CHAPTER II
REVIEW OF RELATED LITERATURE AND STUDIES

2.1 General Idea of Supply Chain Collaboration
2.2 Vendor Managed Inventory approached
2.3 Inventory definition
2.4 Replenishment formulation
2.5 Demand forecasting approaches
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2.1 General Idea of Supply Chain Collaboration

In the real world the customer demand is not perfectly stable, businesses must forecast customer demand in order to properly the inventory level and other resources. Forecasts are based on statistics, and are not perfectly accurate also. Therefore forecast errors are given, companies often carry an inventory buffer called "safety stock". Moving up the supply chain from end-consumer to raw materials supplier, each supply chain participant has greater observed variation in demand and thus greater need for safety stock. In periods of rising demand, down-stream participants will increase their orders. In periods of falling demand, orders will fall or stop in order to reduce inventory level. The effect is that variations are amplified the demand from the end-consumer which known as "The Bullwhip Effect"

The Bullwhip Effect is a problem of forecast-driven in supply chain which found by Procter & Gamble (P&G). During the early 1990s, P&G faced a problem of extreme demand variations for one of its best-selling brands - Pampers diapers which the variation of orders increased from the retailer level to the distributor level up the supply chain.

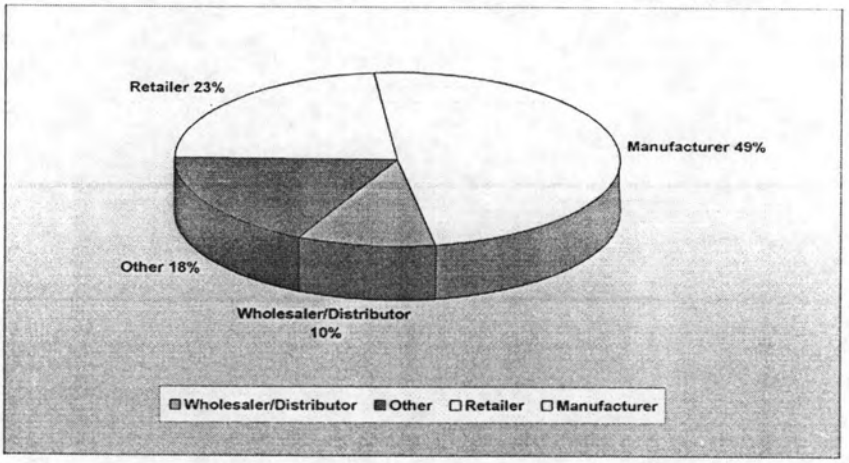
Supply Chain Management (SCM) is the process of planning, implementing, and controlling the operations of the supply chain with the purpose to satisfy customer requirements as efficiently as possible. Supply chain management spans all movement and storage of raw materials, work-in-process inventory, and finished goods from point-of-origin to point-of-consumption.

Consequently the Supply chain collaboration has been established in order to react to actual customer orders, to reduce waste in the Supply chain, but also increases market responsiveness, customer satisfactions and competitiveness. This collaboration later has been most successfully implemented in Wal-Mart's distribution system. Individual Wal-Mart stores transmit point-of-sale (POS) data from the cash register back to corporate headquarters several times a day. This demand information is used to queue shipments from the Wal-Mart distribution center to the store and from the supplier to the Wal-Mart distribution center. The result is near-perfect visibility of customer demand and inventory movement throughout the supply chain. Better information leads to better inventory positioning and lower costs throughout the supply chain. Below are factors which contributing to the Bullwhip Effect

- Forecast Errors
- Lead Time Variability
- Batch Ordering
- Price Fluctuations
- Product Promotions
- Inflated Orders

Figure 2.1 CPFR Survey Respondents by Industry

Source: Seifert, D. CPFR: How to create a Supply Chain Advantage, 2003

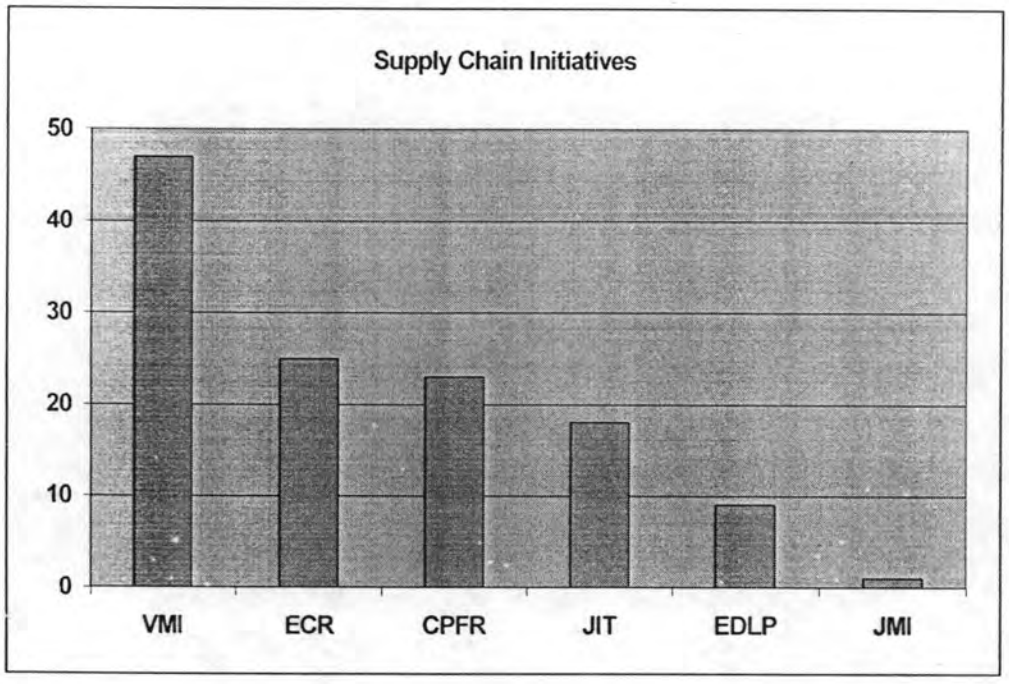


Since early 1990s, many pattern of Supply Chain Collaboration has been developed and widely implemented in many industries as demonstration in Figure 2-1.

The leverage of Supply Chain Collaboration

- Electronic Data Interchange
- Vendor Managed Inventory (VMI)
- Joint Managed Inventory (JMI)
- Just in time (JIT)
- Everyday lowest price (EDLP)
- Continuous Replenishment Planning (CRP)
- Efficient Consumer Response (ECR)
- Collaboration, Planning, Forecasting and Replenishment (CPFR)

Figure 2-2 Supply Chain Initiatives



2.2 Vendor Managed Inventory (VMI)

VMI is a process where the supplier generates order for the customer based on demand information which sent by the customer. The supplier takes responsible for maintaining customer inventory level, fill rates and transaction cost base on mutually agreement.
The customer demand information can transfer from retailers to manufacturer via EDI by varies transactions below

- EDI Transaction 852: Product activity report which sent by customer to tell the supplier of their inventory level and product sales activity. The inventory data is typically segmented into various groups such as on hand, on order, committed, back ordered and so forth. This transaction is the back bone of VMI which sent to prearranged schedule, typically, daily. The decision to order is based on this data.

- EDI Transaction 850: Purchase order report communicates the items to be ordered.
- EDI Transaction 855: Purchase order acknowledgement which sent by supplier to customer in order to acknowledge an order.
- EDI Transaction 856/857: Advanced ship notice which sent by supplier out right before the shipment leaves the manufacturer. It is a notice of the contents of the shipment and any additional information relating to the shipment.
- EDI Transaction 861: Receipt advice that sent by the customer to communicates what was actually received.
- EDI Transaction 810: Invoice that sent by the supplier as an electronic billing.
- EDI Transaction 820: Payment/Remittance advice sent by the customer.

Benefit of VMI

- Lower Distributor Inventories is the benefit most people name first when they discuss VMI. Distributor inventory turns frequently double under a VMI relationship. The real question is why. Under VMI, the supplier is able to control the lead time component of order point better than a distributor with thousands of suppliers can ever hope. Additionally, the supplier takes on a greater responsibility to have the product available when needed, thereby lowering the need for safety stock. Finally, the manufacturer reviews the information on a more frequent basis which also lowers the safety stock component. These three factors combine to significantly lower inventories.

- Lower supplier inventory from better forecasts are achievable, but there are two caveats. The first caveat that better forecasts do not result from sharing information about normal turn business. Better forecasts result from having a more forecastable demand. Under VMI, the orders created for the distributor more closely match the true demand in the marketplace. That demand is reflected in more frequent orders for the same parts and therefore lower variability of demand on normal turn business. At the same time, better communication of exceptional demand is required in a VMI relationship. This result in the manufacturer seeing the exceptional demand, such as

project work or promotional demand, earlier than under the traditional relationship. improving their ability to forecast those bumps. The second caveat is that better forecasts are only attainable if a substantial percentage of the business is handled via VMI. Most manufacturers are not able to lower their inventories with VMI today because VMI represents too small a percentage of their overall business. However. the smoothing of demand brought by VMI is potentially the largest benefit for suppliers engaging in VMI with a significant portion of their business.

- Lower Administrative Costs accrue to both parties. The benefit to the distributor is easy to see. The distributor spends less time ordering. In addition to this, both parties spend less time following up on bad order information correcting orders for non-shippable parts or quantities, and reconciling differences between orders and shipments. This benefit can be traced to a better, more frequent flow of information. If the supplier changes carton quantities, the next order created by the manufacturer will reflect those quantities. If the distributor changes a catalog number by mistake, it will show up on the next 852 before it needs to be ordered. This allows the manufacturer time to correct the problem when it occurs instead of allowing it to build up costs

- Lower administrative costs can be a substantial piece of the VMI benefit for both parties. Both manufacturers and distributors see their sales increase from VMI. The most obvious cause of increased sales is better inventory placement resulting in fewer out-of-stock situations. The manufacturer has information about the use of their products, the overall marketplace, as well as coming industry-wide events that allow them to direct the inventory investment to the right products. This knowledge, when combined with frequent communication about specific geographic marketplace issues communicated by the distributor, results in higher sales per dollar of inventory investment.

- In addition to the sales increase from having the right part at the right place and at the right time, many distributors reinvest some of the savings from inventory reduction

and administrative savings into building their business. This investment can fund lower end user prices or a broader selection of product. This investment increases business for both parties.

Trading partners who focus on the changing business relationship can maximize their benefits. Under VMI, manufacturers and distributors can both recognize and focus on the same issue how to sell more products to the end user more efficiently. This changes the manufacturer's focus from how to get the distributor to buy more to how to help the distributor sell more. This change in relationship is the most exciting feature of VMI.

In conclusion, the benefits of VMI are due to the increased information flow between the distributor and manufacturer. This information needs to be part of the day to day process for all parties in order to assure the quality and freshness of the data.

2.3 Inventory definition

Basically the Inventory compose of Cycle Stock and Safety stock which inventory cost generally fall into ordering cost and holding cost. However, even the inventory is considered as the waste and costs of the company, inventory play the important roles for the reason of

- Predictability
- Fluctuation in demand
- Unreliable of supply
- Uncertainly of lead time
- Price protection
- Quantities or Lot purchase discount
- Lower Ordering cost
- Lower transportation cost

In generally Inventory can form in 5 categories as

- Raw Materials
- Finished goods
- Work in process
- Intermediate storage location (Distribution center)
- Maintenance , Repair and Operating (MRO)

Inventory functions basically fall to 6 categories as below

- **Cycle Stock**

  Cycle stock is the inventory level that meets the constant demand under conditions of certainly lead time.

- **In-transit Inventories**

  In-transit Inventories are the items are on route from one location to another location. Sometimes this inventory type included as part of cycle stock calculation.

- **Safety or Buffer Stock**

  Concern to uncertain of demand and lead time, Safety or Buffer Stock apply for cover the demand and lead time deviation to avoid the stock out and maintain customer service level.

- **Speculative Stock**

  Speculative stock is the inventory which been held for reason other than the current demand but purchasing objective may concern to lot purchase discount or forecasted of price increase.

- **Seasonal Stock**

  Seasonal stock is another form of Speculative stock in order to maintain the stable of labor work and production run.

- **Dead Stock**

  Dead Stock or Obsolete stock is meaning the stock that no demand need for the specific period.

2.4 Inventory Control & Replenishment formulation

Basically there are 2 essential approaches concern Inventory Management.

- **Independent Demand Method which included**
  - Economic Order Quantity
  - Model for Known Demand
  - Model for Uncertain Demand

- **Dependent Demand Method which included**
  - Material Requirements Planning
  - Just-In-time

2.4.1 Independent Demand Method assumes that overall demand for an item is made up for large number of independent, small demands from individual customers which introduce quantitative models of inventory control included.

2.4.1.1 Economic Order Quantity (EOQ) has been developed by F.W. Harris of General Electric in 1915 and become the basis and famous model of inventory control. This approach give an idea that "How much the inventory to order?" and calculate the fixed order quantity which minimize the total cost. The basis assumptions under this method are contain

- The demand is known exactly , continuous and constantly
- All costs are known exactly
- No shortage are allow
- Lead time is zero
- Single item consideration
- Purchase price and Ordering cost do not vary with the quantity order

The basic Formula of EOQ is

$$\mathbf{EOQ} = \sqrt{\mathbf{2RC \times D / HC}}$$

By assume that

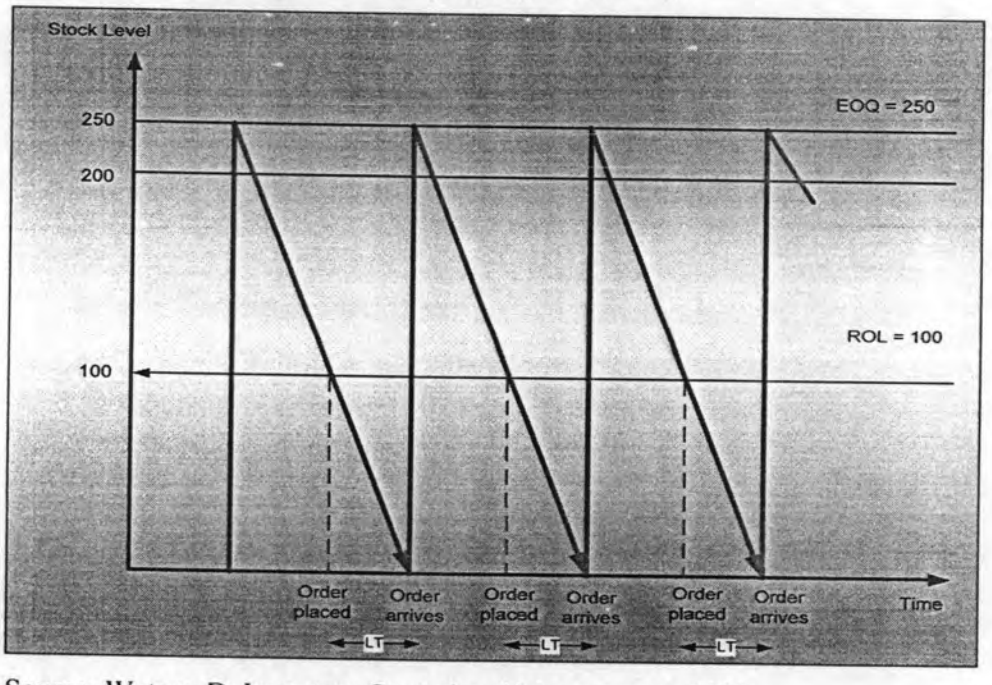
RC = Reorder Cost / Time

D = Demand Unit / Year

HC = Holding Cost / Unit

However, these assumptions are far away from real business world, thus the EOQ model has been developed in order to response to real business factors such as lead times which concern both of supplier and customer site, order preparation and delivery preparation. The reorder point has been considered to effect the finite lead time on the specific inventory level and constantly demand.

Figure 2.3 the lead time and corresponding reorder level



Source: Waters, D. Inventory Control and Management, 2003

2.4.1.2 Model for Known Demand which more realistic than EOQ by removing the inappropriate assumption from the basic EOQ model. This model keeps the conditions that all variables are known as giving deterministic model with many factors involved such as Figure 2.4 - 2.8 depict below.

Figure 2.4 Price discounts for large volume order

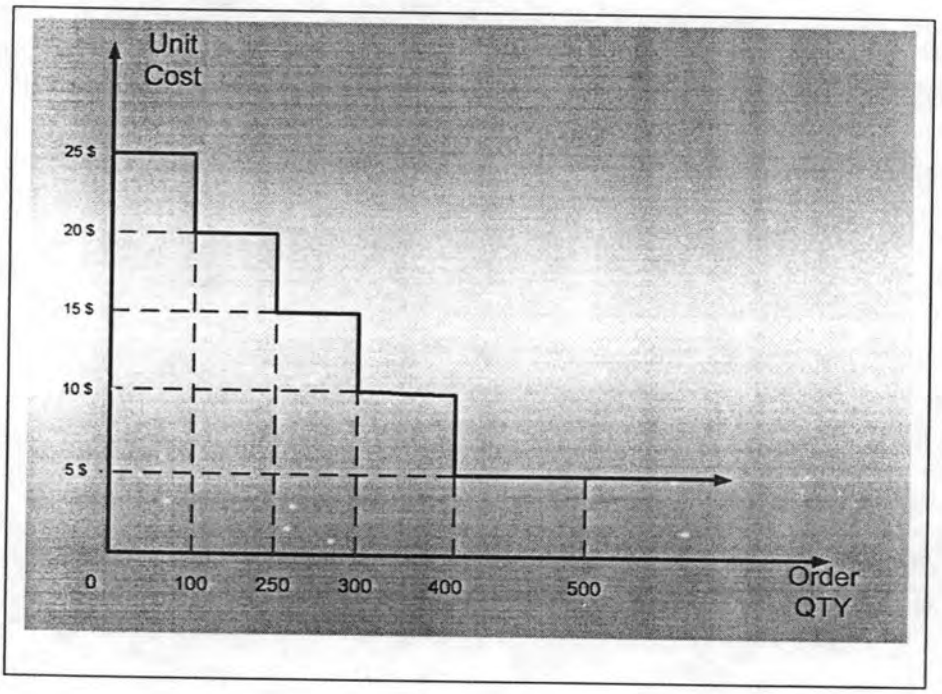


Figure 2.5 Optimize batch size

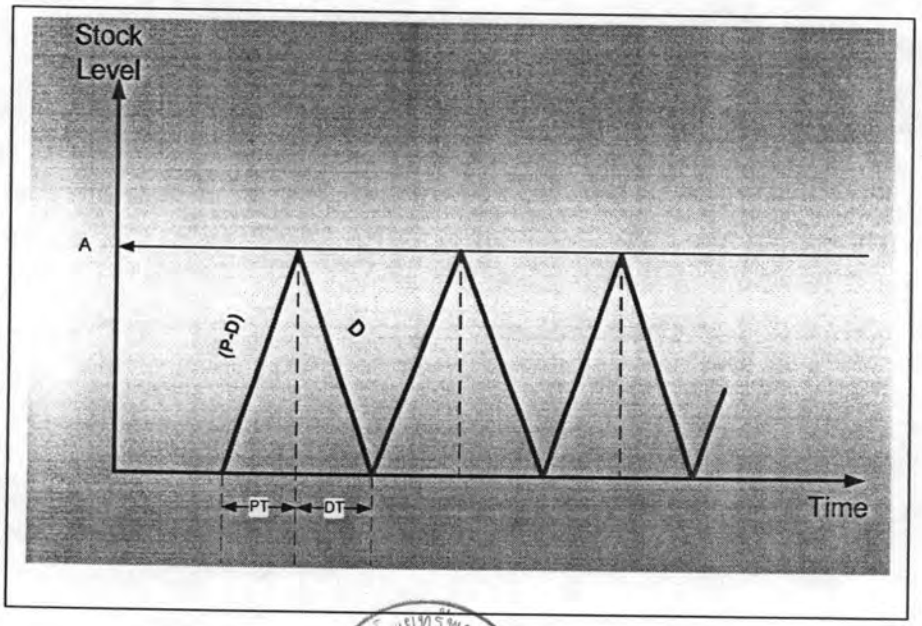


Figure 2.6 Back Order

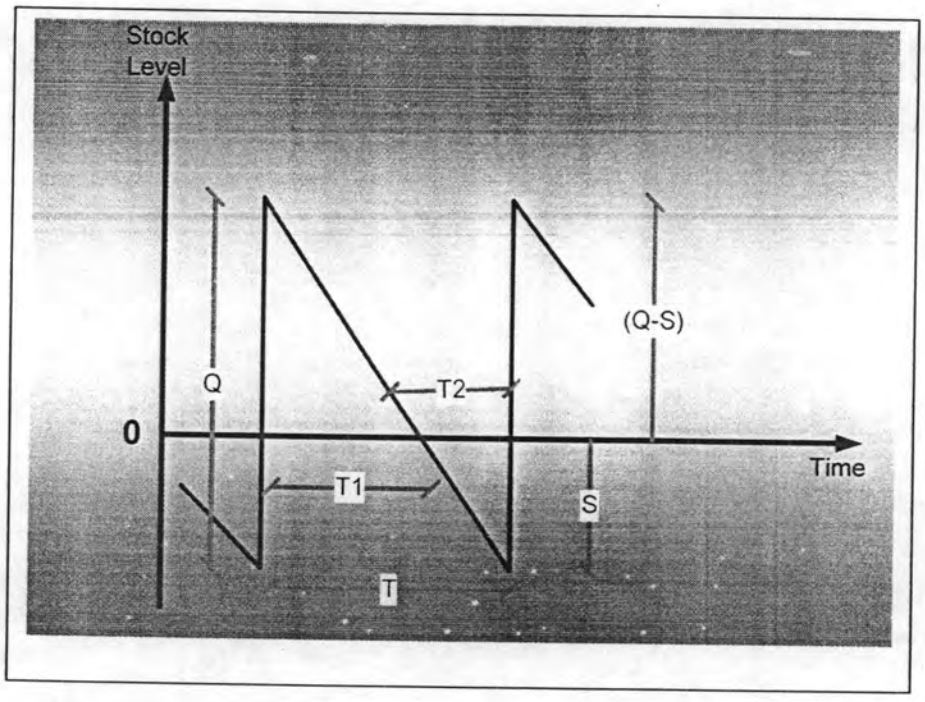


Figure 2.7 Lost Sales

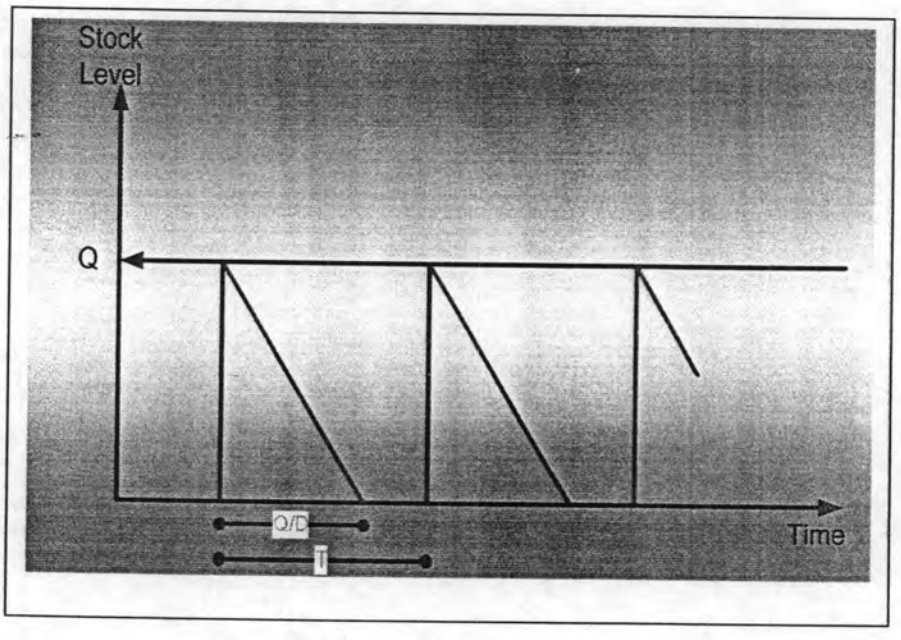
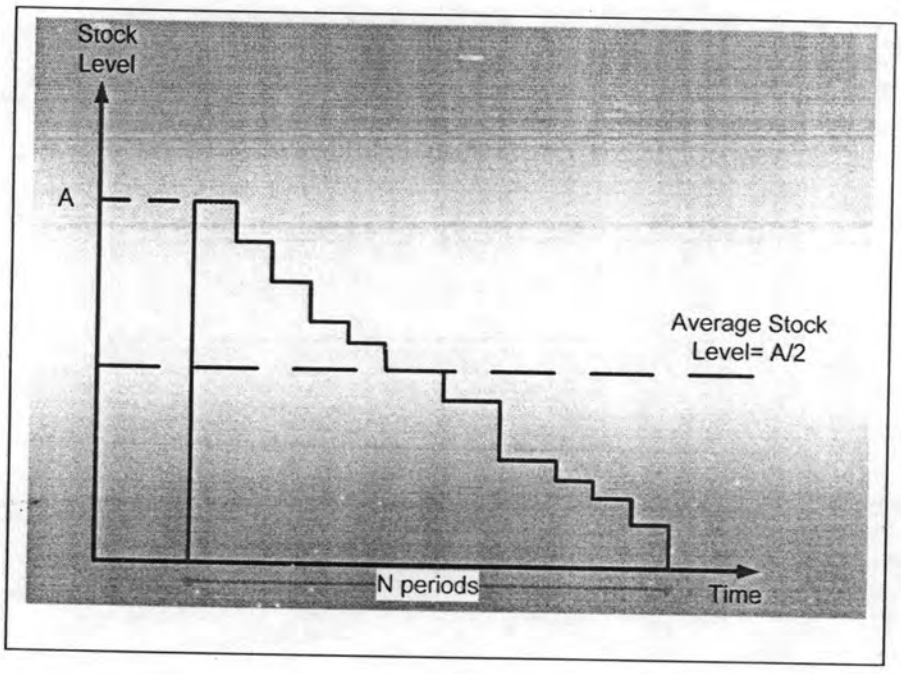


Figure 2.8 Discrete, Variable demand



2.4.1.3 Model for Uncertain Demand

By the meaning of Uncertainty for inventory management would means that the value is not known exactly, but its figure can drawn from the probability distribution. These uncertain are affecting in many areas such as Demand, Cost, Lead time, Deliveries and Service level.

However these Uncertainties may come from internal operation work such as employee, work process, time, stress, material etc. and external factors such as the National Economics, Government Policies, Competitor and other Organization in Supply Chain. The key issue for probabilities is uncertainty in demand and lead time.

Discrete Demand

- Marginal Analysis model sometimes particular use for seasonal goods as need to control stock over a single cycle. The Marginal Analysis can use to find the best order quantity.
- Newsboy problem is the extension from the Marginal Analysis that fined the optimal stock level when there is the shortage cost.

Uncertain Lead time demand

- **Uncertain Demand**

When the aggregate demand is uncertain even if the lead time is constantly, it would cause the lower of service level. Therefore to avoid of it, the safety stock had put to constant the cycle of service level. The effect of this safety stock has raised the reorder level. However, as assume that both of demand and lead time is normally distributed as model below.

$$\text{Reorder Point} = \text{Lead time Demand} + \text{Safety Stock}$$
$$= LT \times D + Z \times \sigma \times \sqrt{LT}$$

- **Uncertain Lead time**

By the assumption that both of demand and lead time has normal distributions. The demand is constant while as the lead time is uncertain would have the possible outcome of the unused stock cost and the shortage. To avoid of these problem, safety stock has been added and rise to the reorder point. However, the probability of a shortage meanwhile the probability of lead time demand that greater than the reorder point.

$$\text{Service Level} = \text{Prob}(LT \times D < ROL)$$
$$= \text{Prob}(LT < ROL/D)$$

- **Uncertain in both Lead time and Demand**

By the assumption that both of demand and lead time has normal distributions. Both of demand and lead time are uncertainty, the lead time demand which means LT x D, thus the standard deviation of lead time demand would be as below

$$\sigma LTD = \sqrt{LT \times \sigma^2 D + D^2 \times \sigma^2 LT}$$

Periodic Review Method

The Periodic Review Methods allow for uncertainty by placing order in varies sizes at fix time interval (T), the stock level would be examined at a specific time by the order quantity which bring up to stock target level such as petrol station which may check the petrol stock level everyday and order quantity to reach the daily stock level.

Figure 2.9 Fix order quantity method

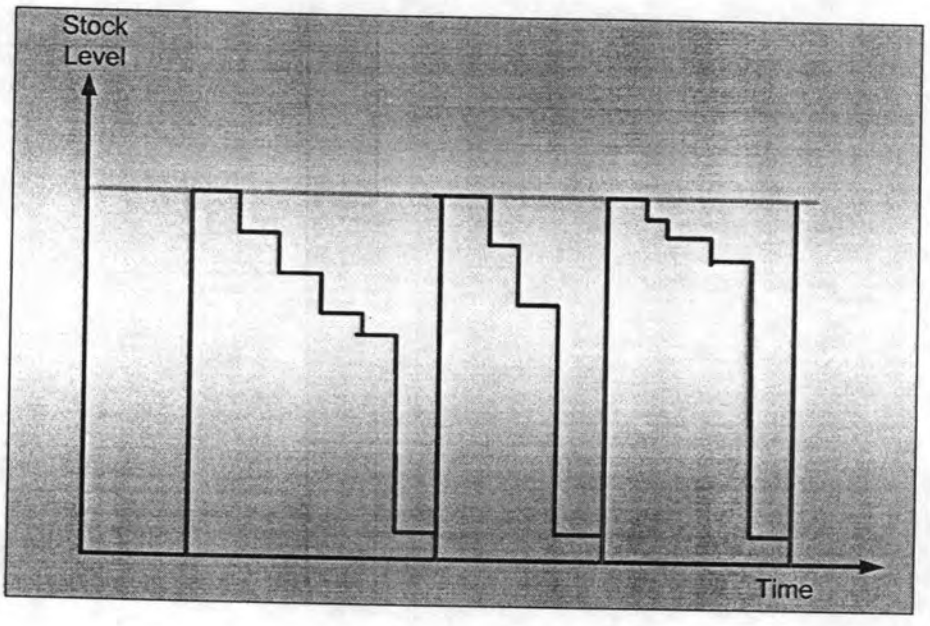
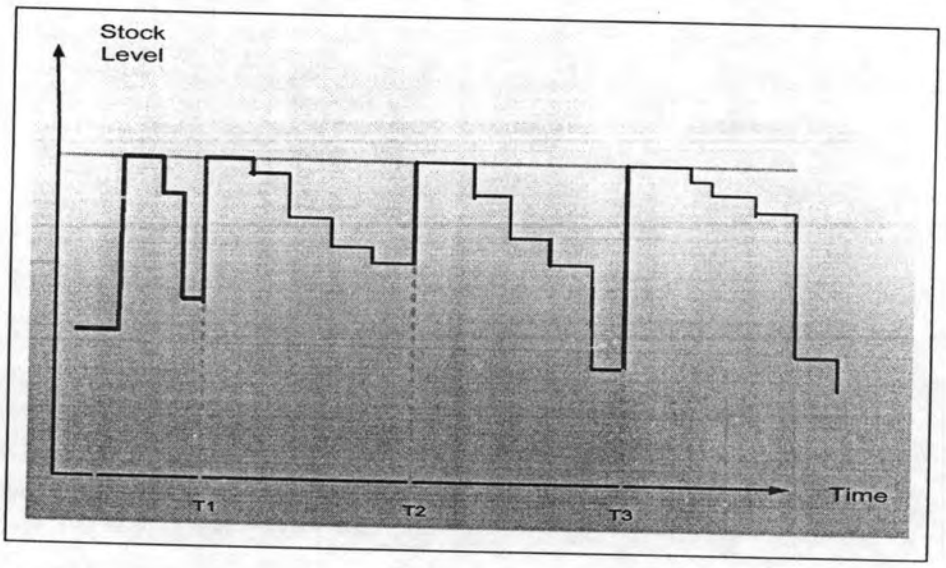


Figure 2.10 Periodic review method



The overall key question for Periodic review method would be

- When or how long for the time interval for each order?
- What should be the target stock level?

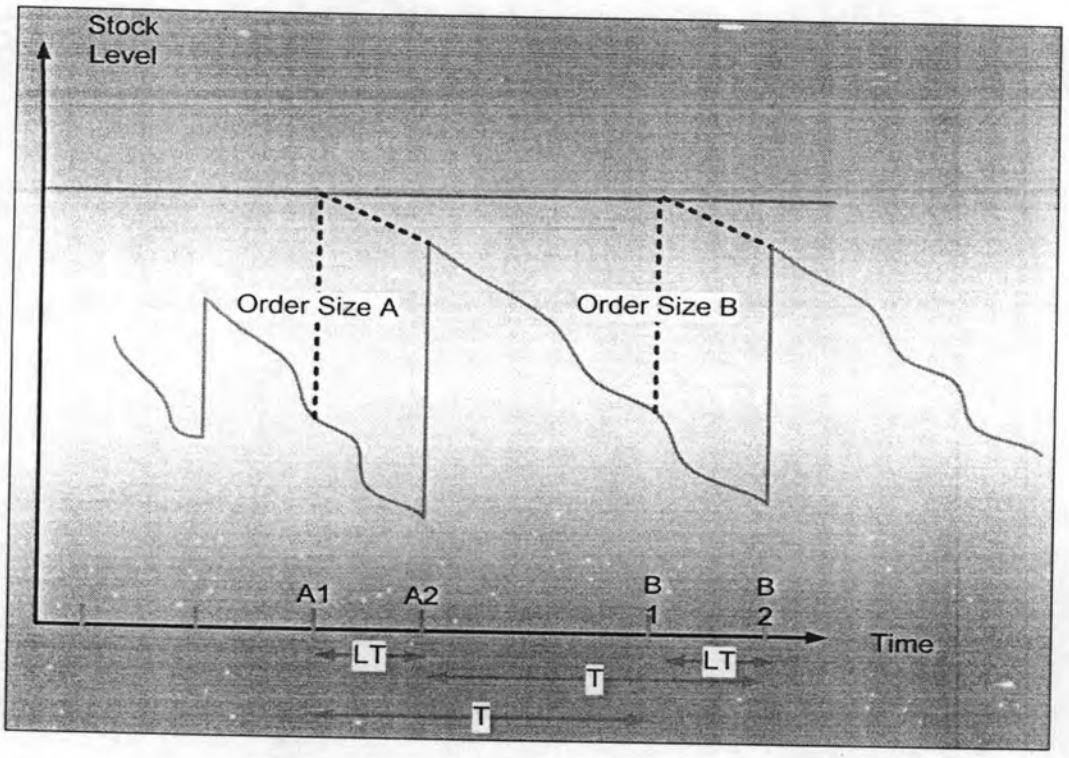
The useful approach that can satisfy these questions is EOQ method which can specify the optimal order quantity and find the period for each order interval. In addition, the assumption that both of demand and lead time's distribution is constant. The stock target level can calculate as below

$$\text{Stock Target Level} = \text{Mean Demand over } (T + LT) + \text{Safety Stock}$$

$$\text{Safety Stock} = Z \times \sigma \times \sqrt{(T + LT)}$$

As Figure 2.11 on next page shows that the order quantity has to satisfy all demand over the period A1 to B2 which is T + LT

Figure 2.11 timing of orders with periodic review



In some circumstance the Periodic Review Method would highly benefit as it's simple and convenient in administrative task such as the routine checking stock at regular time as well the ordering and delivery. However, this model suitable for the cheap products which has high demand.

In the contrary, Fixed Order Quantity method which has the varying of time interval gives the main advantage of administrative task for constant order size which more easy for supplier to supply the product and manage the transportation. However, the major benefit of fixed order quantity method is the lower stock which allows the lower in safety stock.

In some case, it allow to mix both approached benefit as hybrid method as

- Period review with reorder level which similar to Periodic review method but the order would only place when the stock on hand is lower than a specific reorder level, if stock on hand is over than the reorder level, just wait until next period.

- Reorder Level and Target Stock which similar to Fixed order quantity method but the addition order would place when stock fall below the reorder level with the quantity that less than the EOQ, hence the current rise to the target stock level. This is sometimes calling Min-Max system.

2.)

2.4.2 Dependent Demand Method

2.4.2.1 Material Requirement Planning (MRP) uses a Bill of Material (Bom) to explode a master schedule and find the gross requirements for materials needed for production. Information of current stock, order outstanding and reserved stocks is used to find the order quantity. Consequently lead times are use to time phase these order so that materials arrive in the right time of need. The resulting stocks are match directly to the production plan which benefit to lower of stocks and relate costs.

2.4.2.2 Just in time (JIT) has been developed by Japanese company with aiming to eliminate all waste. JIT see stocks as a waste of resource that serves no useful purpose. JIT organizes operation to occur at exactly time they are needed. The elimination of the stock can be done by coordinating in the supply chain. The characteristic of this approached is to identify the problems and then solve them, rather than hiding them under the excessive stock.

2.5 Demand Forecasting Approaches

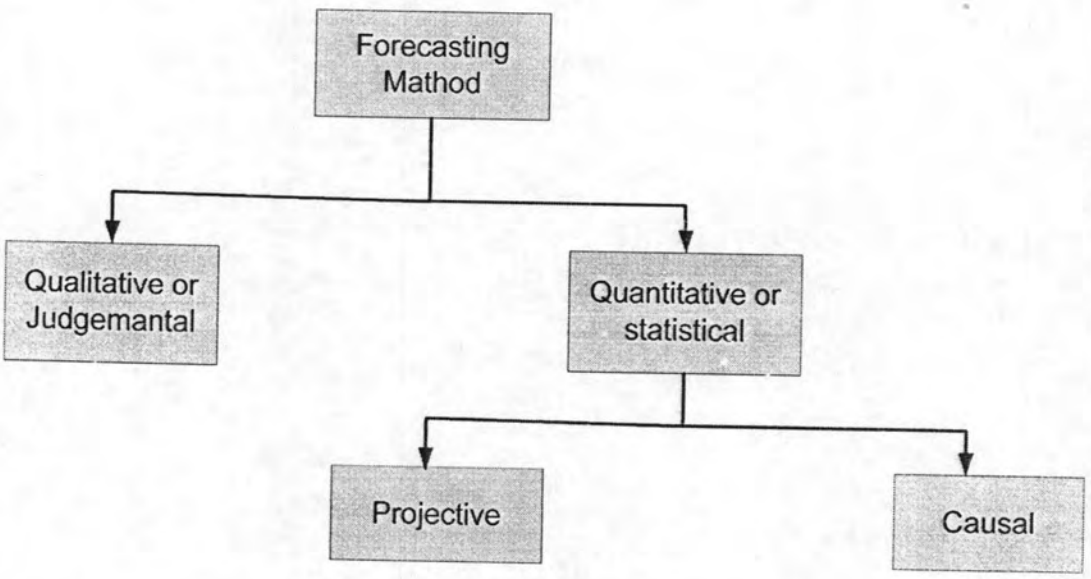
Forecasting is the process of predicting the future which is an integral part of the business enterprises. Manufacturing forecast demand for their production in order to provide the necessary raw materials and manpower. Retailers forecast the customer demand to maintain the optimal inventory level up to the specific service level. Hence, the forecast must base on both of the current circumstances and the prevailing circumstances when the plan becomes effective.

For the inventory management, forecast is become important as its input. However forecasting need the information from the other sources also which included the best type of forecasting model, value of parameters, historical data and so on. Since there are many ways of forecasting by varies of circumstances and with the different of product types. The suitable method to forecast should contain many factors such as time covered in the future, historical data, relevant of historical data to the future, product types, variability of demands, accuracy need and cost of errors, benefit expect from the forecast, amount of money and time cost. In addition the good result of forecasting must included of the accurately with small error, unbiased, responsiveness to the change of customer demand, cost effective and easy to understand. The methods of forecasting can classification as

- **Time horizon classification which included**
    - Long term forecasts which look ahead to several years that concern the strategic decision.
    - Medium term forecasts which look ahead from three months to one year that concern the tactical decision.
    - Short term forecasts which look ahead from one day to few weeks that concern the operation decision.

- Available of historical data
    - Qualitative forecast use when the business neither has any historical customer demand nor the factors affect.
    - Quantitative forecast use when the business has the historical data of customer demand and knows the factors that affect it.

Figure 2.12 Forecasting Approaches



2.5.1 Qualitative or Judgmental forecast

As Qualitative forecast approach do not base on the historical data, it's usually base on the judgment or the opinion of expert or management which relying on the subjective views. The methods are very flexible and wide range of circumstances but are not reliable as quantitative forecast. The most widely used for judgmental method are Personal insight, Panel consensus as it allows several expert to discuss for best solution, Market surveys which tend to expensive and time consume, Historical analog which

follow the lifespan pattern of the similar products, Delphi method which use the questionnaire to get the opinion from the experts and let discuss the original answer to get the final result.

2.5.2 Quantitative or Statistical forecast

Quantitative or Statistical forecast is base on the historical data which known as a time series that are series of observations taken at regular interval of time. The most common of time series patterns are

- Constant series, where demand continues at roughly the same level over time.
- Long term trend where demand either rises or falls steadily.
- Seasonality where demand increase or decrease during the certain time interval.
- Cyclical variation where the temporary upturn or downturn seems to follow no discernible pattern which usually results from changes in economics condition.

2.5.2.1 Projective method

Projective forecast use the historical demand data to projecting past pattern demand to the future. The common approaches of projective forecasting for the constantly demand are as follow.

- Simple average

This approach is finding the average of demand in the past which easy and can give the good result only when the demand data is stable over long period. Thus as its figure, the forecast does not respond quickly to the change.

- Moving average

Moving average is the forecast approach that averages the values for the immediately preceding *n* period which ignore the old data that probably out of date but use most recently data instead.

- **Weight moving average**

  As in the moving average the weight of all observation data is equally. However in some situation the forecast should reflect more heavily on more recently values. Therefore, weight moving average technique has been adopted. In this procedure, the sum of the weights used must equal 1, and weights given to observation value are none increasing with their age.

- **Exponential smoothing**

  This approach is another technique that avoids the problem of equally weight as in the moving average technique. This method based on the idea that data gets older become less relevant and should be given less weight. So this method gives high weight to the most recent data while as the weight decline exponentially with age.

The projective method described above are suitable for the constantly data pattern. However, in some situation the data pattern are seasonality and trend. Seasonality is a regular cyclical pattern which each cycle repeats in the same general pattern, the measurement of variation in demand can find by using the seasonal index.

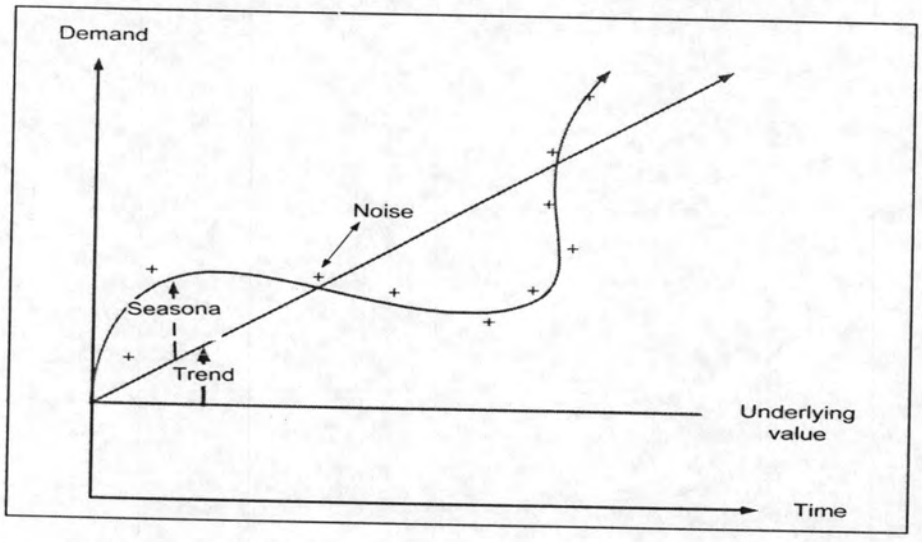
Seasonal index = Seasonal Value / Deseasonal Value

However, the easy way to forecast the complicate time series is classical decomposition technique which split the demand in to separate component, then recombine these separate components to get the final forecast. The basic component of seasonal and trend are follow.

- Underlying value or the intercept is the basic demand that must be adjusted for seasonality and trend.
- Trend or the gradient which shows the change in demand in each period.
- Seasonality is the cyclical variation around the trend
- Noise

Demand = (Underlying values + Trend) x Seasonal index + Noise

Figure 2.13 Components of a time series with seasonality and trend



2.5.2.2 Causal method

The causal method looks for a cause of relationship between the variables which demonstrate linearly trend as the approach illustrated below.

- **Linear Regression**

  This method assumes that dependent variable is linearly related to an independent variable. The Regression analysis attempts to predict the values of the continuous, interval scaled dependent variable from specific values of the independent variable.

$$Y = a + bX$$

Where

X	=	Independent variable
Y	=	Dependent variable
a	=	Intercept
b	=	Gradient of the line

- **Lest square method of Regression analysis**

  This method use to ensure that the straight line will best represent the relation ship between independent and dependent variable. Least square method use the criterion of attempting to make the least amount of total error in prediction by minimize the sum of square deviation of the actual values from the predicted regression line.

$$\text{Least square} = \sum_{i=1}^{n} ei^2$$

where,

$ei = Yi - \hat{Y}i$

Yi = Actual value of the dependent variable

$\hat{Y}i$ = Estimate value of the dependent variable

n = Number of observation

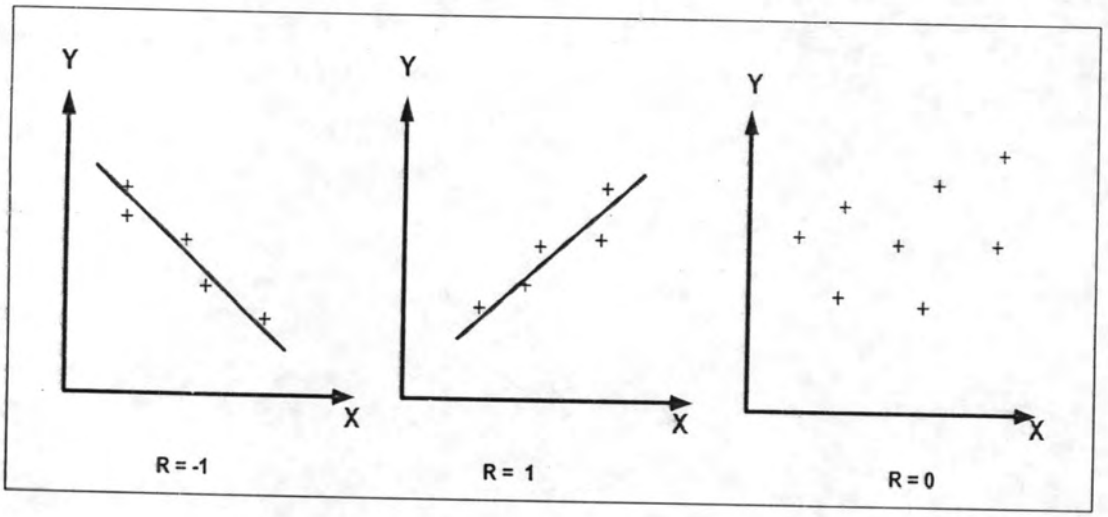
i = Number of particular observation

The measurement of the dependent values that determine how much they far away from their mean is call goodness of fit or coefficient of determination (r^2). By its value would between 0 and 1($0 \leq r^2 \leq 1$), if the value is near 1, most of the variation is explain by the regression as it means that there is little noise and straight line is very good fit to the data. In the contrast way, if the value is near 0, means that most of the variation is unexplained and the line is not good fit.

Another useful measurement in regression is the coefficient of correlation (r) which shows the linearly relation between dependent and independent variable. The relation value is between +1 and -1 ($-1 \leq r \leq 1$) as the positive shows the way of relation that increase or decrease in the same way. In the contrast, negative value explains the

opposite relation of the variable. The high value r shows the level of linear relation while as if r value is 0, means that no correlation at all between the variables.

Figure 2.14 Coefficient of correlations



- **Multiple regression analysis**

  This method is the extension of the regression analysis, which allow for the investigation of the effect of two or more independent variable on a single interval scales dependent variable for a linear relationship.

$$Y = a + b1X1 + b2X2 + \ldots + bnXn$$

Where X = Independent variable

Y = Dependent variable

a = Intercept

b = Gradient of the line

2.6 Related Literature and Studies

In the real business world, most business in the supply chain had faced the problem of demand amplification or as called "The bullwhip effect" which is an observed phenomenon in forecast-driven distribution channels. Because customer demand is rarely perfectly stable, businesses must forecast demand the properly position of inventory and other resources. Forecasts are based on statistics, and they are also rarely perfectly accurate. Because forecast errors are given, companies often carry an inventory buffer as called "safety stock" which moving up the supply chain from end-consumer to raw materials supplier. Each supply chain participant has greater observed variation in demand and thus greater need for safety stock. In periods of rising demand, down-stream participants will increase their orders. In periods of falling demand, orders will fall or stop in order to reduce inventory. The effect is that variations are amplified the farther from the end-consumer demand. http://www.answers.com has mentioned the factors contributing the Bullwhip effect as below

- Forecast Errors
- Lead Time Variability
- Batch Ordering
- Price Fluctuations
- Product Promotions
- Inflated Orders

Supply Chain Collaboration has been adopt in order to eliminate or reduce the level of amplify in the Supply chain while as increase the competitive advantage to the business chain.

Impact of information sharing in the supply chain collaboration has been study by Cheng and Wu (2005) as they has separated the information sharing in a two-level supply chain to 3 level as next page.

- Level 1 is the traditional ordering process where the manufacturer and retailer belong to different organizations and they operate in a decentralize system. Neither information sharing nor any ordering coordination.
- Level 2, the retailer and manufacturer decided their inventory policies under coordination control. Manufacturer or supplier can access to customers' demand information, in addition also access to the ordering information from the retailer.
- Level 3, the manufacturer and the retailer co-operate under centralized control. The manufacturer established their inventory policy based on EDI information of customer demand directly. Meanwhile, the manufacturer helps the retailer to make it replenishment decision. The kind of collaboration has so called Vendor- Managed Inventory or VMI. However the collaboration has in many levels such as CMI, CRP, ECR, and CPFR.

From their study shows that the information sharing would results in reductions both of inventory level and expected cost directly for the manufacturer. In addition they found that no difference in inventory level and cost directly to the manufacturer for the information sharing between level 2 and level 3. However, this conclusion may lack of good assumptions as they assume that the retailers have the perfect information of end customer demand and there is no further customer demand information that retailers can obtain when they share the information with the manufacturer.

Wal-Mart the biggest of retailer in the world, has developed their strategy with supply chain collaboration from VMI to CPFR with Sala Lee brand apparel which press at http://www.vics.org Wal-Mart believes that vendor partners are among their keys to success, and that exchanging information with them creates a unique synergy which allows both companies to be successful. By exchanging information of forecast and replenishment data with vendor partners, it can ensure the right item at the right time in the right place, resulting in increased customer satisfaction.

The CPFR collaboration has been adopted and addressed in 3 phases as

- Creating the Sales Forecast
- Identifying Exceptions to the Sales Forecast
- Collaborating and Resolving Exceptions to the Sales Forecast

The collaboration focused more on identifying exceptions and resolving the exceptions than on creating sales forecast .Changes in the way the sales forecasts are updated continue to evolve as information is exchanged and exceptions are identified and resolved. In addition 4 metrics advices to evaluate are In-stock, weeks on hand at store level, forecast accuracy and lost sales. After 24 weeks of implementation, 2% improvement in retail store in-stock, a reduction of 14% in store-level inventory compared to a 32% increase in sales, and an increase of 17% in retail turns on the pilot items.

Another pilot project of CPFR is Hewlett-Packard who already in place with its Tier One distributors. The pilot products are hard copy products (ink jet printers and laser-jets) which characterized by a short product life measured in months and sometimes in weeks. Product which remains in the channel after a SKU becomes obsolete is returned to HP for disposal. Accurately gauging future demand for production would minimizes lost sales opportunities as spikes in demand occur, and minimizes the amount of obsolete product returned. The CPFR approach was introduced to all distributors at HP planning sessions. This pilot incorporated i2 planning tools to create a forecast based on the sales and inventory numbers reported by the distributors to HP via EDI. The metrics adopted are

1. HP forecast accuracy vs. distributor forecast accuracy, tracked at the distributor SKU level by week.
2. DC service level.
3. Promotional sales as a percent of total sales by product line.
4. Returns as a percent of units shipped.

Even the number of successful cannot be released to the public, the program has already had sufficient success to be slated for expansion to two additional product groups, representing over $15 billion in annual sales.

The ECR Thailand (Efficient Consumer Response) www.ecrthailand.com is the initiative collaboration among participant in the supply chain included Manufacturer, Wholesaler, Retailer and Distributors. There are three main improvement areas which are Demand Management, Supply Management and Enabling Technology. As important as demand management, the improvement of the supply side activities lead to a significant saving by increasing the operation efficiency and reliability and reducing the inventory cost. The six supply improvement activities are Integrated Supplier, Reliable Operation, Synchronized Production, Cross Docking, Continuous Replenishment and Automated Store Ordering.

By being a participant in ECR, Carrefour Thailand had launched their initiative Supply Chain collaboration with it supplier as called "CMI" or Co-Managed Inventory. As year 2006 there are 6 partners and would be increase to 11 partners in year 2007. Carrefour worldwide has experience with the CMI program more than 15 years which introduced 60% turnover of Grocery Product group. Dedicate of successful CMI in Carrefour Thailand had increased 5% of fill rate from 92% to 97% while as reduce the stock cover day from 12 days to 8 days. www.carrefour.com. Not only the modern trade distributor that implement the initiative Supply Chain Collaboration approach. In the fuel industrial, Petronas Malaysia's national petroleum corporation has launched the VMI project for fuels marketing to optimize the distribution of fuels and specialty liquid petroleum products. www.aspentech.com Petronas had adopted supply chain business processes to streamline and automate the distribution of more than 7.5 billion liters of petroleum products per year to its customers across peninsular Malaysia, including more than 600 retail service stations. The solution is expected to reduce the company's distribution costs and to deliver improved service to its customers. The implementing of AspenTech's solution for fuels marketing as the central element of a project to create an Automated Road Tanker Scheduling System (ARTSS). This project is expected to create

a single system capable of managing and optimizing the distribution of all petroleum products. including vehicle gasoline, aviation fuel, diesel, fuel oil, liquefied petroleum gas (LPG), lubricants and bitumen from bulk terminals or plants to the end-customer. The system would collaborate with multiple transport companies, provide major customers with automated stock replenishment using vendor-managed inventory by calculate the reliable demand forecast and then creating replenishment plans to ensure the optimal stock level, and link the ordering and fulfillment process with its enterprise resource planning (ERP) system, thus with these plan and system, it would creates an optimized delivery schedule for the entire market that provides the desired reduced overall cost per volume.

Another sample is Shell chemicals companies www.shellchemicals.com who have embraced e-Business tools that help to make it easier to do business process. These tools can be utilized by customers, suppliers and partners to reduce errors through automated transactions, to improve decision-making through access to more timely and accurate information, and to lower costs through standardized and streamlined business processes. The expanding capabilities are being used to deliver the next generation of Vendor Managed Inventory (VMI) solutions. VMI shifts the onerous day-to-day tasks of stock management, purchasing and order tracking from the customer to the supplier.

The supply chain service developed through Elemica software which captures and manages daily inventory readings, consumption forecasts, product receipts and current customer consumption. It's planning, forecasting and replenishment services are combined with the added advantages of ERP system integration through the Elemica software. Further more it's integrated to road carriers to enable transport instructions to be sent electronically. Accurate, transparent and timely transmission of this information is key to delivering high levels of service to customers and crucial for the safety, reliability and cost effectiveness of supply chain operations. A successful connection to the largest road transport logistics providers has enabled thousands of transport instructions generated every month to be sent automatically, removing the need for manual faxing and the potential for errors has been reduced and issues are easier to resolve.

As the information technology has had a substantial impact on supply chain by allows firm to share demand and inventory data quickly and inexpensive. Cachon and Fisher (2000) study to measure the value of information sharing and comparing this value to two others sources of supply chain improvement included reducing lead time and increasing delivery frequency by reducing shipment batch size. The question addressed there is not whether information technology improves supply chain performance, but how. The research considers two level of information sharing included Tradition information sharing and Full information sharing. The value of information sharing measured by compare the potential cost improvement. The result of the research contrast to research's expected that the model would demonstrate significant benefit to information sharing model. In addition, it shows that a reduction in lead time and batch size can have a significant impact on supply chain costs and a significantly greater impact than sharing information. However, the result of this research limit to the model setting consideration such as known demand and no capacity constrains.

In addition, several strategies to optimize the supply chain has been introduced in order to find the answer to the firm as when the firm should replenish item to maximize the profits and how many item should be replenished in many circumstance. Berman and Kim (2003) has study in order to find the solution of optimal inventory control in a supply chain in which customer arrive at the firm who provide the service which takes exponential amount of time, using supply from the external supplier with exponential lead time process. The study identify a replenishment policy which respect to system parameter such as cost of service delay, inventory holding cost in order to optimize the profit by using Markow decision theory. However, the study significant that the lead time variable effect on the firm profit, in particular, when the firm faces either high utilization or long replenishment lead time process. Numerical investigation the better performance of policy by using both customer and inventory information over the one that use only inventory information. The study has recommend to develop the supply chain collaboration between the partners such as Vendor managed inventory (VMI) in order to eliminate uncertain in the supply chain flow such as lead time and demand which lead to increasing of profit. However, not only implement of supply chain collaboration would

result of successful to the firm. Fry (2002) had studied about collaborative and cooperative agreements in the supply chain. The study adopt two types of VMI in scenario A which involve one manufacturer and one retailer and VMI in scenario B which involve one manufacturer, multiples retailers with none stationary customer demand. The study finds that both type of VMI can provide significant saving only if the contract parameters are chosen carefully and correctly. VMI can perform quite poor if the contract parameter are not chosen with care. The penalty coefficient to the retailer's holding and backlogging costs results in robust benefit. However, given appropriate values for penalty coefficient by varying the flexibility to manufacturer in VMI can be used to distribute the saving between the retailer and manufacturer. The overall analysis finds that the collaborative and cooperate agreement such as VMI and information sharing can provide great benefit for a supply chain. However, care must be used in implementation of such agreement as correctly defined the contracts which can promote the agreement's effectiveness.

As Information sharing between supply chain members is necessary for implementing VMI. Nevertheless, information sharing in a VMI partnership raises a number of issues such as different incentive and performance measures exit between vendor and customer, confidentially, trust, technology investment. However, the VMI issue that highly impact to the firm performance is the inaccuracy information that generate from the customer to vendor. Angulo, Nachtmann and Waller (2004) had studied the effect of using inaccurate inventory information and available of information from its delay in replenishment decisions on inventory levels and fill rates. The supply chain examined there consists of 4 echelons included Manufacturing, Distribution Center, Retailer and Outlet Store. All echelons of the supply chain operate under an (R, S) inventory policy, where R is the review interval (1 day) and S is the order up to level. Demand and lead time are the stochastic elements of the simulation model by using Arena simulation software. The performance measured by average of inventory level, fill rates and various cost calculation incurred in the process of manufacturing, storing, and distributing of the products. There are three primary implication of the research. First, VMI may still beneficial even if there are some inaccuracies in information. In the

stationary demand case, information accuracy did not affect any measure of performance. In contrary, the information accuracy only effect performance measures in the nonstationary demand case. Second, the retailer should carefully audit the replenishment process of VMI supplier to ensure of using information sharing in the timely manner as the information delay effect all measures of performance and had significant interaction effect with almost all the other factors such as safety stock, fill rate, handling cost. Third, sharing forecast should be emphasized on items with nonstationary demand such as new items, seasonal items, on promotion items or items with brand loyalty.

Further more inventory management is the main key factor that stimulates the successful of supply chain collaboration. Steven (2004) has addressed about Purchasing inventory best practices that having a direct impact on inventory included reducing safety stock by shrinking lead time with more collaboration in the supply chain to accelerate the flow of information both of internal and external, require frequent deliveries of small quantities which the optimal order quantity must introduced to both of customer and supplier. However, with the frequent of order, the supplier can not make sure the repeat order. Therefore issue a large purchase order for affixed purchase quantity but split into a number of deliveries has been introduced. Adopt rolling schedules is an alternative best practices that address some aspect of the long term commitment. As the customer forecast update on rolling basis with in certain min-max boundaries. Hence, the customer purchase still commit to the approximate purchasing level over the long term while more closely to it actual demand. Meanwhile suppliers still obtain the purchase commitment min-max boundaries which allow them to allocation of sufficient production. However, this approach is work well for high-usage items that are reordered frequently.

The study of Improvement of finished product inventory control by Jirawan Totanakom (1999) in case study of lube oil blending plant is the sample of inventory management by use ABC analysis to criteria the products by sales volume and profit margin in order to specific the optimal inventory and replenishment policy. Further more both of qualitative forecast approach with collaborative of internal departments and also the customer in the business chain and quantitative forecast approach has been

applied to the study to increase the efficiency of demand forecast and inventory management. Not only applied of ABC analysis to classify the product items. Kim, Suh and Hwangl (2006) has also propose the ABC analysis or 80/20 rules for analyzing customer and segmentation customers based on their value in order to build the strategies to retain profitable customer with consider the cross selling and up selling opportunity. By the way, forecasting method is the substantial factor to inventory management. Taylor (2003) paper considers univariate online electricity demand forecasting for lead times from a half-hour-ahead to a day ahead which the demand record time series pattern that contain more than one seasonal pattern. The model proposed has adapted from Holt-Winter smoothing formula which only able to accommodate one seasonal pattern by produce forecasting method for within day seasonal and within week seasonal. The adaptation method as call ARIMA produced the forecasting method which using double seasonal Holt-Winter or multiplicative double seasonal. The result of MAPE value shows that within day method by Holt-Winter is so poor due to the method failing to accommodate the within week seasonal. Consequently the best result is double seasonal method ARIMA.

However the conclusion of the study not only recommend a new method preference but further recommend to use the different method with weights varying according to the particular period of the week and the forecast origin. The day of the week and the week of the month effect by Brusa and Liu (2004) is another sample of studying the weights varying according to the particular period of the week and the forecast origin. The study examines Monday returns sorted by week of the month in stock indexes to provide the explanation for the existence of the positive Monday return.

Simulation approach is widely use to model the optimal of inventory management policy as Bertolini and Rizzi (2002) introduced the simulation model to mange optimally finished good inventory level of zoo technical feeds industry. The input variable of the model are safety stock level which the coefficient of inventory define the service level and the stochastic distribution function of product demand. The model operate with a mixed push/pull inventory management policy as the push approach adopt an order point

to define the MPS, planning the production of economic lot size which based on forecasted demand and the net inventory position. However, the pull approach adopted as it take in to account the real demand data observed, thus MPS is daily adjust the replenishment or order point net inventory position for each product which lead to the addition cost, termed flexibility cost. The initialization process consists of the Pareto analysis of products, in the assessment of demand forecasts, reorder point, safety stock levels and order quantities for each product. The variables considered are the products' profit margins and sales volumes. Al-Zubaidi and Tyler (2004) also construct the simulation model for the clothing supply chain and apply to retail inventory control. ARENA simulation packaged applied to retail inventory control and quantifies the performance of Quick Response (QR) procedures for seasonal merchandise. As the decreasing shelf life of apparels and long lead time incurred markdown cost which is the single largest cost of their case study company. The main interest in this research is evaluating replenishment strategy. Two QR supply strategies have been simulated included fixed quantity re-ordering method which necessary to monitor the inventory to ensure that the replenishment is taken when the appropriate stock level is reach and fixed interval re-ordering method which replenishment quantity in such situation is pre-determined and require a forecast of inventory usage over the next interval of time. The research concludes that shorter lead time implies the need of a shorter forecasting period that would achieve greater accuracy. In addition, a better quantity of forecast input lead to more flexible lead time and to the lowest level of lost sales by adopting fixed interval re-ordering method.

Abuhilal, Rabadi and Sousa-Poza (2006) study supply chain inventory control by comparison among JIT, MRP and MRP with information sharing by using ARENA simulation model. The research presents a methodology of how to carry out a comparison between two order management system, JIT (Pull method) and MRP (Push method) with stationary and cyclical demand pattern. In addition research also examines the collaboration and information sharing which impact of cost reduction and planning improvement in the supply chain. Numerous simulation scenarios were designed to study the impact of inventory ordering, holding cost as well as the demand level and pattern to

answer the question that which production system provides lower total chain cost under specific supply chain parameters? How does information sharing affect the supply chain cost? Another question is what is the effect of the demand pattern on that influence? The study highlight the fact that the decision to use either JIT or MRP inventory control systems depend on several variables, among the most important of which are the inventory cost, demand pattern and the average demand level. The value of information sharing is maximized at cyclical and highly variable demand patterns, while its effect is statistically significant at a stationary demand pattern. In addition, for a certain service level, the ratio of the ordering cost to holding cost is a main driver that could be utilized as a decision variable, while the average demand level is the other main variable.

Humphrey and Tayler (1998) operate the study to examining the behavior of various stocking methodologies in repair/rework operations. The major focus on the sensitivity key model parameters are the area of stochastic replenishment lead time, product demand, and overhaul factors. The computer simulation used to evaluate the inventory model performance included total inventory cost, backorder delays and the percentage of items backordered. Several inventory model included Depot inventory stocking model, Economic order quantity standard model, Continuous Review EOQ model, Periodic review model and Single period model which perform with the sensitive analysis scenario when cost, demand, parameter estimations and distributions are either wrong or do not behave as originally estimated. The results of the research show that the continuous review policy performs best in the type of repair/rework environment. However the EOQ standard models are generally found to be poorer performing alternatives when compared to the Continuous review EOQ, the Periodic review model does not perform well in any scenario and the Single period model is not advised for stochastic demand environment.

Further more, Aburtoand Weberl (2005) study to improve the supply chain based on hybrid demand forecast. The study combines the Auto Regressive Integrated Moving Average (ARIMA) model and neural networks for improving of supermarket demand forecasting. Not only the good result of improve the demand forecasting in retails

business, it allow the retailers and their business chain to improve their inventory decision. Further more the supply chain collaboration has been recommended for better flow of information helps to improve the respective management decision such as CPFR or the Collaborative Planning, Forecasting and Replenishment along the introduction of technology which promise high potentials which generate an enormous amount of data flow for retailer chain such as EDI, RFID.

Conceptual Framework