,763,227
2	100489	Mi Instan Ind. Ayam Special	1,094,841	934,427	801,182	943,483
3	100491	Mi Instan Ind. Goreng Pedas	2,067,126	5,364,379	3,246,192	3,559,232
4	100493	Mi Instan Ind. Goreng Special Plus	64,962,154	115,784,626	108,064,667	96,270,482
5	100496	Mi Instan Ind. Gr Ayam Panggang Jumbo	2,925,107	4,886,262	3,070,317	3,627,229
6	100497	Mi Instan Ind. Goreng Spesial Jumbo	3,622,774	4,946,926	4,159,723	4,243,141
7	100506	Mi Instan Ind. Soto Mi	3,026,801	5,247,293	4,233,831	4,169,308
8	100507	Mi Telor Kuning	934,051	1,257,842	963,308	1,051,734
9	100508	Mi Telor Merah	1,248,851	245,841	589,657	694,783
10	100766	Mi Instan Sar. Grg Ayam Kecap Dua	19,735,020	19,917,368	13,741,253	17,797,880
…	…	…	…	…	…	…
…	…	…	…	…	…	…
547	199660	Mi Instan Indomie Gr Ayam Geprek	11,055,423	26,650,519	22,684,628	20,130,190
Total			1,377,977,685	1,900,814,253	1,745,983,333	1,714,994,571

Product Average Net Sales of Purworejo Stock-point

| No. | Material No. | Product | Net Sales per Cycle (Rp.) | | | Average Net Sales |
			Cycle 2	Cycle 3	Cycle 4	
1	100488	Mi Instan Ind. Ayam Bawang	9,945,377	9,032,336	13,276,927	10,751,547
2	100489	Mi Instan Ind. Ayam Special	3,996,801	4,673,422	3,576,503	4,082,242
3	100491	Mi Instan Ind. Goreng Pedas	3,595,262	3,366,383	3,487,200	3,482,948
4	100493	Mi Instan Ind. Goreng Special Plus	245,582,402	199,235,266	245,213,390	230,010,353
5	100496	Mi Instan Ind. Gr Ayam Panggang Jumbo	2,268,308	2,735,269	2,241,196	2,414,924
6	100497	Mi Instan Ind. Goreng Spesial Jumbo	2,600,208	2,184,930	1,891,116	2,225,418
7	100506	Mi Instan Ind. Soto Mi	2,584,140	5,182,875	3,318,452	3,695,156
8	100507	Mi Telor Kuning	1,253,658	1,614,007	608,377	1,158,681
9	100508	Mi Telor Merah	1,584,280	1,110,853	930,518	1,208,550
10	100542	Mi Instan Sup. Ayam Bawang	-1,776			-1,776
…	…	…	…	…	…	…
…	…	…	…	…	…	…
514	199914	QUAKER 3IN1 SIC COKLAT RENCENG 29GR-P	-69,710	-6,062		-37,886
Total			1,266,415,062	1,605,546,198	1,405,144,022	1,476,613,707

Product Average Net Sales of Krian Stock-point

No.	Material No.	Product	Net Sales per Cycle (Rp.)			Average Net Sales
			Cycle 2	Cycle 3	Cycle 4	
1	100488	Mi Instan Ind. Ayam Bawang	35,157,357	37,643,608	25,614,541	32,805,169
2	100489	Mi Instan Ind. Ayam Special	144,571,989	144,603,181	91,842,777	127,005,982
3	100491	Mi Instan Ind. Goreng Pedas	1,993,371	1,870,301	1,148,594	1,670,755
4	100493	Mi Instan Ind. Goreng Special Plus	377,158,270	407,689,995	406,874,093	397,240,786
5	100496	Mi Instan Ind. Gr Ayam Panggang Jumbo	978,775	1,123,184	641,819	914,593
6	100497	Mi Instan Ind. Goreng Spesial Jumbo	2,810,633	2,372,058	1,024,237	2,068,976
7	100506	Mi Instan Ind. Soto Mi	3,765,517	1,532,542	2,977,297	2,758,452
8	100507	Mi Telor Kuning	297,850	785,434	280,512	454,599
9	100508	Mi Telor Merah	221,293	660,762	271,161	384,405
10	100766	Mi Instan Sar. Grg Ayam Kecap Dua	19,965,177	22,892,589	18,145,551	20,334,439
…	…	…	…	…	…	…
…	…	…	…	…	…	…
291	199660	Mi Instan Indomie Gr Ayam Geprek	27,401,153	36,179,931	27,992,379	30,524,488
Total			2,011,825,460	2,474,663,485	2,291,037,778	2,308,339,040

Product Average Net Sales of Kenjeran Stock-point

No.	Material No.	Product	Net Sales per Cycle (Rp.)			Average Net Sales
			Cycle 2	Cycle 3	Cycle 4	
1	100488	Mi Instan Ind. Ayam Bawang	2,657,057	2,523,277	3,014,219	2,731,518
2	100489	Mi Instan Ind. Ayam Special	419,862	449,154	390,569	419,862
3	100491	Mi Instan Ind. Goreng Pedas	1,216,708	944,974	2,001,484	1,387,722
4	100493	Mi Instan Ind. Goreng Special Plus	67,586,727	120,981,769	113,561,292	100,709,929
5	100496	Mi Instan Ind. Gr Ayam Panggang Jumbo	1,037,608	1,411,947	1,324,592	1,258,049
6	100497	Mi Instan Ind. Goreng Spesial Jumbo	829,016	1,313,054	1,548,373	1,230,148
7	100506	Mi Instan Ind. Soto Mi	13,794,330	16,453,450	11,179,562	13,809,114
8	100507	Mi Telor Kuning	417,651	322,703	261,810	334,055
9	100508	Mi Telor Merah	310,317	265,285	222,009	265,870
10	100542	Mi Instan Sup. Ayam Bawang		-87,351		-87,351
…	…	…	…	…	…	…
…	…	…	…	…	…	…
291	199914	QUAKER 3IN1 SIC COKLAT RENCENG 29GR-P	-3,031			-3,031
Total			672,801,319	1,093,431,421	874,496,712	904,876,121

Product Average Net Sales of Babat Stock-point

No.	Material No.	Product	Net Sales per Cycle (Rp.)			Average Net Sales
			Cycle 2	Cycle 3	Cycle 4	
1	100488	Mi Instan Ind. Ayam Bawang	3,081,518	5,968,510	5,186,611	4,745,546
2	100489	Mi Instan Ind. Ayam Special	4,430,425	3,077,527	4,096,549	3,868,167
3	100491	Mi Instan Ind. Goreng Pedas	3,972,997	3,250,632	4,809,004	4,010,878
4	100493	Mi Instan Ind. Goreng Special Plus	369,441,949	451,464,392	393,373,566	404,759,969
5	100496	Mi Instan Ind. Gr Ayam Panggang Jumbo	1,164,633	1,088,305	1,095,999	1,116,312
6	100497	Mi Instan Ind. Goreng Spesial Jumbo	2,436,067	2,238,339	2,435,316	2,369,907
7	100506	Mi Instan Ind. Soto Mi	3,682,789	3,234,886	335,868	2,417,848
8	100507	Mi Telor Kuning	516,467	642,065	124,433	427,655
9	100508	Mi Telor Merah	4,965,461	4,376,013	4,201,881	4,514,452
10	100766	Mi Instan Sar. Grg Ayam Kecap Dua	6,256,416	9,993,562	6,210,080	7,486,686
…	…	…	…	…	…	…
…	…	…	…	…	…	…
454	199660	Mi Instan Indomie Gr Ayam Geprek	27,766,728	29,971,912	65,339,514	41,026,051
Total			1,183,412,499	1,567,363,475	1,471,542,977	1,496,927,263

Product Average Net Sales of Sidoarjo Stock-point

No.	Material No.	Product	Net Sales per Cycle (Rp.)			Average Net Sales
			Cycle 2	Cycle 3	Cycle 4	
1	100488	Mi Instan Ind. Ayam Bawang	31,585,386	33,965,868	28,059,087	31,203,447
2	100489	Mi Instan Ind. Ayam Special	1,367,770	869,010	1,173,658	1,136,813
3	100491	Mi Instan Ind. Goreng Pedas	1,186,285	1,204,534	622,545	1,004,455
4	100493	Mi Instan Ind. Goreng Special Plus	337,012,686	398,384,206	269,093,435	334,830,109
5	100496	Mi Instan Ind. Gr Ayam Panggang Jumbo	810,294	1,762,326	2,626,107	1,732,909
6	100497	Mi Instan Ind. Goreng Spesial Jumbo	2,807,958	3,941,837	5,118,504	3,956,100
7	100506	Mi Instan Ind. Soto Mi	51,597,490	54,757,404	41,456,922	49,270,605
8	100507	Mi Telor Kuning	610,896	1,514,764	1,464,896	1,196,852
9	100508	Mi Telor Merah	511,157	1,022,309	744,916	759,461
10	100766	Mi Instan Sar. Grg Ayam Kecap Dua	14,000,758	16,268,731	18,774,144	16,347,878
…	…	…	…	…	…	…
…	…	…	…	…	…	…
299	199914	QUAKER 3IN1 SIC COKLAT RENCENG 29GR-P	-59,102	-86,381	-28,794	-58,092
Total			1,044,376,043	1,434,342,386	1,077,359,244	1,240,435,089

Product Average Net Sales of Waru Stock-point

No.	Material No.	Product	Net Sales per Cycle (Rp.)			Average Net Sales
			Cycle 2	Cycle 3	Cycle 4	
1	100488	Mi Instan Ind. Ayam Bawang	9,873,587	10,974,216	9,267,138	10,038,314
2	100489	Mi Instan Ind. Ayam Special	1,480,525	988,140	624,911	1,031,192
3	100491	Mi Instan Ind. Goreng Pedas	811,138	867,917	1,128,318	935,791
4	100493	Mi Instan Ind. Goreng Special Plus	83,904,823	101,765,688	82,605,435	89,425,315
5	100496	Mi Instan Ind. Gr Ayam Panggang Jumbo	1,888,016	933,313	1,026,912	1,282,747
6	100497	Mi Instan Ind. Goreng Spesial Jumbo	3,583,485	2,594,018	3,337,460	3,171,654
7	100506	Mi Instan Ind. Soto Mi	27,613,904	31,954,788	23,585,062	27,717,918
8	100507	Mi Telor Kuning	2,412,610	3,029,528	3,154,211	2,865,450
9	100508	Mi Telor Merah	1,075,885	997,364	1,199,974	1,091,074
10	100766	Mi Instan Sar. Grg Ayam Kecap Dua	17,625,601	16,699,425	13,413,813	15,912,946
…	…	…	…	…	…	…
…	…	…	…	…	…	…
261	199914	QUAKER 3IN1 SIC COKLAT RENCENG 29GR-P		-21,217		-21,217
Total			819,127,268	1,027,256,594	892,876,830	941,956,974

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Product Average Net Sales of Burneh Stock-point

No.	Material No.	Product	Net Sales per Cycle (Rp.)			Average Net Sales
			Cycle 2	Cycle 3	Cycle 4	
1	100488	Mi Instan Ind. Ayam Bawang	612,307	336,968	-391,508	185,922
2	100489	Mi Instan Ind. Ayam Special	384,976	483,820	217,329	362,042
3	100491	Mi Instan Ind. Goreng Pedas	224,062	892,205	-3,726	370,847
4	100493	Mi Instan Ind. Goreng Special Plus	115,948,943	183,630,207	128,766,352	142,781,834
5	100496	Mi Instan Ind. Gr Ayam Panggang Jumbo	143,328	-2	-81,873	20,484
6	100497	Mi Instan Ind. Goreng Spesial Jumbo	391,869	308,580	475,249	391,899
7	100506	Mi Instan Ind. Soto Mi	518,145	402,695	813,338	578,059
8	100507	Mi Telor Kuning	-12,946	217,805	-32,360	57,500
9	100508	Mi Telor Merah	6,473	208,813	-32,360	60,975
10	100766	Mi Instan Sar. Grg Ayam Kecap Dua	792,147	618,528	145,282	518,652
…	…	…	…	…	…	…
…	…	…	…	…	…	…
329	199914	QUAKER 3IN1 SIC COKLAT RENCENG 29GR-P		-10,608		-10,608
Total			423,596,016	650,926,124	527,482,634	540,252,653

APPENDIX B PRODUCT CLASSIFICATION

ABC Classification of Product on Tuban Stock-point

No.	Material No.	Product	Average Net Value (Rp.)	Contribution Percentage	Cumulative Contribution Percentage	Class
1	100493	Mi Instan Ind. Goreng Special Plus	97,902,755	5.0463%	5.0463%	A
2	129153	Susu Steril Indomilk Choco 190 ml	72,896,607	3.7574%	8.8037%	
3	155032	Ichi Ocha Melati PET 350ml	62,763,221	3.2351%	12.0387%	
4	148000	Krimer Kental Manis Kremer Plain 500g	61,065,514	3.1475%	15.1863%	
5	105729	Mi Instan Ind. Rs Soto Spesial	47,026,369	2.4239%	17.6102%	
…	…	…	…	…	…	
104	124392	Mi Instan Sar Rasa Soto Ayam Dua	3,971,867	0.2047%	80.1295%	B
105	109950	Snack Qtela BBQ 60g	3,861,820	0.1991%	80.3285%	
106	100508	Mi Telor Merah	3,852,187	0.1986%	80.5271%	
107	161463	Susu UHT Indomilk Chocolate 1000 ml	3,842,128	0.1980%	80.7251%	
108	184555	SAAMP135/IF Sambal Asam Manis PET 135ml	3,761,178	0.1939%	80.9190%	
…	…	…	…	…	…	
239	185648	AISHADERM LIGHTENING NIGHT CREAM 20G	1,161,600	0.0599%	95.0030%	C
240	192624	KAHURIPAN KLASIK ORIGINAL KOTAK	1,157,434	0.0597%	95.0627%	
241	193164	Soffell Botol Bengkoang 80gr	1,141,920	0.0589%	95.1215%	
242	125971	ID-68 PEL KATUN KOTAK MEDIUM SET (12)	1,121,140	0.0578%	95.1793%	
243	162276	Pepsi Blue PET 450 ml	1,119,242	0.0577%	95.2370%	
…	…	…	…	…	…	
555	186048	Susu Botol Milkuat Blackcurrant 65 ml	-265,417	-0.0137%	100.0000%	

ABC Classification of Product on Pamekasan Stock-point

No.	Material No.	Product	Average Net Value	Contribution Percentage	Cumulative Contribution Percentage	Class
1	158606	Krimer Kental Manis Kremer Plain 37g	99,035,495	5.7747%	5.7747%	A
2	100493	Mi Instan Ind. Goreng Special Plus	96,270,482	5.6135%	11.3881%	
3	176612	Kental Manis Indomilk Putih Sachet 37g	96,194,795	5.6090%	16.9972%	
4	163564	Susu Kental Manis Indomilk Plain 370g	91,297,261	5.3235%	22.3207%	
5	129153	Susu Steril Indomilk Choco 190 ml	78,723,103	4.5903%	26.9109%	
…	…	…	…	…	…	
63	198007	Mi Instan Sarimi Isi2Rs Mi Dok-Dok Deerr	4,728,054	0.2757%	80.1895%	B
64	180233	Genki Moko Pants L1A	4,717,823	0.2751%	80.4646%	
65	124392	Mi Instan Sar Rasa Soto Ayam Dua	4,659,806	0.2717%	80.7363%	
66	188498	Wonderland Wafer Assorted 300g	4,595,181	0.2679%	81.0043%	
67	175111	Mi Instan Ind Goreng Sambal Rica-rica	4,529,610	0.2641%	81.2684%	
…	…	…	…	…	…	
170	141884	Mi Instan Ind. Goreng Rasa Iga Penyet	1,179,042	0.0687%	95.0230%	C
171	153577	Mi Instan Ind.Kaldu Ayam 75 Gr	1,177,033	0.0686%	95.0916%	
172	185524	Mi Instan Sup Extra Rasa Soto Daging	1,160,913	0.0677%	95.1593%	
173	175862	Susu UHT Kids FC Plain 115 ml	1,155,045	0.0673%	95.2266%	
174	187296	Mi Instan Indomie Rasa Soto Padang	1,154,613	0.0673%	95.2940%	
…	…	…	…	…	…	
547	179351	Garam Meja Gyuri 200gr BAL	-2,100,644	-0.1225%	100.0000%	

ABC Classification of Product on Purworejo Stock-point

No.	Material No.	Product	Average Net Value	Contribution Percentage	Cumulative Contribution Percentage	Class
1	100493	Mi Instan Ind. Goreng Special Plus	230,010,353	15.5769%	15.5769%	A
2	129153	Susu Steril Indomilk Choco 190 ml	107,856,842	7.3043%	22.8812%	
3	176612	Kental Manis Indomilk Putih Sachet 37g	77,880,799	5.2743%	28.1555%	
4	153577	Mi Instan Ind.Kaldu Ayam 75 Gr	56,275,515	3.8111%	31.9666%	
5	129154	Susu Steril Indomilk Straw 190 ml	51,586,452	3.4936%	35.4602%	
…	…	…	…	…	…	
57	136918	Mi Instan Pop Mie Rs Soto Ayam Jumbo	4,659,078	0.3155%	80.1069%	B
58	175702	FSLBF/Freiss Squash Leci Botol 500 ml	4,612,000	0.3123%	80.4192%	
59	163563	Kental Manis Cap Enaak Coklat 370g	4,547,817	0.3080%	80.7272%	
60	153915	Mi Instan Gelas Sarimi Rs Baso Sapi	4,130,807	0.2797%	81.0069%	
61	100489	Mi Instan Ind. Ayam Special	4,082,242	0.2765%	81.2834%	
…	…	…	…	…	…	
160	133485	Mi Instan Sar Soto Koya Jeruk Nipis Dua	924,360	0.0626%	95.0160%	C
161	138823	SUN BC SUSU BERAS MERAH KOTAK	917,964	0.0622%	95.0782%	
162	188751	Total Bunga Softener 650 EKSTRA	914,500	0.0619%	95.1401%	
163	164029	ID-T39 EKONOMIS - SABUT SPONS	911,391	0.0617%	95.2018%	
164	197042	Mi Instan Ind. Krtg Rs Ay Panggang - 20	908,821	0.0615%	95.2634%	
…	…	…	…	…	…	
514	153609	Susu Botol Milkuat Jeruk 130 ml	- 952,394	-0.0645%	100.0000%	

ABC Classification of Product on Krian Stock-point

No.	Material No.	Product	Average Net Value	Contribution Percentage	Cumulative Contribution Percentage	Class
1	100493	Mi Instan Ind. Goreng Special Plus	397,240,786	17.2089%	17.2089%	A
2	100489	Mi Instan Ind. Ayam Special	127,005,982	5.5021%	22.7110%	
3	129153	Susu Steril Indomilk Choco 190 ml	94,819,212	4.1077%	26.8187%	
4	148000	Krimer Kental Manis Kremer Plain 500g	82,225,146	3.5621%	30.3808%	
5	155032	Ichi Ocha Melati PET 350ml	80,852,861	3.5026%	33.8834%	
…	…	…	…	…	…	
32	136916	Mi Instan Pop Mie Rasa Baso Jumbo	20,044,696	0.8684%	80.6813%	B
33	107043	MINYAK GORENG BIMOLI 5LT JRG	17,160,008	0.7434%	81.4246%	
34	136915	Mi Instan Pop Mie Rasa Ayam Jumbo	16,915,960	0.7328%	82.1575%	
35	129155	Susu Steril Indomilk Melon 190 ml	15,179,387	0.6576%	82.8151%	
36	136918	Mi Instan Pop Mie Rs Soto Ayam Jumbo	14,348,050	0.6216%	83.4366%	
…	…	…	…	…	…	
81	100506	Mi Instan Ind. Soto Mi	2,758,452	0.1195%	95.1086%	C
82	101470	Bubur Bayi SUN BC Kacang Hijau Ekonomis	2,687,510	0.1164%	95.2250%	
83	165758	Racik Nasi Goreng Pedas WET (RNGPW)	2,577,859	0.1117%	95.3367%	
84	135539	GOVIT Coklat	2,569,833	0.1113%	95.4480%	
85	111426	Biskuit Wonderland Butter Cookies 300 gr	2,551,624	0.1105%	95.5586%	
…	…	…	…	…	…	
291	172734	RKR / Racik Adonan Kremesan 40gr	-111,364	-0.0048%	100.0000%	

ABC Classification of Product on Kenjeran Stock-point

No.	Material No.	Product	Average Net Value	Contribution Percentage	Cumulative Contribution Percentage	Class
1	100493	Mi Instan Ind. Goreng Special Plus	100,709,929	11.13%	11.13%	A
2	155032	Ichi Ocha Melati PET 350ml	63,766,108	7.05%	18.18%	
3	129153	Susu Steril Indomilk Choco 190 ml	44,479,901	4.92%	23.09%	
4	145210	Susu UHT Indomilk Kids Choco 115 ml	39,366,703	4.35%	27.44%	
5	183578	Mi Instan Indomie Goreng Mi Goreng Aceh	31,237,518	3.45%	30.89%	
…	…	…	…	…	…	
40	101466	Bubur Bayi SUN BC Beras Merah Ekonomis	5,800,149	0.64%	80.12%	B
41	138891	Sun BC Susu Beras Merah Sachet	5,630,353	0.62%	80.74%	
42	136915	Mi Instan Pop Mie Rasa Ayam Jumbo	5,236,602	0.58%	81.32%	
43	110040	RNG/Bumbu Racik Nasi Goreng 200x20gr	5,208,177	0.58%	81.90%	
44	136917	Mi Instan Pop Mie Rs Kari Jumbo	4,987,802	0.55%	82.45%	
…	…	…	…	…	…	
88	100491	Mi Instan Ind. Goreng Pedas	1,387,722	0.15%	95.07%	C
89	171319	Mi Instan Gelas Srm Rasa Kari Ayam	1,321,081	0.15%	95.22%	
90	100496	Mi Instan Ind. Gr Ayam Panggang Jumbo	1,258,049	0.14%	95.36%	
91	149271	Snack Chiki Ball CHE 10G	1,253,388	0.14%	95.50%	
92	159112	MILKUAT POUCH STRAWBERRY 50 ML	1,249,277	0.14%	95.64%	
…	…	…	…	…	…	
291	165129	Fruitamin Cocobit Splash Coco 350 ML @12	-440,682	-0.05%	100.00%	

ABC Classification of Product on Babat Stock-point

No.	Material No.	Product	Average Net Value	Contribution Percentage	Cumulative Contribution Percentage	Class
1	100493	Mi Instan Ind. Goreng Special Plus	404,759,969	27.0394%	27.0394%	A
2	148000	Krimer Kental Manis Kremer Plain 500g	48,640,383	3.2493%	30.2887%	
3	161921	PSPS/PL SAMBAL PEDAS SCH 960 x 8 gr	43,986,587	2.9385%	33.2272%	
4	179351	Garam Meja Gyuri 200gr BAL	42,271,092	2.8239%	36.0511%	
5	145210	Susu UHT Indomilk Kids Choco 115 ml	41,117,262	2.7468%	38.7978%	
…	…	…	…	…	…	
70	175111	Mi Instan Ind Goreng Sambal Rica-rica	4,069,691	0.2719%	80.2684%	B
71	100491	Mi Instan Ind. Goreng Pedas	4,010,878	0.2679%	80.5363%	
72	107394	GARAM MEJA REFINA REF500GR BAL	3,974,863	0.2655%	80.8019%	
73	184556	SAPP135/IF Sambal Pedas PET 135 ml	3,875,656	0.2589%	81.0608%	
74	100489	Mi Instan Ind. Ayam Special	3,868,167	0.2584%	81.3192%	
…	…	…	…	…	…	
179	125991	ID-86 LAP DAPUR MICROFIBER (24)	1,048,331	0.0700%	95.0350%	C
180	145218	Susu UHT Indomilk Vanila 190 ml	1,040,552	0.0695%	95.1045%	
181	166302	Snack Jetz Hollow FRC 40G	1,035,638	0.0692%	95.1737%	
182	146337	Bukrim Floral 45	1,021,832	0.0683%	95.2419%	
183	107011	MARGARIN SIMAS 15KG	1,019,273	0.0681%	95.3100%	
…	…	…	…	…	…	
454	165754	Racik Nasi Goreng Ayam WET (RNGAW)	-399,031	-0.0267%	100.0000%	

ABC Classification of Product on Sidoarjo Stock-point

No.	Material No.	Product	Average Net Value	Contribution Percentage	Cumulative Contribution Percentage	Class
1	100493	Mi Instan Ind. Goreng Special Plus	334,830,109	26.9930%	26.9930%	A
2	100506	Mi Instan Ind. Soto Mi	49,270,605	3.9720%	30.9650%	
3	199060	SUSU KENTAL MANIS INDOMILK CHOCO 37G BDD	40,383,801	3.2556%	34.2206%	
4	176612	Kental Manis Indomilk Putih Sachet 37g	39,507,898	3.1850%	37.4056%	
5	199660	Mi Instan Indomie Gr Ayam Geprek	37,727,089	3.0414%	40.4471%	
…	…	…	…	…	…	
33	110040	RNG/Bumbu Racik Nasi Goreng 200x20gr	7,403,380	0.5968%	80.5590%	B
34	189586	Snack JetZ Stick CHF 12G Renceng	6,400,774	0.5160%	81.0750%	
35	143632	SAPSR/IF Sambal Pedas Sch Joint-3 9 gr	6,147,104	0.4956%	81.5706%	
36	136916	Mi Instan Pop Mie Rasa Baso Jumbo	5,897,220	0.4754%	82.0460%	
37	136918	Mi Instan Pop Mie Rs Soto Ayam Jumbo	5,670,169	0.4571%	82.5031%	
…	…	…	…	…	…	
94	106107	Mi Instan Ind. Goreng Kriuk Pedas	1,335,727	0.1077%	95.0289%	C
95	166097	ID-T57 BASIC - SABUT STAINLESS	1,322,293	0.1066%	95.1355%	
96	106861	SATELIT SO WELL BB PUTIH	1,308,348	0.1055%	95.2410%	
97	184050	Terigu Cakra Kembar P.1 kg	1,283,470	0.1035%	95.3445%	
98	161734	Mi Instan Popmie Mini Ay Bwng RL	1,249,333	0.1007%	95.4452%	
…	…	…	…	…	…	
299	192625	KAHURIPAN KLASIK VANILLA KOTAK	-295,285	-0.0238%	100.0000%	

ABC Classification of Product on Waru Stock-point

No.	Material No.	Product	Average Net Value	Contribution Percentage	Cumulative Contribution Percentage	Class
1	100493	Mi Instan Ind. Goreng Special Plus	89,425,315	9.4936%	9.4936%	A
2	145210	Susu UHT Indomilk Kids Choco 115 ml	33,699,237	3.5776%	13.0711%	
3	106661	Mi Instan Ind. New Kari	30,977,184	3.2886%	16.3597%	
4	100506	Mi Instan Ind. Soto Mi	27,717,918	2.9426%	19.3023%	
5	129153	Susu Steril Indomilk Choco 190 ml	27,326,892	2.9011%	22.2034%	
…	…	…	…	…	…	
42	193151	Kispray Pouch Glamorous Gold 300ml	7,042,671	0.7477%	80.5358%	B
43	161921	PSPS/PL SAMBAL PEDAS SCH 960 x 8 gr	6,424,621	0.6821%	81.2179%	
44	189587	Snack Cheetos Twist ROC 15G Renceng	6,304,221	0.6693%	81.8871%	
45	184559	SAEP135/IF Sambal Ekstra Pedas PET135ml	6,273,890	0.6660%	82.5532%	
46	143632	SAPSR/IF Sambal Pedas Sch Joint-3 9 gr	5,554,626	0.5897%	83.1429%	
…	…	…	…	…	…	
92	156845	Mi Instan Sup Ayam Bawang75Gr	1,161,750	0.1233%	95.0478%	C
93	149273	Snack Chiki Ball CHO 10G	1,108,135	0.1176%	95.1655%	
94	135539	GOVIT Coklat	1,093,223	0.1161%	95.2815%	
95	100508	Mi Telor Merah	1,091,074	0.1158%	95.3974%	
96	175705	FSMBF/Freiss Sirup Melon Botol 500 ml	1,069,213	0.1135%	95.5109%	
…	…	…	…	…	…	
261	162276	Pepsi Blue PET 450 ml	-295,751	-0.0314%	100.0000%	

ABC Classification of Product on Burneh Stock-point

No.	Material No.	Product	Average Net Value	Contribution Percentage	Cumulative Contribution Percentage	Class
1	100493	Mi Instan Ind. Goreng Special Plus	142,781,834	26.4287%	26.4287%	A
2	154536	Mi Instan Sar Ayam Bawang 75 Gr	36,467,762	6.7501%	33.1788%	
3	145210	Susu UHT Indomilk Kids Choco 115 ml	27,894,220	5.1632%	38.3420%	
4	199660	Mi Instan Indomie Gr Ayam Geprek	27,534,103	5.0965%	43.4386%	
5	148000	Krimer Kental Manis Kremer Plain 500g	20,046,296	3.7105%	47.1491%	
…	…	…	…	…	…	
29	101466	Bubur Bayi SUN BC Beras Merah Ekonomis	3,046,501	0.5639%	80.3223%	B
30	143017	AMDK CLUB 240 ML	3,026,723	0.5602%	80.8825%	
31	107043	MINYAK GORENG BIMOLI 5LT JRG	3,017,507	0.5585%	81.4411%	
32	129152	Susu Steril Indomilk Vanila 190 ml	2,430,218	0.4498%	81.8909%	
33	130815	Mi Instan Ind Goreng Cabe Ijo 85 Gr	2,253,917	0.4172%	82.3081%	
…	…	…	…	…	…	
90	139967	Sun Marie Roll Kecil New	577,622	0.1069%	95.0677%	C
91	191734	Wonderland Wafer Coconut 45g	545,454	0.1010%	95.1686%	
92	187295	Mi Instan Sarimi Isi 2 Rs Grg Teri Pedas	534,074	0.0989%	95.2675%	
93	100766	Mi Instan Sar. Grg Ayam Kecap Dua	518,652	0.0960%	95.3635%	
94	110037	RAG/Bumbu Racik Ayam Goreng 200x26gr	515,267	0.0954%	95.4589%	
…	…	…	…	…	…	
329	111426	Biskuit Wonderland Butter Cookies 300 gr	- 1,003,167	-0.1857%	100.0000%	

APPENDIX C DEMAND DATA OF THE SAMPLES

Demand Data for Samples - 2018

Stock point	Material No	Product	Unit	Days	1	2	3	4	5	…	5
			Cycle		**1**					**…**	**12**
			Week		**1**						**52**
SP BOJONEGORO	155032	Ichi Ocha Melati PET 350ml	Car	2018	0.0	5.0	30.0	20.0	67.0	…	1025.0
SP BOJONEGORO	138891	Sun BC Susu Beras Merah Sachet	Car		0.0	0.3	0.5	0.4	1.4	…	5.5
SP BOJONEGORO	108387	SAPS-N/Sambal Pedas Sch 504 x 9 gr	Car		0.0	0.0	0.0	0.0	0.0	…	0.0
SP TUBAN	129153	Susu Steril Indomilk Choco 190 ml	Car		0.0	10.1	19.8	80.0	22.8	…	323.1
SP TUBAN	109950	Snack Qtela BBQ 60g	Car		0.0	0.0	3.0	0.0	0.0	…	12.1
SP TUBAN	125971	ID-68 PEL KATUN KOTAK MEDIUM SET (12)	Car		0.0	0.0	0.0	0.0	0.0	…	0.0
SP PAMEKASAN	158606	Krimer Kental Manis Kremer Plain 37g	Car		0.0	16.3	8.2	68.7	29.3	…	0.0

Stock point	Material No	Product	Unit	Days	1	2	3	4	5	...	5
				Cycle			1			...	12
				Week			1				52
SP PAMEKASAN	173597	Genki Moko Moko Pants L1A	Car		0.0	2.0	1.3	0.7	0.4	...	0.0
SP PAMEKASAN	155983	IKMT-N/Indofood Kecap Manis PET 275 ml	Car		0.0	0.0	0.0	0.0	0.0	...	0.0
SP PURWOREJO	129153	Susu Steril Indomilk Choco 190 ml	Car		0.0	0.0	14.0	4.8	23.4	...	0.0
SP PURWOREJO	165942	Bukrim Oxyklin Romantic Floral 800	Car		0.0	0.0	0.0	0.0	2.0	...	0.0
SP PURWOREJO	138823	SUN BC SUSU BERAS MERAH KOTAK	Car		0.0	0.0	0.0	0.5	1.0	...	0.0
SP KRIAN	129153	Susu Steril Indomilk Choco 190 ml	Car		0.0	2.0	60.5	34.0	362.0	...	0.0
SP KRIAN	107043	MINYAK GORENG BIMOLI 5LT JRG	Car		0.0	0.0	0.0	0.0	1.0	...	0.0
SP KRIAN	101470	Bubur Bayi SUN BC Kacang Hijau Ekonomis	Car		0.0	0.0	0.0	1.3	0.7	...	0.0

| Stock point | Material No | Product | Unit | Cycle | | | 1 | | | ... | 12 |
| | | | | Week | | | 1 | | | | 52 |
				Days	1	2	3	4	5	...	5
SP KENJERAN	155032	Ichi Ocha Melati PET 350ml	Car		0.0	0.0	0.0	4.0	8.0	...	0.0
SP KENJERAN	101466	Bubur Bayi SUN BC Beras Merah Ekonomis	Car		0.0	0.0	0.0	0.3	0.0	...	0.0
SP KENJERAN	187296	Susu UHT Indomilk Choco 190 ml	Car		0.0	0.0	0.5	0.0	0.3	...	0.0
SP BABAT	148000	Krimer Kental Manis Kremer Plain 500g	Car		0.0	0.2	4.3	2.4	1.8	...	0.0
SP BABAT	107394	GARAM MEJA REFINA REF500GR BAL	Bal		0.0	0.0	0.0	0.0	1.0	...	0.0
SP BABAT	126009	Susu UHT Indomilk Vanila 190 ml	Car		0.0	0.0	0.5	0.0	0.0	...	0.0
SP SIDOARJO	176612	Kental Manis Indomilk Putih Sachet 37g	Car		0.0	3.0	39.4	29.3	29.7	...	0.0
SP SIDOARJO	110040	RNG/Bumbu Racik Nasi Goreng 200x20gr	Rcg		0.0	0.0	25.0	29.0	46.0	...	0.0

Stock point	Material No	Product	Unit	Days	1	2	3	4	5	…	5
				Cycle			1			…	12
				Week			1				52
SP SIDOARJO	166097	ID-T57 BASIC - SABUT STAINLESS	Car		0.0	0.0	0.0	0.2	0.0	…	0.0
SP WARU	145210	Susu UHT Indomilk Kids Choco 115 ml	Car		0.0	5.0	24.5	17.5	29.5	…	0.0
SP WARU	161921	PSPS/PL SAMBAL PEDAS SCH 960 x 8 gr	Car		0.0	0.0	1.0	2.0	0.0	…	0.0
SP WARU	149273	Snack Chiki Ball CHO 10G	Car		0.0	0.0	0.0	3.0	1.0	…	0.0
SP BURNEH	145210	Susu UHT Indomilk Kids Choco 115 ml	Car		0.0	1.0	5.1	12.5	14.7	…	0.0
SP BURNEH	101466	Bubur Bayi SUN BC Beras Merah Ekonomis	Car		0.0	0.336	0.916	0.25	1.749	…	0.0
SP BURNEH	139967	Sun Marie Roll Kecil New	Car		0.0	0.0	0.0	0.0	0.0	…	0.0

Demand Data of Samples - 2019

Stock point	Material No	Product	Unit	Days	1	2	3	4	5	…	2
Cycle					**1**					**…**	**5**
Week					**1**						**20**
SP BOJONEGORO	155032	Ichi Ocha Melati PET 350ml	Car	2019	0.0	0.0	0.0	0.0	5.0	…	36.0
SP BOJONEGORO	138891	Sun BC Susu Beras Merah Sachet	Car		0.0	0.0	0.0	0.0	0.8	…	0.5
SP BOJONEGORO	108387	SAPS-N/Sambal Pedas Sch 504 x 9 gr	Car		0.0	0.0	0.0	0.0	0.0	…	2.0
SP TUBAN	129153	Susu Steril Indomilk Choco 190 ml	Car		0.0	0.0	14.3	0.5	51.1	…	0.0
SP TUBAN	109950	Snack Qtela BBQ 60g	Car		0.0	0.0	0.0	0.0	3.0	…	0.0
SP TUBAN	125971	ID-68 PEL KATUN KOTAK MEDIUM SET (12)	Car		0.0	0.0	0.0	0.0	0.0	…	0.0
SP PAMEKASAN	158606	Krimer Kental Manis Kremer Plain 37g	Car		0.0	0.0	0.0	0.0	4.5	…	0.0

Stock point	Material No	Product	Unit	Days	1	2	3	4	5	…	2
				Cycle			1			…	5
				Week			1				20
SP PAMEKASAN	173597	Genki Moko Moko Pants L1A	Car		0.0	0.0	6.5	0.0	3.8	…	0.0
SP PAMEKASAN	155983	IKMT-N/Indofood Kecap Manis PET 275 ml	Car		0.0	0.0	0.3	0.0	0.5	…	0.0
SP PURWOREJO	129153	Susu Steril Indomilk Choco 190 ml	Car		0.0	0.0	0.0	15.5	51.3	…	28.5
SP PURWOREJO	165942	Bukrim Oxyklin Romantic Floral 800	Car		0.0	0.0	0.0	0.0	0.0	…	0.0
SP PURWOREJO	138823	SUN BC SUSU BERAS MERAH KOTAK	Car		0.0	0.0	0.0	0.0	1.1	…	0.0
SP KRIAN	129153	Susu Steril Indomilk Choco 190 ml	Car		0.0	0.0	0.0	3.0	54.5	…	0.0
SP KRIAN	107043	MINYAK GORENG BIMOLI 5LT JRG	Car		0.0	0.0	0.0	0.0	0.0	…	0.0
SP KRIAN	101470	Bubur Bayi SUN BC Kacang Hijau Ekonomis	Car		0.0	0.0	0.0	0.0	1.3	…	0.0

Stock point	Material No	Product	Unit	Days	1	2	3	4	5	...	2
				Cycle			1			...	5
				Week			1				20
SP KENJERAN	155032	Ichi Ocha Melati PET 350ml	Car		0.0	0.0	12.0	23.0	3.0	...	0.0
SP KENJERAN	101466	Bubur Bayi SUN BC Beras Merah Ekonomis	Car		0.0	0.0	0.5	1.7	0.0	...	0.0
SP KENJERAN	187296	Susu UHT Indomilk Choco 190 ml	Car		0.0	0.0	0.2	1.0	1.1	...	0.0
SP BABAT	148000	Krimer Kental Manis Kremer Plain 500g	Car		0.0	0.0	1.0	1.6	2.4	...	0.8
SP BABAT	107394	GARAM MEJA REFINA REF500GR BAL	Bal		0.0	0.0	0.0	0.0	1.0	...	3.1
SP BABAT	126009	Susu UHT Indomilk Vanila 190 ml	Car		0.0	0.0	0.0	0.0	0.0	...	0.0
SP SIDOARJO	176612	Kental Manis Indomilk Putih Sachet 37g	Car		0.0	0.0	0.0	22.7	34.8	...	13.9
SP SIDOARJO	110040	RNG/Bumbu Racik Nasi Goreng 200x20gr	Rcg		0.0	0.0	0.0	18.0	39.0	...	9.6

Stock point	Material No	Product	Unit	Days	1	2	3	4	5	…	2
				Cycle			1			…	5
				Week			1				20
SP SIDOARJO	166097	ID-T57 BASIC - SABUT STAINLESS	Car		0.0	0.0	0.0	0.2	0.0	…	0.0
SP WARU	145210	Susu UHT Indomilk Kids Choco 115 ml	Car		0.0	0.0	42.0	5.0	12.3	…	0.0
SP WARU	161921	PSPS/PL SAMBAL PEDAS SCH 960 x 8 gr	Car		0.0	0.0	2.0	0.0	1.0	…	0.0
SP WARU	149273	Snack Chiki Ball CHO 10G	Car		0.0	0.0	0.0	0.0	0.0	…	0.0
SP BURNEH	145210	Susu UHT Indomilk Kids Choco 115 ml	Car		0.0	0.0	6.5	7.5	30.8	…	19.6
SP BURNEH	101466	Bubur Bayi SUN BC Beras Merah Ekonomis	Car		0.0	0.0	6.5	7.5	30.75	…	1
SP BURNEH	139967	Sun Marie Roll Kecil New	Car		0.0	0.0	0.0	0.333	2.332	…	0.3

APPENDIX D DEMAND DISTRIBUTION FOR QUARTER 2, 3, 4

Demand distribution for Quarter 2

Stock Point	Product Name	Q2			
		C1	C2	C3	C4
SP BOJONEGORO	Ichi Ocha Melati PET 350ml	0	Unif (0.727,10.272)	Unif (9.441,101.391)	Unif (12.004,186)
	Sun BC Susu Beras Merah Sachet	0	Unif (0.070,1.016)	Unif (0.917,4.975)	Unif (4.85,6.35)
	SAPS-N/Sambal Pedas Sch 504 x 9 gr	0	Norm (0.231.209)	Norm (2.996,2.926)	
SP TUBAN	Susu Steril Indomilk Choco 190 ml	0	Unif (0.790,10.305)	Unif (8.546,95.38)	Unif (87.633,528.45)
	Snack Qtela BBQ 60g	0	Norm (0.207,0.265)	Norm (3.488,2.157)	
	ID-68 PEL KATUN KOTAK MEDIUM SET (12)	0	1	0	
SP PAMEKASAN	Krimer Kental Manis Kremer Plain 37g	0	Unif (0.174,9.874)	Unif (8.632,97.915)	Unif (77.124,412.86)
	Genki Moko Moko Pants L1	0	Norm (0.467,0.284)	Norm (2.688,1.757)	
	IKMT-N/Indofood Kecap Manis PET 275 ml	0	Norm (0.386,0.304)	Norm (2.06,0.661)	
SP PURWOREJO	Susu Steril Indomilk Choco 190 ml	0	Norm (19.746,17.72)	Norm (264.07,132.61)	
	Bukrim Oxyklin Romantic Floral 800	0	Norm (0.444,0.249)	Norm (3.798,4.464)	
	SUN BC SUSU BERAS MERAH KOTAK	0	Norm (0.662,0.361)	Norm (1.916,0.341)	
SP KRIAN	Susu Steril Indomilk Choco 190 ml	0	Norm (24.569,16.304)	Norm (258.04,116.08)	

Stock Point	Product Name	Q2			
		C1	C2	C3	C4
	MINYAK GORENG BIMOLI 5LT JRG	0	Norm (3.442,2.146)	Norm (15.4,5.272)	
	Bubur Bayi SUN BC Kacang Hijau Ekonomis	0	Norm (0.499,0.215)	Norm (1.8616,1.2076)	
SP KENJERAN	Ichi Ocha Melati PET 350ml	0	Unif (0.82,10.18)	Unif (8.629,77.37)	Unif (44.714,677.29)
	Bubur Bayi SUN BC Beras Merah Ekonomis	0	Norm (0.537,0.268)	Norm (2.872,1.914)	
	Susu UHT Indomilk Choco 190 ml	0	Norm (0.416,0.091)	Norm (1.689,0.862)	
SP BABAT	Krimer Kental Manis Kremer Plain 500g	0	Norm (2.620,2.060)	Norm (19.203,9.977)	
	GARAM MEJA REFINA REF500GR BAL	0	Norm (1.322,0.604)	Norm (6.348,3.075)	
	Susu UHT Indomilk Vanila 190 ml	0	Norm (0.328,0.145)	Norm (2.333,1.598)	
SP SIDOARJO	Kental Manis Indomilk Putih Sachet 37g	0	Norm (16.987,15.564)	Norm (93.857,35.837)	
	RNG/Bumbu Racik Nasi Goreng 200x20gr	0	Norm (19.695,12.314)	Norm (94.188,30.35)	
	ID-T57 BASIC - SABUT STAINLESS	0	Norm (0.130,0.062)	1.743	
SP WARU	Susu UHT Indomilk Kids Choco 115 ml	0	Norm (4.804,2.47)	Norm (24.006,11.302)	
	PSPS/PL SAMBAL PEDAS SCH 960 x 8 gr	0	Norm (0.258,0.132)	Norm (2.242,1.693)	
	Snack Chiki Ball CHO 10G	0	Norm (1.416,1.228)	Norm (13.125,8.207)	

Stock Point	Product Name	Q2			
		C1	C2	C3	C4
SP BURNEH	Susu UHT Indomilk Kids Choco 115 ml	0	Norm (6.306,2.336)	Norm (21.865,11.289)	
	Bubur Bayi SUN BC Beras Merah Ekonomis	0	Norm (0.471,0.230)	Norm (3.069,3.507)	
	Sun Marie Roll Kecil New	0	0.075	Norm (0.752,1.244)	

Demand Distribution for Quarter 3

Stock Point	Product Name	Q3			
		C1	C2	C3	C4
SP BOJONEGORO	Ichi Ocha Melati PET 350ml	0	Unif (0.7,10.3)	Unif (9.106,101.894)	Unif (37.645,2128.4)
	Sun BC Susu Beras Merah Sachet	0	Unif (0.006,1.013)	Unif (0.939,4.899)	Unif (4.528,11.471)
	SAPS-N/Sambal Pedas Sch 504 x 9 gr	0	Norm (0.242,0.119)	Norm (2.805,1.746)	
SP TUBAN	Susu Steril Indomilk Choco 190 ml	0	Unif (0.452,10.214)	Norm (27.776,19.442)	Unif (107.87,619.47)
	Snack Qtela BBQ 60g	0	Norm (0.315,0.241)	Norm (3.439,2.254)	
	ID-68 PEL KATUN KOTAK MEDIUM SET (12)	0	Unif (0.388,10.325)	Unif (2.154,101.028)	
SP PAMEKASAN	Krimer Kental Manis Kremer Plain 37g	0	Unif (0.091,9.908)	Norm (33.611,18.82)	Unif (95.63,328.52)
	Genki Moko Moko Pants L1	0	Norm (0.345,0.197)	Norm (2.956,2.269)	

Stock Point	Product Name	Q3			
		C1	C2	C3	C4
	IKMT-N/Indofood Kecap Manis PET 275 ml	0	Norm (0.236,0.178)	Norm (1.553,0.438)	
SP PURWOREJO	Susu Steril Indomilk Choco 190 ml	0	Norm (24.076,19.173)	Norm (270.69,223.06)	
	Bukrim Oxyklin Romantic Floral 800	0	Norm (0.233,0.148)	Norm (4.671,4.035)	
	SUN BC SUSU BERAS MERAH KOTAK	0	Norm (0.697,0.334)	Norm (1.517,0.292)	
SP KRIAN	Susu Steril Indomilk Choco 190 ml	0	Norm (30.822,21.784)	Norm (326.61,226.71)	
	MINYAK GORENG BIMOLI 5LT JRG	0	Norm (3.571,2.306)	Norm (17.833,8.111)	
	Bubur Bayi SUN BC Kacang Hijau Ekonomis	0	Norm (0.462,0.206)	Norm (2.2976,1.7535)	
SP KENJERAN	Ichi Ocha Melati PET 350ml	0	Unif (0.795,10.204)	Unif (8.75,76.25)	Unif (77.333,402.67)
	Bubur Bayi SUN BC Beras Merah Ekonomis	0	Norm (0.496,0.281)	Norm (2.636,1.713)	
	Susu UHT Indomilk Choco 190 ml	0	Norm (0.422,0.17)	Norm (1.777,0.907)	
SP BABAT	Krimer Kental Manis Kremer Plain 500g	0	Norm (2.169,1.929)	Norm (17.491,5.380)	
	GARAM MEJA REFINA REF500GR BAL	0	Norm (1.232,0.591)	Norm (7.454,3.989)	
	Susu UHT Indomilk Vanila 190 ml	0	Norm (0.333,0.191)	Norm (13.658,17.735)	
SP SIDOARJO	Kental Manis Indomilk Putih Sachet 37g	0	Norm (19.591,11.387)	Norm (77.253,23.255)	

Stock Point	Product Name	Q3			
		C1	C2	C3	C4
	RNG/Bumbu Racik Nasi Goreng 200x20gr	0	Norm (21.983,13.157)	Norm (81.125,26.069)	
	ID-T57 BASIC - SABUT STAINLESS	0	Norm (0.159,0.094)	Norm (2.065,1.183)	
SP WARU	Susu UHT Indomilk Kids Choco 115 ml	0	Norm (4.45,3.485)	Norm (25.306,10.475)	
	PSPS/PL SAMBAL PEDAS SCH 960 x 8 gr	0	Norm (0.328,0.260)	Norm (1.913,1.025)	
	Snack Chiki Ball CHO 10G	0	Norm (0.298,0.326)	Norm (2,1.414)	
SP BURNEH	Susu UHT Indomilk Kids Choco 115 ml	0	Norm (5.29,3.260)	Norm (19.978,9.739)	
	Bubur Bayi SUN BC Beras Merah Ekonomis	0	Norm (0.548,0.231)	Norm (1.845,1.039)	
	Sun Marie Roll Kecil New	0	Norm (0.094,0.062)	Norm (0.257,0.129)	

Demand Distribution for Quarter 4

Stock Point	Product Name	Q4			
		C1	C2	C3	C4
SP BOJONEGORO	Ichi Ocha Melati PET 350ml	0	Unif (0.795,10.204)	Unif (9.145,101.854)	Unif (100.21,3263.2)
	Sun BC Susu Beras Merah Sachet	0	Unif (0.086,1.013)	Norm (2.521,0.856)	Unif (4.8,6.6)
	SAPS-N/Sambal Pedas Sch 504 x 9 gr	0	Norm (0.483,0.379)	Norm (2.156,0.88)	
SP TUBAN	Susu Steril Indomilk Choco 190 ml	0	Unif (0.465,10.369)	Unif (9.078,100.677)	Unif (172.58,568)
	Snack Qtela BBQ 60g	0	Norm (0.316,0.208)	Norm (3.210,2.276)	

Stock Point	Product Name	Q4			
		C1	C2	C3	C4
	ID-68 PEL KATUN KOTAK MEDIUM SET (12)	0	Unif (0.2,0.985)	1	
SP PAMEKASAN	Krimer Kental Manis Kremer Plain 37g	0	Unif (0.270,10.321)	Unif (8.498,100.052)	Unif (61.517,579.98)
	Genki Moko Moko Pants L1	0	Norm (0.409,0.251)	Norm (2.689,1.965)	
	IKMT-N/Indofood Kecap Manis PET 275 ml	0	Norm (0.441,0.339)	Norm (1.712,0.560)	
SP PURWOREJO	Susu Steril Indomilk Choco 190 ml	0	Norm (26.336,22.13)	Norm (281.28,149.13)	
	Bukrim Oxyklin Romantic Floral 800	0	Norm (0.5,0.288)	Norm (5.583,4.928)	
	SUN BC SUSU BERAS MERAH KOTAK	0	Norm (0.592,0.357)	Norm (1.833,0.376)	
SP KRIAN	Susu Steril Indomilk Choco 190 ml	0	Norm (29.146,20.242)	Norm (294.28,135.5)	
	MINYAK GORENG BIMOLI 5LT JRG	0	Norm (3.489,2.315)	Norm (15,4.690)	
	Bubur Bayi SUN BC Kacang Hijau Ekonomis	0	Norm (0.472,0.223)	Norm (1.858,0.985)	
SP KENJERAN	Ichi Ocha Melati PET 350ml	0	Unif (0.790,10.209)	Unif (9.2571,73.743)	Unif (65.8,656.2))
	Bubur Bayi SUN BC Beras Merah Ekonomis	0	Norm (0.530,0.254)	Norm (2.674,1.753)	
	Susu UHT Indomilk Choco 190 ml	0	Norm (0.443,0.196)	Norm (1.944,1.150)	
SP BABAT	Krimer Kental Manis Kremer Plain 500g	0	Norm (2.439,1.996)	Norm (16.156,6.246)	

Stock Point	Product Name	Q4			
		C1	C2	C3	C4
	GARAM MEJA REFINA REF500GR BAL	0	Norm (1.411,0.652)	Norm (6.507,3.34)	
	Susu UHT Indomilk Vanila 190 ml	0	Norm (0.347,0.189)	Norm (3.120,2.234)	
SP SIDOARJO	Kental Manis Indomilk Putih Sachet 37g	0	Norm (18.533,13.57)	Norm (91.118,32.683)	
	RNG/Bumbu Racik Nasi Goreng 200x20gr	0	Norm (20.539,12.799)	Norm (94.412,34.57)	
	ID-T57 BASIC - SABUT STAINLESS	0	Norm (0.196,0.182)	Norm (1.416,0.404)	
SP WARU	Susu UHT Indomilk Kids Choco 115 ml	0	Norm (5.221,2.879)	Norm (27.321,11.613)	
	PSPS/PL SAMBAL PEDAS SCH 960 x 8 gr	0	Norm (0.207,0.125)	Norm (1.950,1.330)	
	Snack Chiki Ball CHO 10G	0	Norm (0.250,0.144)	Norm (1.45,0.759)	
SP BURNEH	Susu UHT Indomilk Kids Choco 115 ml	0	Norm (5.688,2.730)	Norm (22.19,11.272)	
	Bubur Bayi SUN BC Beras Merah Ekonomis	0	Norm(0.145,1.021)	Norm (1.930,0.852)	
	Sun Marie Roll Kecil New	0	0.75	Norm (0.254,0.139)	

AUTHOR'S BIOGRAPHY

Made Gilang Sedayu Bagaskara .S was born on Denpasar, 9th of February 1998. Author is the middle son of 3 siblings from Putu Rizet Suharta and Yanti Rosita Wati. Formal education that has been passed by the author comes from SD Santo Yoseph 2 Denpasar, SMP Negeri 7 Denpasar, SMA Negeri 4 Denpasar, and moves to undergraduate study on Industrial Engineering of Sepuluh Nopember Institute of Technology Surabaya. During his time as a university student, the writer was active in several activities beside study, such as organization, competition, and internship.

On October 2017, author was given the opportunity to be a part of laboratory assistant of Logistics and Supply Chain Management Laboratory ITS. During his tenure, author has taken the responsibility as teaching assistant of several lectures, which are Production Planning and Inventory Control (PPIC) and Logistic System. Besides that, author also active on joining competition during his study and has winning some of it, which are Winner of National Case Competition by Universitas Lambung Mangkurat, 1st Runner Up of Astra Motor Business Case Competition by Astra Motor, and Best of Team on National Business Plan Competition by BEM FEB UNS. Author also have experiences on internship for several companies, such as PT. HM Sampoerna Tbk, on their internship program titled INKOMPASS placed on People and Culture Division, PT. Toyota Astra Finances as Human Resources Management Internee, and PT. Indomarco Adi Prima. During his time as a university student, the authors has awarded 2 scholarships, which are Astra1st scholarship program by PT. Astra International Tbk. and Schneider Electric Campus Ambassador (SECA) by PT. Schneider Electric. Author has some interest on logistics and supply chain management field, which has been reflected by the completion of this research. For further information, author is able to be contacted via email on *gilangsedayu98@gmail.com*