# An Analysis of Inventory Management of T-Shirt at Mahanagari Bandung Pisan

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***ABSTRACT***

*Inventory management plays an important role in business activity for fulfilling the demand from the customer. Mahanagari Bandung Pisan, a retail company that runs its business in designing and creating the merchandise of Bandung, currently faces a problem within its inventory management of T-shirt, the main product of the company that contributes about 79 percent of the whole total sales. The company produces a high number of inventories, but there is still lost sales occurred. This research is aimed at reviewing and finding the root causes of the problems occurred within inventory management of T-shirt in Mahanagari Bandung Pisan, by using the concept of inventory cycle for describing the current system implemented by Mahanagari Bandung Pisan in planning and managing the inventory of T-shirt. From the research, there are four main problems faced by the company in managing the inventory of the T-shirt. Those problems are inaccurate forecasting, unfixed schedule in ordering the T-shirt to the vendor, lateness from vendor, and the office does not know current condition of T-shirt's inventory. This paper proposed some solutions for solving the problem, which are combining the intuitive prediction method with moving average model for getting the more accurate demand forecasting, making the timeline in controlling and producing the inventory of T-shirt, implementing periodical control system and put a clause about sanction in the contract made by Mahanagari Bandung Pisan and the vendor and controlling the salesperson everyday and creating the rules about inventory recording.*

*Key words: inventory management, inventory cycle, mahanagari bandung pisan, forecasting, t-shirt*

## Introduction

In running a business, inventory management has a big role in fulfilling the demand from the customer. Without a good inventory management, the continuity of fulfilling the demand will not run well because when the company does not have any inventory, the demand from the customer cannot be fulfilled.

Beside, that poor inventory management will also cause a bad image from the customer through the company.

The customer may move into the other competitors when they cannot find the product they are looking for. Of course, this condition will bring a great loss to both the company and the customer. In a retail company, the cost spent for the inventory is quite big. For some retail companies, even more than a half of the total capital invested by the company is used for making the inventory. Besides considering the cost, there is also lead-time for getting the inventory. Lead-time is the time interval from the ordering time until the product is ready to be used by the customer. To prevent the

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products from the stock out, a company must consider about the lead-time of its products. Because of that, the control through the inventory becomes very vital. Nowadays, the retail companies put more attention in improving their inventory management in order to minimize the cost and to maximize the profit. A well-planned inventory management can support the company to expand their operational activity and to compete with its competitors to get the market share.

Mahanagari Bandung Pisan is a retail company located in Bandung that runs its business in creative sector. Mahanagari Bandung Pisan produces merchandises of Bandung by using t-shirt, pin, keychain and other contemporary media. Currently, this company has two retail outlets that located in Cihampelas Walk and Bandung Indah Plaza. Moreover, this company is not only an ordinary company. Mahanagari Bandung Pisan stated itself as a culture campaign company. This company carries a social mission, which is increasing the love and the sense of belonging of the Bandung's citizen to their own city. Mahanagari Bandung Pisan also tries to actively participate in introducing Bandung's culture to the visitors. Therefore, Mahanagari Bandung Pisan runs a business that designs and creates a lot of creative apparel and merchandise that contains and describes a lot of knowledge and history about Bandung.

From all products sold by Mahanagari Bandung Pisan, T-shirt is the main media used by the company to spread the message and knowledge about Bandung. It is because people can directly see the message or knowledge about Bandung put in this media when the customer wears the T-shirt sold by the company. Not only become the best media for spreading the social mission of the company, from the sales point of view, T-shirt is the main product of Mahanagari Bandung Pisan that contributes the highest sales proportion among all products sold by the company. Figure 1 shows that as much as 79% of the total revenue gained by the company is resulted from the sales of T-shirt. Because of that, the continuity of T-shirt's inventory must be prioritized and controlled very well.

Mahanagari Bandung Pisan has to improve their performance through the management system of T-shirt's inventory in order to increase the efficiency and to maximize the profit of the company. Related to this condition, the author will study about inventory management used by Mahanagari Bandung Pisan in arranging and controlling the T-shirt.
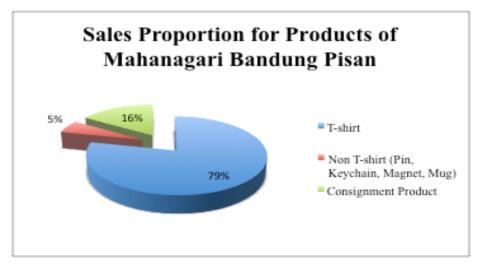


Figure 1. Sales proportion for products of Mahanagari Bandung Pisan

## Theoretical Foundation

### Merchandise

Based on en.wikipedia.or/wiki/Merchandise, "*Merchandise, in terms of marketing, is any product that can be offered to a market that might satisfy a want or need*". This sentence shows that merchandise is not only about the physical object of a thing. Merchandise can also mean the benefits perceived by the customer from the products they buy. Usually, merchandise is sold in retail.

The main characteristic of merchandise is its visual display that using the product design, packaging, pricing, and display to influence the customer to buy the products. Merchandise has different annual cycle between countries and also the products itself. Typically, the sales of merchandise increases during the cultural customs, such as holiday and seasonal issues such as climate and recreation.

**Supply Chain**

"A supply chain consists of all parties involved, directly or indirectly, in fulfilling customer request. The supply chain includes the manufacturer and suppliers, but also transporters, warehouses, retailers, and even customer themselves. A supply chain is dynamic and involves the constant flow of information, product, and funds between different stages. A typical supply chain may involve a variety of stages include customers, retailers, wholesalers/distributors, manufacturers, and component/raw material suppliers"(Chopra and Meindl, 2007:19-21).

Beside the definition above, APICS dictionary defines SCM as the "*design, planning, execution, control, and monitoring of supply chain activities with the objective of creating net value, building a competitive infrastructure, leveraging worldwide logistics, synchronizing supply with demand, and measuring performance globally.*"

Every company has to set the most strategic and appropriate supply chain to maximize its profitability. The concept above defines that supply chain does not only include the interaction between the company and its supplier and manufacturer. Supply chain must consider about all party that related with the company. All of these functions' aim is to fulfill the demand from the customer. Nowadays, the competition in the business is no longer happened between the companies, but also between the supply chains. Company can increases their competitiveness by using some ways, such as product customization, qualified products, cost minimization, and responsiveness to the market. The table below shows the difference between several strategies in making supply-chain decisions.

Table 1. Supply chain strategies

| | **Low-Cost Strategy** | **Response Strategy** | **Differentiation Strategy** |
|---|---|---|---|
| Supplier's goal | Supply demand at lowest possible cost | Respond quickly to changing requirements and demand to minimize stock outs | Share market research; jointly develop products and options |
| Primary Selection Criteria | Select primarily for cost | Select primarily for capacity, speed, and flexibility | Select primarily for product and development skills |
| Process Characteristics | Maintain high average utilization | Invest in excess capacity and flexible process | Use modular processes that lend themselves to mass customization |
| Inventory characteristics | Minimize inventory throughout the chain to hold down costs | Develop responsive system, with buffer stocks positioned to ensure supply | Minimize inventory in the chain to avoid obsolesce |
| Lead-time characteristics | Shorten lead times as long as it does not increase costs | Invest aggressively to reduce production lead time | Invest aggressively to reduce development lead time |
| Product-design characteristics | Maximize performance and minimize cost | Use products designs that lead to low setup time and rapid production ramp-up | Use modular design to postpone product differentiation for as long as possible |

## Inventory Management

Inventory is one of the most important assets had by the company. The management of inventory becomes very crucial since this asset determines the company's sale and also requires a high portion of total invested capital. When a company used to reduce the cost, reducing the number of inventory can be one of the strategies. However, this action will cause the lost sales, where the customer cannot get the products they needed. In contrast, a company will spend a high expense for purchasing and storing the material if the company has too much inventory. Because of that, a company must design a good and suitable inventory management.

Russell and Taylor defines inventory as the stock of items kept to meet the future demand. The purposes of doing inventory management are to count how many units to order and to decide when to order the items. Based on Heizer and Render (2006), there are four types of inventories: raw materials inventory (materials that are usually purchased but have yet to enter the manufacturing process), work-in-process inventory (products or components that are no longer raw material but have yet to become finished products), MRO inventory (maintenance, repair, and operating materials), and finished goods inventory (an end item ready to be sold, but still an asset on the company's book). According to Heizer and Render (2006), the inventory has four basic functions: to decouple or separate various parts of the production process, to decouple the firm form fluctuations in demand and provide a stock of goods that will provide a selection for customers, to take advantage of quantity discount, and to hedge against inflation and upward price changes.

## Business Process

"*A business process is a set of linked activities that creates value by transforming an input into a more valuable output*" (en.wikipedia.org, 2007).

In business process, there are some steps that are created to produce the output whether products or services. The business process begins with the needs from the customer and ends with the customer's need fulfillment.

The characteristics of business process are:
1. Definability: clearly defined boundaries, input and output
2. Order: consist of activities that are ordered according to their position in time and space
3. Customer: a recipient of the process' outcome, a customer
4. Value adding: the transformation taking place within the process must add value to the recipient, either upstream or downstream
5. Embeddedness: process cannot exist in itself: it must be embedded in an organization structure.
6. Cross-functionality: a process regularly can, but not necessarily must, span several functions.

## Methodology

### Data Collection

There are two types of data gathered, primary data and secondary data. The method used for collecting the primary data is by doing interview and direct observation. The purpose of the interview is to gather the data related to the company profile, business process, supply chain strategy, the inventory cycle and other information needed that related to the inventory management of T-Shirt to find out the problem in the company. The primary data is also collected through direct observation. The observation focuses on the inventory management method used by Mahanagari Bandung Pisan to arrange the inventory of T-shirt. The observation was done during February to April by directly involve in daily office activities and also in both retail outlets.

At the office, the observation was focused on the planning (preparation) process for producing the T-shirt, including the process of forecasting the demand, making the Purchase Order and ordering the T-shirt to the vendor and also on the execution steps, including receiving the product from the vendor, controlling product's quality, and delivering the product to the retail outlets. On the retail outlets, the author observed about the inventory management activity at both stores, including the recording system and the availability of T-shirt inventory on the store.

The other objective of the observation at the retail store is also for identifying the demand from customer towards the T-shirt sold by Mahanagari Bandung Pisan. The secondary data is gathered from the company's file. The author collects the data that consists of company's historical data, organization structure, sales data, Standard Operating Procedure (SOP), and stock data.

### Data Processing and Analysis

For processing the data, the method used is by determining the supply chain strategy, describing the inventory cycle in Mahanagari Bandung Pisan, and also defining the product and information flow. By describing the strategy and process above, then the analysis can be done by analyzing every aspect of the T-shirt inventory management at Mahanagari Bandung Pisan and to analyze the root problem that causes the lack of inventory

management's performance at Mahanagari Bandung Pisan.

### Data Analysis

For analyzing the data, this research combines the primary data collected from the interview and the observation and the secondary data from the company's file. Based on the historical data, a graphic is made to show the comparison between the number of stock and the number of sales of T-shirt sold by Mahanagari Bandung Pisan along the last one year, from June 2009 until May 2010. The graphic shows that there is a significant difference between the stock had by Mahanagari Bandung Pisan and the number of T-shirt sold by the company. The stock of T-shirt every month always way exceeds its point of sales.
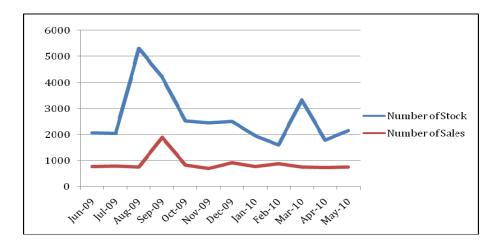


Figure 2. Comparison between the number of stock and the number of sales during June 2009-May 2010

Although the company has provided a great number of inventories to prevent the lost sales, according to the observation for three months, it has found that there were some unsatisfied potential buyers, means that those customers did not find the design of T-shirt that they were looking for. The number of unsatisfied demand is high enough, range from

6% up to 26% of the total sales of the company every month. This unsatisfied demand brings the lost sales to the company, because they do not want to wait until the T-shirt is reproduced. Table 2 shows the number of potential buyer that cannot be satisfied by Mahanagari Bandung Pisan.

Table 2. Lost sales of T-shirt

| MONTH | LOST SALES | NUMBER OF SALES | PERCENTAGE |
|---|---|---|---|
| Jun-09 | 191 | 762 | 25% |
| Jul-09 | 102 | 787 | 13% |
| Aug-09 | 173 | 754 | 23% |
| Sep-09 | 122 | 1895 | 6% |
| Oct-09 | 174 | 828 | 21% |
| Nov-09 | 174 | 697 | 25% |
| Dec-09 | 204 | 926 | 22% |
| Jan-10 | 140 | 775 | 18% |
| Feb-10 | 227 | 874 | 26% |
| Mar-10 | 158 | 754 | 21% |
| Apr-10 | 169 | 736 | 23% |
| May-09 | 128 | 754 | 17% |

**Inventory Cycle in Mahanagari Bandung Pisan**

The system along invetory management process is connected with the daily operational activity done by the company. During the process, that will be an interaction among three fundamental component in the inventory system, which are the company, the vendor, and the customer. This interaction will form a mechanism process of creating the product and fulfiilng the demand from the customer that is called inventory cycle. The description of inventory cycle of T-shirt will be used as the basic concept in analyzing the problem occurred along the inventory management system in Mahanagari Bandung Pisan.
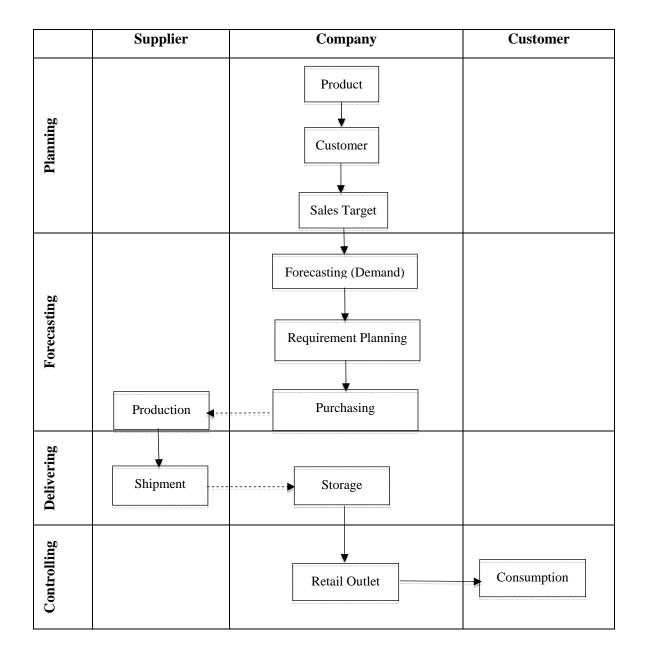
| | Supplier | Company | Customer |
|---|---|---|---|
| **Planning** | | Product → Customer → Sales Target | |
| **Forecasting** | Production | Forecasting (Demand) → Requirement Planning → Purchasing | |
| **Delivering** | Shipment | Storage | |
| **Controlling** | | Retail Outlet → Consumption | |

Figure 3. Inventory cycle in Mahanagari Bandung Pisan

**Forecasting**

The cycle in inventory is begun with the existence of demand from the customer. To fulfill the demand from the customer, a company has to identify the customer's need and then determine the number of product that will be suitable to satisfy the customer. Mahanagari Bandung Pisan assigned retail manager to forecast the demand of the T-shirt. There are three historical data of T-shirt used by the retail manager as the guidance in determining the demand from customer. The historical data used are the sales data of T-shirt during the last one year and stock control data that contains the number of inventory on hand of T-shirt at the beginning of the month. The number of T-shirt showed in the historical data, both sales data and stock control data, is the total number of T-shirt from both stores. By using this total number, the retail manager forecast both retail outlets simultaneously. Beside both historical data above, Mahanagari Bandung Pisan also uses the Purchase Order (PO) form of the previous month. Mahanagari Bandung Pisan uses those historical data only for reviewing and determining the design that will be produced. But, for estimating the number of demand, the main method used is intuitive and subjective prediction.

Until now, Mahanagari Bandung Pisan does not use any theoretical method in estimating the required number of T-shirt. The retail manager determines that there are three peak seasons during the year, in August (Peak Season I) because of the school holiday, in Ramadhan month (Peak Season II), and in December (Peak Season III) because of Christmas and New Year holiday. For those peak seasons, the company will increase much greater number of T-shirt that will be ordered to the vendor based on the intuitive prediction of the forecaster.

**Requirement Planning and Purchasing**

After forecasting the demand from customer, the step continues by determining the type of design and the number of T-shirt that will be ordered to the vendor. For doing this process, the retail manager, who is responsible in making the Purchase Order (PO), needs the result from demand forecasting and also the stock control data. In making the Purchase Order, the retail manager considers the lead-time of and the regulation from the vendor. The vendor determines a certain rule that the minimum order for one T-shirt's design is 36 pieces, without any rules for the minimum number of order per size. Currently, Mahanagari Bandung Pisan has four different vendors that produce the T-shirt designed by the company.

During this process, the production division is responsible in deciding which design that will be produced by each vendor. For the old design with repeat order, Mahanagari Bandung Pisan usually uses the same vendor that produces the T-shirt on the previous periods because the vendor has known and understood the specification of the designs. If Mahanagari Bandung Pisan creates a new design, the production of an old design with a low demand from the customer will be stopped. Therefore, the order for the new design will be given to the vendor that produces the old design that was discontinued.

The production manager is responsible in ordering the T-shirt to the vendor every month, before the date of 10. When ordering the T-shirt to the vendor, Mahanagari Bandung Pisan does not need to give the down payment. But, the full payment has to be done one month after the date of order.

**Shipment and Storage**

The lead-time in producing the T-shirt is two weeks. It means that the order will arrive and be received by Mahanagari Bandung Pisan two weeks after the ordering date. After the vendor has finished producing the T-shirt ordered by Mahanagari Bandung Pisan, the product must be sent first to the company's office. The shipment process from the vendor to the office of Mahanagari Bandung Pisan is fully the responsibility of the vendor. Because of that, Mahanagari Bandung Pisan does not need to spend more cost for carrying the order from the vendor.

For storing the inventory, Mahanagari Bandung Pisan uses a room in the office to keep all products that have not been distributed to the store without having to spend any cost for storage. When the order has been delivered to the office by the vendor, Quality Control (QC) process will be done. The production manager will check and separate

the qualified T-shirt from the defect T-shirt. The company will also count and adjust the number of incoming T-shirt with the ordered T-shirt. The T-shirt that passes the quality control process will be delivered to the retail outlets while the defect T-shirt will be returned to the vendor. The vendor will try to fix the defect on the T-shirt and the T-shirt that can be fixed will be sent back to Mahanagari Bandung Pisan. But, those T-shirts can only be paid and accepted if Mahanagari Bandung Pisan has received the T-shirt before the next ordering date.

## Consumption

During the consumption process, the highest responsibility is taken by the salesperson because the salesperson will directly interact with the customer of Mahanagari Bandung Pisan. Currently, Mahanagari Bandung Pisan employs twenty salespersons that keep the store by turn at both stores based on the schedule made by the company. The duty of salesperson is selling the product and serving the customer. They are also responsible in recording the incoming, outgoing, and sold product on the available form.

The retail manager is the one who take the duty in controlling the sales activity at the store. Controlling the sales activity is very important to keep all activities in the store run well. All problems occurred in the retail store, such as the lack of inventory; lack of supporting equipment, such as bill of sales, inventory form, and store note; complaint from the customer; etc; will be informed directly to the retail manager. In controlling the retail's activity, the retail manager is more often using telephone rather that visiting the retail outlet. Checking the inventory on hand is done at the beginning of the month during the stock control. In the middle of the month, the stock of T-shirt in both retail outlets will be checked and counted. Then, when there is still plenty number of T-shirt in a retail outlet whereas the other retail outlet only has a few amount of T-shirt, the T-shirt in that retail outlet will be distributed to the other.

### Information and Product Flow

The figure below shows the information and product flow in Mahanagari Bandung Pisan to manage the inventory of the T-shirt. Because Mahanagari Bandung Pisan has not had an advance system in communicating the information, the company uses manual way, which is directly communicate with the people who is responsible in each step of the process. The communication could be done by using email, telephone, or direct talks.
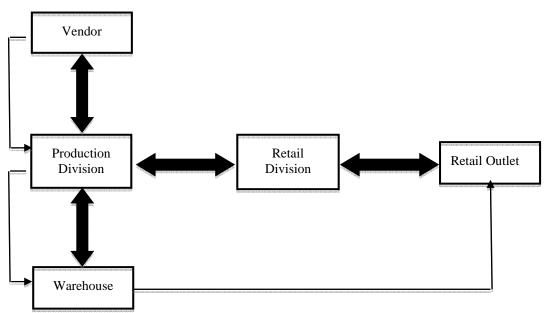


Figure 4. Information and product flow

During the forecasting step, the retail manager decides the designs that will be produced by the vendors, forecasts the demand from the customer and determines the number of T-shirt needed by the company to forecast the demand from customer. After forecasting the demand from customer, he then makes the Purchase Order (PO). The retail manager then informs the production manager to order the products to the vendors by handing out the Purchase Order form. The Purchase Order Form contains all information about the type of design, the number of order, the ordering date, and the total cost required. The production manager will deliver the Purchase Order Form to the vendor while the retail manager keeps the copy of the Purchase Order Form to record the number of T-shirt ordered to the vendor. After receiving the products from the vendor, the production manager informs the retail manager that the products have been arrived at the office, but there is no recording process in this step. Then, the production manager does quality control process to separate the suitable products and the defect products. The suitable products will be distributed to the retail stores at both

Cihampelas Walk and Bandung Indah Plaza by also bringing the delivery receipt to record the number of product delivered. When the salespersons in the retail store receive the T-shirts, the salesperson counts the number of incoming products and records them on the available form. The salesperson also receives the copy of delivery receipt and keeps it at the store as the store database. There are two types of form used at the store, product's flow form for recording all incoming, outgoing, and sold products and stock form, for recording the updated stock of the T-shirt. The salesperson is responsible in updating the data of T-shirt's store every day.

## Discussion and Recommedation

### Discussion

From the data gathered, secondary data and the result from interview and observation, it can be determined that there are four main problems occurred along the inventory management system used by Mahanagari Bandung Pisan. The problems are mentioned below.

Table 3. Root Causes

| No. | Problem | Root Causes | Reason |
|---|---|---|---|
| 1. | Inaccurate Forecasting | Estimation made based on the intuitive prediction and historical data. | The forecasting is done by only taking the inside views because the forecaster has not had capability to determine the suitable forecasting method that can result in more accurate forecasting. |
| 2. | Unfixed schedule in ordering the T-shirt to the vendor | The time for making the PO is uncertain. | Mahanagari Bandung Pisan has not had a clear timeline for making the Purchase Order (PO). Beside, Mahanagari Bandung Pisan has not been aware about time efficiency and underestimates the impact of delay in ordering the T-shirt to the vendor. |
| 3. | Lateness from vendor | - Lack of control from Mahanagari Bandung Pisan<br>- No sanction given by Mahanagari Bandung Pisan to the vendor if delay happens | Mahanagari Bandung Pisan does not control the delivery process from vendor because the company does not really aware about the risk and the effect from the delay. Mahanagari Bandung Pisan even gives time tolerance for one week to the vendor. |
| 4. | The office does not know the current condition of T-shirt's inventory | - Salesperson does not update the inventory data everyday<br>- The office only checks the inventory recording in the middle of the month | - Lack of awareness about the important of having an update inventory recording<br>- Lack of discipline from the salesperson<br>- Lack of control from the retail manager |

**Inaccurate forecasting**

In forecasting the demand of T-shirt, Mahanagari Bandung Pisan uses the T-shirt's historical data. There are three kinds of historical data used, which are sales data of the last one year, stock control data, and Purchase Order of the previous month. The company uses the historical data only for determining the type of design demanded by the customer, not for calculating the number of T-shirt demanded. For forecasting the demand, mostly used the subjective and intuitive prediction of the retail manager. The retail manager will also consider the lead-time, the trend of the T-shirt and also the season that will be faced, whether it is a low or peak season. The retail manager will increase or decrease the number of order if there is a peak or low season during the month that will be forecasted.

However, because the retail manager mostly uses the intuitive prediction, the current estimation results in inaccurate calculation. It is because the forecasting only use inside view of the forecaster, without considering the external factor such as the change of demand from the customer. The inaccurate result from the forecasting can be seen by the significant difference between the number of inventory and the number of sales of the T-shirt. During June 2009 until May 2010, every month the company has great excess in inventory while based on the observation, the customer's demand often cannot be fulfilled by Mahanagari Bandung Pisan.

From this condition, it can be concluded that Mahanagari Bandung Pisan has not been suitable enough in identifying the design that will be produced. This condition brings negative effects to the company. Because there are too many inventories made, the company has to spend more cost to produce the inventory. In the other hand, Mahanagari Bandung Pisan loses the potential customer because the company often does not provide the T-shirt demanded by the customer.

**Unfixed schedule in ordering the T-shirt to the vendor**

The second problem occurred is unfixed schedule for making the Purchase Order (PO). Every month, Mahanagari Bandung Pisan always does stock control (SO) process on the first working day in the new month. The inventory data from stock control process will be used to forecast the demand from customer and to make the Purchase Order. Beside the inventory data, the other data needed for making the Purchase Order are sales report and Purchase Order form of the previous month.

Therefore, all data needed for making the Purchase Order has been gathered on the second working day in the new month and Mahanagari Bandung Pisan may directly start making the Purchase Order to increase the time efficiency. However, the company does not set detail and clear date for making and finishing the Purchase Order (PO). This condition brings into the lateness in ordering the T-shirt to the vendor. Because the ordering is late, then the time required to deliver the T-shirt to the retail store for being sold to the customer is longer.

During that period, Mahanagari Bandung Pisan wastes the time that should be used for making the sales because of the lateness. This condition is happened because the company does not have a clear and strict timeline defining about the activity within the company along inventory cycle of the T-shirt. Mahanagari Bandung Pisan also has not been aware about time efficiency and the impact of lateness in making and also delivering the Purchase Order (PO), such as the lost sales.

**Lateness from vendor**

Mahanagari Bandung Pisan uses vendor to produce the T-shirt. Currently, there are four different vendors that cooperate with the company. The lead-time in producing the T-shirt is two weeks whereas the T-shirt will be ordered to the vendor every beginning of the month. During the observation, the vendor is often late in delivering the T-shirt to the office of Mahanagari Bandung Pisan.

Delay in this term means that the vendor cannot fulfill the order from Mahanagari Bandung Pisan on time, which is two weeks since the ordering date. Because the T-shirt arrives late to the office, the T-shirt is late to be delivered to the retail outlets. The delay causes the lack of inventory on hand in the retail store during the delay time. Therefore, the customer may not find the demanded T-shirt during the delay time. Not only loosing

the potential buyer during the delay time, the delay will also bring a negative impact through the company's image. The customer may go to the competitors because their demanded T-shirt is out of stock.

Based on the observation, the delay occurred because of the lack of control from Mahanagari Bandung Pisan through the vendor. Mahanagari Bandung Pisan only contacts the vendor on the deadline by using telephone. If the vendor cannot fulfill the demand from Mahanagari Bandung Pisan in accordance with the agreed deadline, Mahanagari Bandung Pisan gives additional time for one week to the vendor for fulfilling the demand. This condition causes the lack of discipline from the vendor because there are some tolerances of time given by Mahanagari Bandung Pisan to the vendor.

The company also does not consider risk of lateness from the vendor in delivering the order. Because of this unawareness, the company does not strictly control the order to the vendor. Beside the lack of control, the problem is also occurred because there is no sanction given by Mahanagari Bandung Pisan when the vendor is late delivering the product. On the contract made by Mahanagari Bandung Pisan, there is no clause that describe about the sanction that will be got by the vendor when there is a delay in delivering the product.

**The office does not know current condition of T-shirt's inventory**

The other problem occurred within inventory management of T-shirt is the office does not know current condition of T-shirt's inventory. If the company does not know the condition of the T-shirt, then the company will not know the design already sold out. Mahanagari Bandung Pisan does not pay attention with inventory recording of the T-shirt whereas recording the inventory is very important to know exactly current inventory condition of T-shirt.

Based on the observation, this problem occurred because the salesperson rarely updates the inventory recording on the retail outlet. Because the salesperson does not know the product that is already sold out, the salesperson does not inform the office about this condition. Because the office does not know that there are some sold out T-shirt, the

office does not check the stock to the other retail outlet and do cross replenishment between both retail outlets. The lack of discipline from the salesperson is not apart from the lack of control from the office through the salesperson.

The company is rarely control the inventory recording at both retail outlets whereas Mahanagari Bandung Pisan employs twenty salespersons that keep the stores by turns every day. The control is only done randomly, without a periodic time. Because of the lack of control, most of the salesperson rarely updates the inventory recording.

Beside the data is not updated, the problem also occurred because the office checks the number of inventory on hand in both retail outlets for replenishing the stock from other outlet only in the middle of the month. At that time, the company will do cross replenishment if there are some overstock T-shirts in one retail outlet while the inventory in other retail outlet is under stock. Because the company only checks the inventory in the middle of the month, the company will not know if there are some T-that have been sold out before the middle of the month.

## Recommendation

For solving the problem occurred at Mahanagari Bandung Pisan, there are several solutions given to improve the inventory management of T-shirt at Mahanagari Bandung Pisan.

### Inaccurate forecasting

The proposed solution given for solving the problem is by combining the intuitive prediction with the quantitative forecasting model. The quantitative forecasting model is used as the basic for using the intuitive prediction while the intuitive prediction can be used to cover the error of the quantitative forecasting model when the company faces a peak or low season. The suitable quantitative forecasting model that adjusts with current condition of Mahanagari Bandung Pisan is time-series forecasting method because the company has no factor that significantly affects the demand towards the T-shirt of Mahanagari Bandung Pisan. There are two models of time-series forecasting that will be

compared to look for the most suitable forecasting model for Mahanagari Bandung Pisan. Those two models are moving-average and exponential smoothing. To use and compare both of these models, the sample will be taken from one type of T-shirt's design.

a. Moving Average

To generate a forecast, this model uses several historical actual data values. For determining the forecasting's value, a four month moving average will be used. This calculation is used by simply summing the demand of T-shirt during the previous four month periods, then dividing it by four.

*Moving Average = $\sum$ Demand in previous n periods / n*

Table 4. Forecasting using moving average

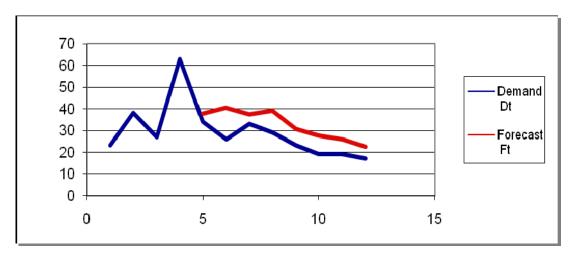| Period t | Demand $D_t$ | Level $L_t$ | Forecast $F_t$ | Error $E_t$ | Absolute Error $A_t$ | $MAD_t$ |
|---|---|---|---|---|---|---|
| 1 | 23 | | | | | |
| 2 | 38 | | | | | |
| 3 | 27 | | | | | |
| 4 | 63 | 38 | | | | |
| 5 | 34 | 41 | 38 | 4 | 4 | 4 |
| 6 | 26 | 38 | 41 | 15 | 15 | 9 |
| 7 | 33 | 39 | 38 | 5 | 5 | 8 |
| 8 | 29 | 31 | 39 | 10 | 10 | 8 |
| 9 | 23 | 28 | 31 | 8 | 8 | 8 |
| 10 | 19 | 26 | 28 | 9 | 9 | 8 |
| 11 | 19 | 23 | 26 | 7 | 7 | 8 |
| 12 | 17 | 20 | 23 | 6 | 6 | 8 |
| 13 | | | 20 | | | |
| 14 | | | 20 | | | |
| 15 | | | 20 | | | |
| 16 | | | 20 | | | |



Figure 5. Demand and forecast using moving average

### b. Exponential Smoothing

Exponential smoothing is also easy to use and without complex concept. The new forecast is got by summing the previous forecast with the fraction of the difference between the previous period's actual demand and the previous forecast.

Where $F_t$ = new forecast
$F_{t-1}$ = previous forecast
$\alpha$ = smoothing constant (using $\alpha = 0.1$)
$A_{t-1}$ = previous period's actual demand

$$F_t - F_{t-1} + \alpha \ (A_{t-1} - F_{t-1})$$

Table 5. Forecasting using exponential smoothing

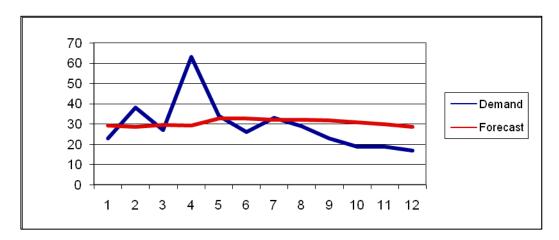| Period t | Demand $D_t$ | Level $L_t$ | Forecast $F_t$ | Error $E_t$ | Absolute Error $A_t$ | $MAD_t$ |
|---|---|---|---|---|---|---|
| 0 | | 29 | | | | |
| 1 | 23 | 29 | 29 | 6 | 6 | 6 |
| 2 | 38 | 30 | 29 | -9 | 9 | 8 |
| 3 | 27 | 29 | 30 | 3 | 3 | 6 |
| 4 | 63 | 33 | 29 | -34 | 34 | 13 |
| 5 | 34 | 33 | 33 | -1 | 1 | 11 |
| 6 | 26 | 32 | 33 | 7 | 7 | 10 |
| 7 | 33 | 32 | 32 | -1 | 1 | 9 |
| 8 | 29 | 32 | 32 | 3 | 3 | 8 |
| 9 | 23 | 31 | 32 | 9 | 9 | 8 |
| 10 | 19 | 30 | 31 | 12 | 12 | 8 |
| 11 | 19 | 29 | 30 | 11 | 11 | 9 |
| 12 | 17 | 28 | 29 | 12 | 12 | 9 |
| | | | 28 | | | 9 |
| | | | 28 | | | |
| | | | 28 | | | |
| | | | 28 | | | |



Figure 6. Demand and forecast using exponential smoothing

To determine the best forecasting model for Mahanagari Bandung Pisan, those two models are compared by using Mean Absolute Deviation (MAD). Less value of MAD reflects the less forecasting error. The value of MAD is got by taking the sum of the absolute error of each forecast error, then dividing it by the number of periods (n).

$$MAD = \sum |Actual\ Demand\text{-}Forecast\ Value\ | / n$$

The result shows that the MAD's value of moving average is less than the MAD's value of exponential smoothing. From this result, moving average model is preferred because it has less MAD's value.

However, this method is actually assumed only to be used during normal season. By using moving average, it does not consider the presence of peak season. Based on the historical data, Mahanagari Bandung Pisan also has peak season, where the number of demand towards the T-shirt increases significantly compared to the other months. To avoid the lost sales during the peak season, Mahanagari Bandung Pisan is proposed to do two times order to the vendor to cover the demand from customer. Two times order means, during the peak season, Mahanagari Bandung Pisan order the T-shirt to the vendor at the beginning of the month and at the middle of the month. By using two times

order, Mahanagari Bandung Pisan can forecast the demand from the customer after selling the T-shirt for two weeks then reorder the T-shirt to the vendor. This way of order is actually applicable to be done by Mahanagari Bandung Pisan because the vendor is flexible in receiving and doing the order.

**Unfixed schedule in ordering the T-shirt to the vendor**

To solve the second problem, the proposed important solution is by creating a timeline for all process during the inventory cycle of T-shirt. By making the timeline, the company has a clear schedule for doing every task to increase the time efficiency. In order to run the timeline well, every player in the process has to be responsible and strict to the timeline made to achieve time efficiency. On the timeline, the proposed action to be taken is directly making the Purchase Order on the next day after doing stock control, As mentioned before, it is because the company has had all data needed to make the Purchase Order on that day. By doing this action, the ordering time to the vendor will not be late and there will be more efficiency in the use of time. Figure 7 shows the proposed timeline to solve the problem occurred related to unfixed schedule in ordering the T-shirt to the vendor.
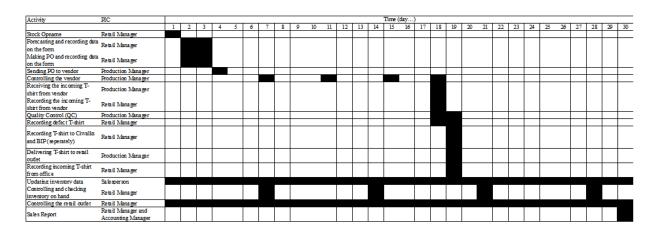


Figure 7. Proposed timeline for problem 2

**Lateness from the vendor**

The first solution to avoid the lateness from vendor is by controlling the T-shirt's production periodically. Because Mahanagari Bandung Pisan has not had advance technology, the company may control the T-shirt to prevent the delay by doing direct communication, such as by using telephone and visiting the vendor. Both actions are simple and applicable to be done by Mahanagari Bandung Pisan. The proposed action and time for controlling the vendor is divided into three parts. Three days after the ordering date, the production manager is responsible in contacting the vendor by telephone to make sure that the order from Mahanagari Bandung Pisan has entered the production process.

Then, seven days (one week) after the ordering date, the production manager may prevent the delay by visiting the vendor by checking the number of order that has been made. The last part is contacting the vendor via telephone on three days before the agreed deadline of the order to make sure that the order can be delivered on time by the vendor.

Currently, there are two types of vendor cooperated with Mahanagari Bandung Pisan. The first type is vendor with binding contract and the second one is friendship-based vendor. To support the periodic controlling and increase the discipline from the vendor, the second solution that offered to Mahanagari Bandung Pisan for both types of vendor is by arranging a special point in the contract between Mahanagari Bandung Pisan and the vendor that describes about the sanction that will be got by the vendor if the T-shirt is late to be delivered. The proposed sanction could be the cost cutting for the delayed order. This sanction actually depends on the agreement between Mahanagari Bandung Pisan and the vendor. Mahanagari Bandung Pisan is suitable to do this action to make the relationship between the company and the vendor more bound. Mahanagari Bandung Pisan has to be able to differentiate between the working partnership and the friendship so the relationship become clearer and more efficient.

**The office does not know the current condition of T-shirt**

Mahanagari Bandung Pisan currently does not pay attention in the inventory recording of T-shirt. The problem happened because of this condition is the office does not know the condition of T-shirt's inventory. This problem occurred because of the lack of control from the office through the salesperson of Mahanagari Bandung Pisan in updating the inventory recording. The lack of control from the office makes the salesperson that keeps the retail store becomes indiscipline in updating the inventory data. To solve this problem, Mahanagari Bandung Pisan is suggested to be more often in controlling the salesperson and inventory recording. The controlling towards the salesperson must be done every day and the retail manager has to affirm the salesperson that they have to update the inventory recording every day. Besides that, the office also has to inform the salesperson that the salesperson must report the office if there is any sold out T-shirt. So, the company may check to the other retail outlet if there is still any overstock for that T-shirt's design and the cross replenishment between both retail outlets can be done. Giving the warning for the salesperson that does not record and update the data correctly can also be the solution to increase the discipline level of the salesperson.

**Conclusion**

Fulfilling the demand from the customer is very important in running a business. In order to satisfy the demand from the customer, a company needs to provide the product in accordance with the need and want from the customer. The company also is better providing the product whenever the customer looks for it. The presence of inventory cannot be avoided by the company because the inventory cannot be got instantly by the company. There is lead-time in producing the inventory. Because of that, planning and managing the inventory becomes very important for a company in order to increase the efficiency and maximize the profit.

To fulfill the demand from the customer, Mahanagari Bandung Pisan, a retail company that runs its business in creative sector, need to set a good inventory management to satisfy the demand from the customer. But, in planning and managing the inventory, the company needs to consider the optimal amount of inventory needed by the company. It is because having a large number of inventories will require much cost. In contrary, having too little inventory may cause the lost sales for the company because the customer cannot buy the product they are looking for.

T-shirt is the main product with highest proportion towards the total sales gained by Mahanagari Bandung Pisan. This product contributes around 79% of the total sales of the company. Therefore, the company needs to pay more attention on the availability of the T-shirt's inventory. Currently, Mahanagari Bandung Pisan has a problem within its inventory management towards the T-shirt. The number of the inventory of the company is far exceeding its point of sales. However, there are still some lost sales occurred.

This research focuses in improving the inventory management of the company. The author gathers primary data by doing observation and interviewing the management of Mahanagari Bandung Pisan and secondary data from the company's file to analyze the problem and to identify the root causes. For the analysis, the author describes inventory cycle of Mahanagari Bandung Pisan that includes four main activities, which are forecasting, requirement planning and purchasing, shipment and storage, and consumption. By describing and analyzing each of the activities, the author identify the problem occurred along the inventory cycle.

From the analysis, there are four main problems faced by Mahanagari Bandung Pisan, which are inaccurate forecasting, unfixed schedule in making Purchase Order, lateness from the vendor, and the lack of information had by the office towards the condition of T-shirt's inventory. To solve the problem occurred, there are some proposed solutions given, which are combining the intuitive prediction method with moving average model, making the timeline in controlling and producing the inventory of T-shirt, implementing periodical control system and put a clause about sanction in the contract made between Mahanagari Bandung Pisan and the vendor and controlling the salesperson everyday and creating the rules about inventory recording.

## References

Bahagia, S.N., (2006). *Sistem Inventori.* Bandung: Penerbit ITB.

Chopra, S. and Meindl, P., (2007). *Supply Chain Management*. New Jersey: Pearson Education.

Heizer, J. and Render, B., (2006). *Operations Management*. New Jersey: Pearson Education.

Russell, R.S. and Taylor, B.W., (2006). *Operations Management: Quality and Competitiveness in a Global Environment.* New Jersey: John Wiley & Sons, Inc.

Business Process. Available at: <en.wikipedia.org/wiki/Business_process> [Accessed March 2010].

Merchandise Available at: <en.wikipedia.or/wiki/Merchandise> [Accessed March 2010)].

Merchandising Available at: <en.wikipedia.org/wiki/Merchandising> [Accessed March 2010].

Supply Chain Management Available at: <http://www.apics-cind.org/education/apics_cpim_bscm.aspx> [Accessed March 2010].

Supply Chain Management Available at:<http://www.businessdictionary.com/definition/supply-chain-management-SCM.html> [Accessed March 2010].