IMPROVING INVENTORY MANAGEMENT IN A MANUFACTURING COMPANY
THE CASE OF INTRAVENOUS INFUSIONS LIMITED, KOFORIDUA

By
AMOAKO DENNIS KWATIA
(BSC. HONS. COMPUTER SCIENCE)

A thesis Submitted to KNUST School of Business,

KWAME NKRUMAH UNIVEERSITY OF SCIENCE AND TECHNOLOGY

In partial fulfillment of the requirement for the award of

MASTER OF BUSINESS ADMINISTRATION

School of Business

College of Art and Social Sciences

August, 2009.

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DECLARATION

I hereby declare that this thesis was prepared and submitted by me and to the best of my knowledge; it contains no material previously published by any person or group of persons which has been accepted for the award of any other degree in any of the Universities. I therefore accept sole responsibility for mistakes or errors in this work. Acknowledgement is however giving to the various references made.

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Head of Department	Signature	Date

DEDICATION

I dedicate this work to my lovely wife Abigail and my wonderful children Emmanuella, Josephine and Eric- Blessing. Thank you for your love, understanding, faithfulness and encouragement.

ACKNOWLEGEMENT

Several people and Intravenous Infusions Limited provided materials and other relevant information for this thesis including: Dennis, Murktarh (Finance Director) all of Intravenous Infusions Limited, Dr. F. T. Oduro, my supervisor and past head of department; information systems and decision science, KNUST School of Business. I am grateful to the following persons for graciously providing me with a lot of financial and other material support: Ebenezer Koramoa, Rosemond Marshall, Sarah Okantey and Jacob Amoako.

I am also thankful for the great assistance of my brother, Raphael Kwatia Amoako. I want to thank Mr. & Mrs. Apau Koramoa for being a constant source of inspiration and encouragement over the years. I also thank my mother and all my siblings for their many positive influences which have contributed significantly to whatever success I am enjoying in life.

I am grateful to these wonderful friends, Ebenezer Mensah Anann and Isaac Effah for their love and help to me since we became friends.

Recognition to all persons who provided assistance and to all publishers and authors whose materials were used, I am indeed grateful.

ABSTRACT

In an era of aggressive marketing, inventory management in any organization is very relevant since it encompasses the purchases of raw materials right up to the delivery to the customer. It is therefore incumbent upon every business entity to treat the supply chain sector with all the seriousness it deserves since a properly structured and functional inventory management unit ensures customer satisfaction and loyalty and also reduces cost to the business thereby ensuring its sustainability.

This research was conducted on Intravenous Infusions Limited, a company located at Koforidua in the eastern region of Ghana, which undertakes the manufacturing of Infusions, drugs, medicines and other by-products and the selling of pharmaceutical products on the local market and also for export. The purpose of the study was to assess the inventory management procedures of the company. The objectives include, examining the safety stock level, finding out how stock reorder point can be determined. The causes of stock out were also investigated. Using a purposive (non probability) sampling technique, structured interviews were conducted on key personalities and the Economic order quantity models for calculating safety stock level and reorder point level were employed to analyze data from the company. The study revealed that no proper structures in respect of inventory management procedures have been established. This was coupled with the fact that there were no requisite personnel in charge of the supply chain activities. If the recommendations made in this study are put into effect, it should greatly lead to a turn around in operating costs for the company in question.

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CHAPTER ONE
INTRODUCTION

1.0 Background

A close observation reveals that, inventories can be found everywhere. From time immemorial ants and squirrels have kept inventories of their food supplies and yet we do not know how they learned this technique. Both humans and animals have been smart enough to realize the benefits of inventories. Since the stone-age we have been carrying inventories and managing them. But, the development of modern inventory management principles began when Harris (1913) derived the Economic Order Quantity (EOQ) formula. The EOQ assumes that demand occurs at a known, constant rate and supply fulfills the replenishment order after a fixed lead time. Unfortunately, we do not live in an ideal world. In reality, the demand rate is rarely constant; a hard-to-predict market is common in most practical situations. Also, unforeseen events in supply systems can cause unpredictable delays in replenishments. Moreover, in current times when outsourcing is at the centre stage, complex and longer supply chains magnify the length and variability of lead times (Welborn, 2008). Costs associated with inventory make up one of the most critical cost areas within an organization. Whether the company manufactures goods or sells finished products, inventory carrying costs and their component parts can represent a significant portion of the company's cost structure.

In addition, having the wrong amount of inventory on hand can result in severe difficulties. Having too much inventory on hand means that extra warehouse space is needed in addition to the costs associated with the inventory itself. In a manufacturing environment, having too little inventoried for input goods means that production slows

down, or is even halted. In both manufacturing and retail environments, not having inadequate inventories on hand to meet consumer demand results in lost sales, and lower revenue than would otherwise be realized. Inventory management is primarily about specifying the size and placement of stocked goods. (http://www.nextlevelpurchasing.com).

Inventory management is required at different locations within a facility or within multiple locations of a supply network to protect the regular and planned course of production against the random disturbance of running out of materials or goods. The scope of inventory management also concerns the fine lines between replenishment lead time, carrying costs of inventory, asset management, inventory forecasting, inventory valuation, inventory visibility, future inventory price forecasting, physical inventory, available physical space for inventory, quality management, replenishment, returns and defective goods and demand forecasting.

This research examines how inventory can be improved at Intravenous Infusion Limited. The outcome will hopefully, help the organization to reduce overstock and stock out of products, reduce the problem of stock out and suggest a proper reordering point.

1.1 Problem Statement

Inventories are required to be maintained to take care of needs between the time of demand and time of supply. Inventory management involves decisions concerning buffer stocks, lead time and replenishment of stocks.Many organizations do not have control

over their inventory, and their inventory rather controls them. This is as a result of having stock out situations which result in lost sales and an overall decrease in customer service. Another problem area is a situation where the company's safety stock level is not properly determined leading to shortages in the face of increased demand and resulting in lost sales.

There is also the problem of not being able to determine the reorder point.

In view of the problems above, the researcher wants to evaluate the inventory activities of the Intravenous Infusion Limited, Koforidua and recommend certain practices that will help improve inventory management.

1.2 Research Objectives

The objectives of this research include

Firstly examining the safety stock level since this has a potential to over stock or under stock the product, ultimately leading to a tied up capital in inventory or lost sales.

Secondly, this research is undertaken to find out how stock reorder point can be determined.

Thirdly, it is to analyze the process of purchasing raw materials for production which is the beginning of inventory management.

Finally, it is to examine the causes of stock out situations in the bid to meet customer demand and satisfaction.

1.3 Significance of the study

The researcher hopes to put forward recommendations in this study that will help inventory managers to improve the activities of inventory management in organizations. Again this study will add to the wealth of knowledge in the field of inventory management and serve as reference for people researching into the same or related fields

1.4 Purpose of the study

The purpose of this study is to assess the inventory management procedures at Intravenous Infusions Limited, Koforidua.

1.5 Scope of the study

The researcher wishes to select one manufacturing company in the Eastern region of Ghana. The company's name is Intravenous Infusion Limited, an intravenous infusion manufacturing company situate at Koforidua. The researcher's interest will be on their inventory management.

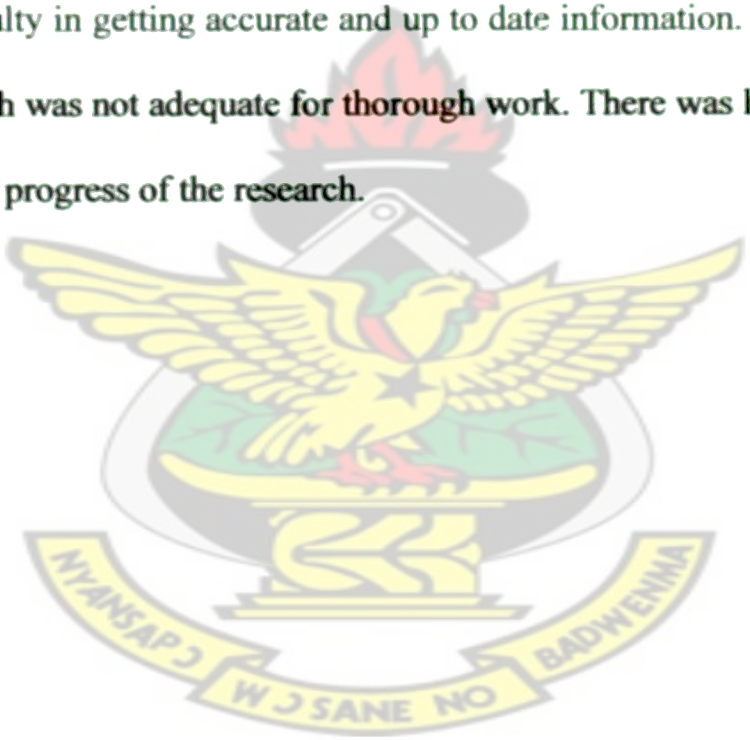
1.6 Organization of the study

This work is organized and structured into five chapters. Chapter one has to do with Background to the study, the Problem statement, Study objectives, Purpose of study, Significance of the study, Scope of the study, Organization of the chapters and the Limitations of the study. Chapter two deals with the Literature Review. Chapter three discusses the Research Methodology and deals with the Study Population, the Sample size, and the Method of data analysis. Chapter four provides the Data analysis and Data

interpretation. Chapter five gives the Summary of Findings, Conclusion and Recommendations

1.7 Limitations of the Study

There was some difficulty in getting accurate and up to date information. The time frame to complete the research was not adequate for thorough work. There was lack of financial support to facilitate the progress of the research.



CHAPTER TWO

LITERATURE REVIEW

2.0. Introduction

This chapter reviews the related literature on the topic-"Improving inventory management in a manufacturing company: A case study of Intravenous Infusion Limited, Koforidua.

The research was carried out in Intravenous Infusions Limited. Koforidua

The company is located on the outskirts of the capital, Koforidua, in the Eastern Region. Apparently, it is the only Intravenous Company in the region serving a very huge customer base. This chapter considers both the empirical and theoretical literature related to the subject matter.

2.1 Definitions

Management view towards inventory has changed significantly over the past several years. Previously managers perceived inventory as an asset because it appeared as an asset in the firm's financial reports. However this is no longer the case. As we see this day's product life cycles are becoming ever shorter, increasing the likelihood of product obsolescence. Excessive inventories tend to conceal a wide variety of problems. Moreover, inventory storage costs are typically very expensive, averaging 30 to 35 percent annually of the value of the inventory and in some cases they are much higher. For all of these reasons, managers now look at inventory as a liability to the firm something to be reduced or eliminated wherever possible. (Jacobs et al., 2003)

During a busy sales season one may ask: "Do I manage inventory or inventory manages me?" Inventory is a retailer's biggest business asset. Yet without the right information it

can spell disaster in bold letters. There is the need to control the flow of inventory from where you first plan your purchases to buying, receiving, selling and even returns. While some of the problems can be attributed to error, more often the problems come from not having the right information about the inventory in order to make informed decisions. It is better to know what are you over-bought, over produce or over-inventoried in a particular department than not having the correct information or not having the correct inventory (Fisher, 1997).

Management of inventories has the primary objective of determining, controlling stock levels within the physical distribution function to balance the need for product availability against the need for minimizing stock holding and handling costs. Therefore inventory management system is the set of policies and controls that monitors levels of inventory and determines what levels should be maintained, when stock should be replenished and how large orders should be. (Song et al., 1996)

Inventory management is primarily about specifying the size and placement of stocked goods (Zipkin, 2000). Inventory is the stock of any item or resources used in an organization (Jacobs et al., 2009). The researcher then defines inventory to be the size of goods and materials being it work in progress, raw materials and finished goods that are in stock in an organization. Raw materials are vendor-supplied items that have not had any labor added. Work-in-progress is items that have been partially processed but are still incomplete. Finished goods are completed products still in possession of the firm.

Even though management in many organizations see inventory as a liability, there are good reasons to hold inventory and when this is managed well, adds to the revenue of the organization (Naylor, 2002).

2.2 The importance of inventory management

Controlling Inventory

To maintain an in-stock position of wanted items and to dispose of unwanted items, it is necessary to establish adequate controls over inventory on order and inventory in stock. There are several proven methods for inventory control. They are listed below, from simplest to most complex.

Visual control enables the manager to examine the inventory visually to determine if additional inventory is required. In very small businesses where this method is used, records may not be needed at all or only for slow moving or expensive items.

Tickler control enables the manager to physically count a small portion of the inventory each day so that each segment of the inventory is counted so many days on a regular basis.

Click sheet control enables the manager to record the item as it is used on a sheet of paper. Such information is then used for reorder purposes.

Stub control (used by retailers) enables the manager to retain a portion of the price ticket when the item is sold. The manager can then use the stub to record the item that was sold.

Organizations maintain inventories for several reasons and these include:

To protect against uncertainty, according to Chase (2003) uncertainty can be examined in three areas. First, there is uncertainty with respect to raw materials, which necessitates raw material inventory. Here uncertainty is viewed as both the lead time that can vary due to unexpected delays and to the amount of raw materials received.

Uncertainty also occurs in the transformation process. Thus work in process inventories absorb the variability that exist between the stages of the process there by providing independence between operations and improving efficiency.

Chase (2003) also argues that, uncertainty exists with respect to the demand for a firm's finished products. If the demand for a product were to be known precisely, then it could be possible to manufacture products so that demand would be exactly met. Most of the time demand is not totally known therefore a safety stock of finished goods inventory is therefore maintained to absorb these variations.

Zipkin (2000) is of the view that inventory could be held to support a firm's strategic plan, thus when a firm adopts a level strategy, an inventory of finished goods is required to buffer the cyclic demand for product from the level output generated by the transformation process. And under these circumstances when demand exceeds production, the difference is withdrawn from inventory and when demand is less than production, the difference is placed back into inventory.

According to Lee (2002), inventory is held to take advantage of economies of scale. Lee explains his point by saying that each time a setup is done to perform an operation, we incur a fixed cost, regardless of the quantity involved. Thus the larger the quantity ordered or produced, the lower the average total cost per unit. In addition companies

often offer discounts for larger quantity orders as an incentive to customers to buy more than they normally would, this situation also brings about economies of scale which with respect to transport costs, especially when products are shipped in full trailer loads or full car loads. In making any decision with respect to inventories the following cost components should be taken into consideration:

Holding or carrying cost. According to Davis et al. (2003) this can be categories or subdivided into three segments: storage costs, and obsolescence/shrinkage costs. Storage costs include the cost of the storage facility in the form of rent or depreciation, insurance, taxes, utilities, security, and facility personnel.

Inventory management is required at different locations within a facility or within multiple locations of a supply network to protect the regular and planned course of production against the random disturbance of running out of materials or goods (Burt et al., 2006). The scope of inventory management also concerns the fine lines between replenishment lead time, carrying costs of inventory, asset management, inventory forecasting, inventory valuation, inventory visibility, future inventory price forecasting, physical inventory, available physical space for inventory, quality management, replenishment, returns and defective goods and demand forecasting. In a literal sense, inventory refers to stocks of anything necessary to do business. These stocks represent a large portion of the business investment and must be well managed in order to generate revenue to maximize profits. Unless inventories are controlled, they are unreliable, inefficient and costly.

According to Winston et al. (2001) companies face two competing pressures. The first is the pressure to have enough inventories on hand, the reason being that, they do not want

to run out of products that customers demand. Another reason being the cost of ordering, if there is a fixed cost incurred each time the company orders from its supplier, where this cost does not depend on the order size, then there is an incentive for the company to place large orders to minimize its annual ordering costs.

The second pressure related to inventory management is the pressure to carry as little inventory as possible. The most obvious reasons for this are the cost of storing items and the interest costs involved in tying up money in inventory. If the company has to pay cash for items that end up sitting on the shelf for long periods of time, it is losing potential interest on this money that could be invested elsewhere. Storage space is sometimes an issue as well. Some companies do not have the space to store as much inventory as they might like. According to Winston et al. (2001) these two competing pressures are at the heart of most inventory models. Thus companies want to order enough, but they do not want to order too much. The balance is typically not easy to find, so there is the need for models to determine the best ordering or production policy.

An inventory problem can usually be broken up into two parts: how much to order on each ordering opportunity and when to order. When it is assumed that customer demand is known, the resulting models are called deterministic models. If customer demand is known and the order quantity has been determined, it is then relatively easy to specify when the orders should be placed. A more realistic situation occurs when customer demand is uncertain. In this situation the decision of placing more orders becomes very difficult. These more difficult problems require probabilistic inventory models.

2.3 Role of Inventory in the Supply Chain

Inventory exists in the supply chain because of a mismatch between supply and demand. This mismatch is intentional at a steel manufacture, where it is economical to manufacture in large lots that are then stored for future sales. The mismatch is also intentional at a retail store where inventory is held in anticipations of future demand. An important role that inventory plays in the supply chain is to increase the amount of demand that can be satisfied by having the product ready and available when the customer wants it (Chopra et al., 2007). Another significant role that inventory plays is to reduce cost by exploiting economies of scale that may exist during production and distribution.

Inventory is held throughout the supply chain in the form of raw materials, work in process, and finished goods. Inventory is a major source of cost in a supply chain and has a huge impact on responsiveness (Chopra et al., 2007). For example, an apparel supply chain with high inventory levels at the retail stage has a high level of responsiveness because a consumer can walk into a store and walk out with the shirt he or she was looking for. In contrast, an apparel supply chain with little inventory could be very efficient but would make customers wait several weeks or even months for their clothes. Inventory also has a significant impact on the material flow time in a supply chain. Material flow time is the time that elapses between the points at which material enters the supply chain to the point at which it exits. For a supply chain, throughput is the rate at which sales occur. If inventory is represented by I, flow time by T, and throughput by D, the three can be related using Little's law as follows:

$$I = DT$$

The logical conclusion here is that inventory and flow time are synonymous in a supply chain because throughput is often determined by customer demand. It is important for managers to use actions that lower the amount of inventory needed without increasing cost or reducing responsiveness, because reduced flow time can be significant advantage in a supply chain (Chopra et al., 2007).

2.4 Role of Inventory in Competitive Strategy

Inventory plays a significant role in a supply chain's ability to support a firm's competitive strategy. If a firm's competitive strategy requires a very high level of responsiveness, a company can achieve this responsiveness by locating large amounts of inventory close to the customer. Conversely, a company can also use inventory to become more efficient by reducing inventory through centralized stocking. The latter strategy would support s competitive strategy of being a low cost producer (Chopra et al., 2007)

2.5 Components of Inventory Decisions

Major inventory-related decisions that supply chain managers must make to effectively create more responsive and more efficient supply chains.

2.5.1 *Cycle Inventory*

Cycle inventory is the average amount of inventory used to satisfy demand between receipts of supplier's shipments. The size of the cycle inventory is a result of the production, transportation, or purchase of material in large lots. Companies produce or

purchase in large lots to exploit economies of scale in the production, transportation, or purchasing process. With the increase in lot size, however, also comes an increase in carrying costs. As an example of a cycle stock decision, consider an online book retailer. This retailer's sales average around 10 truckloads of books a month. The cycle inventory decisions the retailer must make are how much to order for replenishment and how often to place these orders. The e-retailer could order 10 truckloads once each month or it could order one truckload every three days. The basic trade-off supply chain managers, face is the cost of holding larger lots of inventory (when cycle inventory is high) versus the cost of ordering product frequently (when cycle inventory is low) (Magee et al., 1967)

2.5.2 *Safety Inventory*

Safety inventory is inventory held in case demand exceeds expectations; it is held to counter uncertainly. If the world were perfectly predictable, only cycle inventory would be needed. Because demand is uncertain and may exceed expectations, however, companies hold safety inventory to satisfy an unexpectedly high demand. Managers face a key decision when determining how much safety inventory to hold. For example, a toy retailer such as Toy's "R" Us must calculate its safety inventory for the holding buying season. If it has too much safety inventory, toys go unsold and may have to be discounted after the holidays. If the company has too little safety inventory, however, then Toys "R" Us loses sales, along with the margin those sales would have brought. Therefore, choosing safety inventory involves making a trade-off between the costs of having too much inventory and the costs of losing sales due to not having enough inventories. (Chopra et al., 2007)

2.5.3 *Seasonal Inventory*

Seasonal inventory is built up to counter predictable variability in demand. Companies using seasonal inventory buildup inventory in a period of low demand and store it for period of high demand when they will not have the capacity to produce all that is demanded. Managers face key decisions in determining whether to build seasonal inventory, and if they do build it, in deciding how much to build. If a company can rapidly change the rate of its production system at very low cost, then it may not need, seasonal inventory, because the production system can adjust to a period of high demand without incurring large costs, However, if changing the rate of production is expensive (e.g., when workers must be hired or fired), then a company would be wise to establish a smooth production rate and build up its inventory during periods of low demand. Therefore, the basic trade-off supply chain manager face in determining how much seasonal inventory to build is the cost of carrying the additional seasonal inventory versus the cost of having more flexible production rate (Silver et al., 1985).

2.5.4 *Level of Product Availability*

Level of product availability is the fraction of demand that is served on time from product held in inventory. A high level of product availability provides a high level of responsiveness but increase cost because a lot of inventory is held but rarely used. In contrast, a low level of product availability lowers inventory holding cost but results in a higher fraction of customers who are not served on time. The basic trade-off when determining the level of product availability is between the cost of inventory to increase product availability and the loss from not serving customers on time (Chopra et al., 2007)

2.6 Types of Inventory

Raw materials: The purchased items or extracted materials that are transformed into components or products.

Work-in-process (WIP): Any item that is in some stage of completion in the manufacturing process.

Finished goods: Completed products that will be delivered to customers.

Distribution inventory: Finished goods and spare parts that are at various points in the distribution system.

Maintenance, repair, and operational (MRO) inventory (often called supplies): Items that are used in manufacturing but do not become part of the finished product.

(Source: http://www.bus.ucf.edu/rszymanski/ISM3530/CP3indepdeminv.doc)

2.7 Classification of inventory

Anticipation Inventory or Seasonal Inventory: Inventory are often built in anticipation of future demand, planned promotional programs, seasonal demand fluctuations, plant shutdowns, vacations, etc.

Fluctuation Inventory or Safety Stock: Inventory is sometimes carried to protect against unpredictable or unexpected variations in demand. By having an adequate amount of safety stock on hand, a company can meet a sales demand which exceeds the demand they forecasted without altering their production plan. It is held when an organization cannot accurately predict demand for the product (Stock et al., 2001)

Lot-Size Inventory or Cycle Stock Inventory is frequently bought or produced in excess of what is immediately needed in order to take advantage of lower unit costs or quantity

discounts. It is inventory that result from the replenishment process and is required in order to meet demand under conditions of certainty. Thus when demand and lead time are constant then only cycle stock is necessary. (Source: http://www.bus.ucf.edu/rszymanski/ISM3530/CP3indepdeminv.doc)

Transportation or Pipeline Inventory is used to fill the pipeline as products are in transit in the distribution network. They are items that are en route from one location to another. (Source: http://www.bus.ucf.edu/rszymanski/ISM3530/CP3indepdeminv.doc)

Speculative or Hedge Inventory: Inventory can be carried to protect against some future event, such as a scarcity in supply, price increase, disruption in supply, strike, etc. finally goods may be produced seasonally for consumption throughout the year, or at constant level in anticipation of seasonal demand in order to maintain a stable workload and labour force (Stock et al., 2001)

2.8 Independent versus Dependent Inventory:

Some inventory items can be classified as independent demand items, and some can be classified as dependent demand items.

2.8.1 Independent demand inventory item:

An inventory item whose demand is not related to (or dependent upon) some higher level item is called independent demand inventory. Demand for such items is usually thought of as forecasted demand. Independent demand inventory items are usually thought of as finished products. According to Jacobs et al. (2009), independent demand, is that whose

demand for various items are unrelated to each other. For example, a workstation may produce many parts that are unrelated but meet some external demand requirement. The demand for cars is independent; it comes from many sources external to the automobile firm and is not a part of other products; it is unrelated to the demand for other products.

2.8.2 Dependent demand inventory item:

An inventory item whose demand is related to (or dependent upon) some higher level item is called a dependent demand inventory item. Demand for such items is usually thought of as derived demand. Dependent demand inventory items are usually thought of as the materials, parts, components, and assemblies that make up the finished product. Jacobs et al. (2009) also says that in dependent demand, the need for any one item is a direct result of the need for some other item usually a higher-level item of which it is part. For example if an automobile company plans on producing 500 cars per day, then it will need 2000 wheels and tires plus spares. The number of wheels and tires needed are dependent on the production levels. The demand for cars on the other hand is independent.

2.9 Behavior of Cost for Different Inventory Decisions:

In assessing the cost effectiveness of an inventory policy, it is helpful to measure the total inventory costs that will be incurred during some period of time. Most frequently, that time interval used for comparing costs is one year. Over that span of time, there will be a certain need, or demand, or requirement for each inventory item. (Source: http://www.usfca.edu/~villegas/classes/984-307/307ch12/sld025.htm)

The following describes how the annual costs changes in the inventory lot sizing decision.

2.9.1 *Item costs*

For items that are ordered from external sources, the per unit item cost is predominantly the purchase price paid for the item. On some occasions this cost may also include some additional charges, like inbound transportation cost, duties, or insurance. For items that are obtained from internal sources, the per unit item cost is composed of the labor and material costs that went into its production, and any factory overhead that might be allocated to the item. In many instances the item cost is a constant, and is not affected by the lot sizing decision. In those cases, the total annual item cost will be unaffected by the order size. Regardless of the order size, our total annual acquisitions will equal the total annual need. Acquiring that total number of units at the constant cost per unit will yield the same total annual cost.

2.9.2 *Holding costs (also called carrying costs)*

Any items held in inventory will incur a cost for their storage. This cost will be comprised of a variety of components. One obvious cost would be the cost of the storage facility (warehouse space charges and utility charges, cost of material handlers and material handling equipment in the warehouse). (Source http://www.usfca.edu/~villegas/classes/984-307/307ch12/sld025.htm).

In addition to that, there are some other, more subtle expenses that add to the holding cost. These include such things as insurance on the held inventory; taxes on the held

inventory; damage to, theft of, deterioration of, or obsolescence of the held items. The order size decision impacts the average level of inventory that must be carried. If smaller quantities are ordered, on average there will be fewer units being held in inventory, resulting in lower annual inventory holding costs. If larger quantities are ordered, on average there will be more units being held in inventory, resulting in higher annual inventory holding costs. (Source:.http://www.usfca.edu/~villegas/classes/984-307/307ch12/sld025.htm)

2.9.3 *Ordering costs*

Any time inventory items are ordered, there is a fixed cost associated with placing that order. When items are ordered from an outside source of supply, that cost reflects the cost of the clerical work to prepare, release, monitor, and receive the order. This cost is considered to be constant regardless of the size of the order. When items are to be manufactured internally, the order cost reflects the setup costs necessary to prepare the equipment for the manufacture of that order. Once again, this cost is constant regardless of how many items are eventually manufactured in the batch. If one increases the size of the orders for a particular inventory item, fewer of those orders will have to be placed during the course of the year, hence the total annual cost of placing orders will decline. (Source: http://www.usfca.edu/~villegas/classes/984-307/307ch12/sld025.htm)

2.9.4 *Shortage costs*

Companies incur shortage costs whenever demand for an item exceeds the available inventory. These shortage costs can manifest themselves in the form of lost sales, loss of

good will, customer irritation, backorder and expediting charges, etc. Companies are less likely to experience shortages if they have high levels of inventory, and are more likely to experience shortages if they have low levels of inventory. The order size decision directly impacts the average level of inventory. Larger orders mean more inventories are being acquired than is immediately needed, so the excess will go into inventory. Hence, smaller order quantities lead to lower levels of inventory, and correspondingly a higher likelihood of shortages and their associated shortage costs. Larger order quantities lead to higher levels of inventory, and correspondingly a lower likelihood of shortages and their associated costs. The bottom line is this: larger order sizes will lead to lower annual shortage costs. (Source:http://www.usfca.edu/~villegas/classes/984-307/307ch12/sld025.htm).

2.10 *Trade offs of Inventory*

The fundamental trade-off that managers face when making inventory decisions is between responsiveness and efficiency. Increasing inventory generally makes the supply chain more responsive to the customer. A higher level of inventory also facilitates a reduction in production and transportation costs because of improved economies of scale in both functions. This choice, however, tends to increase inventory holding cost (Chopra et al., 2007).

2.11 Classical Economic Order Quantity (EOQ) Model

The EOQ model is a technique for determining the best answers to the how much and when questions. It is based on the premise that there is an optimal order size that will

yield the lowest possible value of the total inventory cost. There are several assumptions regarding the behavior of the inventory item that are central to the development of the model (Anderson et al., 2003).

2.11.1 *EOQ assumptions*

1. Demand for the item is known and constant.
2. Lead time is known and constant. (Lead time is the amount of time that elapses between when the order is placed and when it is received.)
3. The cost of all units ordered is the same, regardless of the quantity ordered (no quantity discounts).
4. Ordering costs are known and constant (the cost to place an order is always the same, regardless of the quantity ordered).
5. When an order is received, all the items ordered arrive at once (instantaneous replenishment).
6. Since there is certainty with respect to the demand rate and the lead time, orders can be timed to arrive just when we would have run out. Consequently the model assumes that there will be no shortages. (Anderson et al.,2003)

Based on the above assumptions, there are only two costs that will vary with changes in the order quantity, (1) the total annual ordering cost and (2) the total annual holding cost. Shortage cost can be ignored because of assumption 6. Furthermore, since the cost per unit of all items ordered is the same, the total annual item cost will be a constant and will not be affected by the order quantity.

2.11.2 *EOQ symbols*

D = annual demand (units per year)

S = cost per order (dollars per order)

H = holding cost per unit per year (dollars to carry one unit in inventory for one year)

Q = order quantity (Stock et al., 2001)

2.11.3 *Annual Ordering Cost*

According to Stock et al (2001) the annual cost of ordering is simply the number of orders placed per year times the cost of placing an order. The number of orders placed per year is a function of the order size. In general, the number of orders placed per year will be the total annual demand divided by the size of the orders. In short,

Total Annual Ordering Cost = (D/Q)S

2.11.4 *Annual Holding Cost*

The holding cost is the average inventory level times the cost to carry a unit in inventory for a year. In short,

Total Annual Holding Cost = (Q/2) H

2.11.5 *Total Annual Cost*

The total annual relevant inventory cost would be the sum of the annual ordering cost and annual holding cost, or

TC = (D/Q) S + (Q/2) H

This is the annual inventory cost associated with any order size, Q.

2.11.6 *EOQ occurs when*

$(D/Q)S = (Q/2)H$

Algebraically:

$Q^2 = (2DS)/H$

and finally

$Q = \sqrt{2DS/H}$

(This optimal value for Q is what we call the EOQ)

(Stock et al., 2001)

2.12 Economic Production Lot-Size model

The economic production Lot size model is similar to the EOQ model. According to (Anderson et al.,2003) this inventory model alters the second assumption of the EOQ model, thus the assumption concerning the arrival of Q units each time an order is received is changed to a constant production supply rate. This model is designed for production situations in which, once an order is placed, production begins and a constant number of units is added to inventory each day until the production run has been completed.

Formula for the lot-size model

Total annual cost,

$TC = \frac{1}{2}(1 - D/P)Q\,C_h + (D/Q)Co$

The order quantity Q that minimizes the total cost can be found by differentiating dTC/dQ and equating to zero and solving for Q*

$dTC/dQ = \frac{1}{2}(1 - D/p)C_h + (D/Q^2)Co = 0$

$\frac{1}{2}(1 - D/p)C_h = (D/Q^2)Co$

$(1-D/p)C_hQ^2=2DCo$

$Q^2 = 2DCo/ (1- D/p)C_h$

$Q^* = sqrt(2DCo/(1- D/p)C_h)$

C_h = holding cost

Co = setup cost

D = annual demand rate

P = annual production rate

Q* = production lot size

2.13 Determination of Safety Stock

One of the most embarrassing situations for a supply chain manager is to run out of stock especially, if it brings certain operations to a halt.

More inventory guards against stock outs. However, inventory represents costs that executives seek to minimize. One needs a balance between high cost and high risk, which involves calculating the safety stock level (SSL) for each key inventory item. (Source: http://www.nextlevelpurchasing.com/articles/safety-stock-calculation.html?)

There is no perfect safety stock calculation applicable to all situations. According to the book "Purchasing and the Management of Materials" by Gary Zenz, "The size of safety stock depends on the importance of the particular item to the process, the value of the investment, and the availability of substitutes on short notice." (Source: http://www.nextlevelpurchasing.com/articles/safety-stock-calculation.html?)

The following calculates safety stock level:

Maximum safety stock level (SSL) = MHDU * (MHLT- ALT)

Where:

MHDU = maximum historical daily usage

MHLT= maximum historical lead time

ALT= average lead time

The theory behind this safety stock calculation is that you will have just enough inventories in stock if two "catastrophic" events happen simultaneously:

1. **Your supplier's lead time slips to the longest it's ever been with that supplier; and**

2. On those days that your supplier is late, your company uses the most inventories it has ever used. **(Source: http://www.nextlevelpurchasing.com/articles/safety-stock-calculation.html?)**

2.13.1 *Reasons for Safety Stock*

Safety Stocks enable organizations to satisfy customer demand in the event of these possibilities:

1. **Supplier may deliver their product late or not at all**

2. The warehouse may be on strike

3. **A number of items at the warehouse may be of poor quality and replacements are still** on order

4. **A competitor may be sold out on a product, which is increasing the demand for your** products

5. **Random demand (in reality, random events occur)**

6. **Machine Breakdown**

7. Unexpected increase in demand

(http://:en.wikipedia.org/wiki/safety_stock 11/08/2009)

Reorder Point: It is important to know when to reorder materials for inventory. **Generally, this point in time is determined when the quantity of materials in stock** decreases to a certain level, called the reorder point. The reorder point is determined by **the formula:**

ROP = SSQ + (QUD x ALT)

Where,

ROP = Reorder Point

SSQ = Safety Stock Quantity

QUD = Quantity Used Daily

ALT = Average Lead Time (in days)

2.14 ABC Inventory Classification (Inventory Value for each Group versus the Groups Position of the Total List

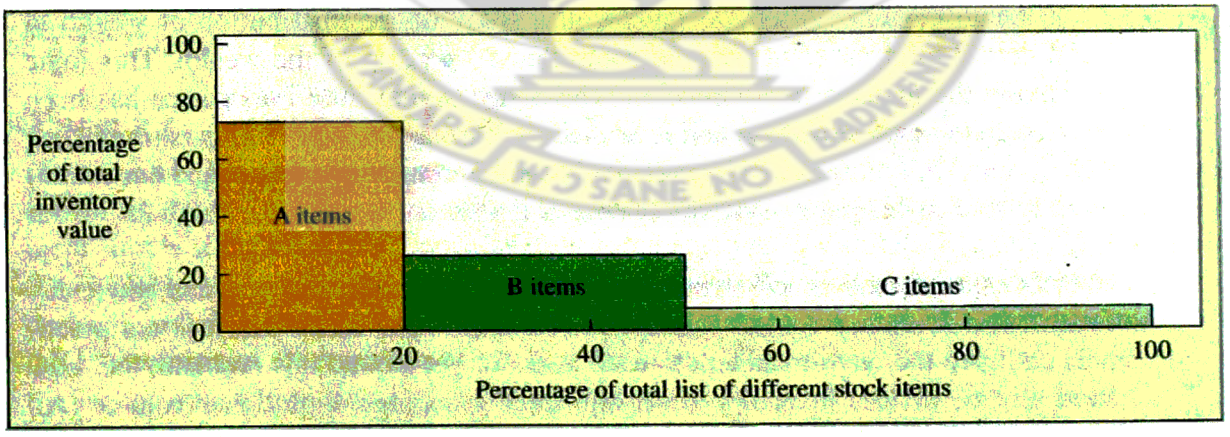


Fig 1. ABC Inventory Classification Source: Jacobs et al (2009)

According to (Jacobs et al., 2009) segmentation may not always occur so neatly. The objective, though, is to try to separate the important from the unimportant. Where the lines actually break depends on the particular inventory under question and on how much personnel time is available. (With more time, a firm could define larger A or B categories.)

The purpose of classifying items into groups is to establish the appropriate degree of control over each item. On a periodic basis, for example, class A items may be more clearly controlled with weekly ordering, B items may be ordered biweekly, and C items may be ordered monthly or bimonthly. The unit cost of items is related to their classification. An A item may have a high dollar volume through a combination of either low cost and high usage or high cost and low usage. Similarly, C items may have a low dollar volume because of either low demand or low cost.

Sometimes an item may be critical to a system if its absence creates a sizable loss. In this case, regardless of the item's classification, sufficiently large stocks should be kept on hand to prevent run-out. One way to ensure closer control is to designate this item an A or a B, forcing it into the category even if its dollar volume does not warrant such inclusion.

2.15 Inventory Monitoring Approaches

2.15.1 *Continuous review system*

This approach maintains a constant order size, but allows the time between the placements of orders to vary. This method of monitoring inventory is sometimes referred

to as a perpetual review method, a fixed quantity system, and a two-bin system. When the inventory is depleted to the reorder point, a replenishment order is placed. The size of that order is the economic order quantity for that item. This type of system provides closer control over inventory items since the inventory levels are under perpetual scrutiny. (Source: http://:en.wikipedia.org/wiki/safety)

2.15.2 *Periodic review system*

This approach maintains a constant time between the placements of orders, but allows the order size to vary. This method of monitoring inventory is sometimes referred to as a fixed interval system or fixed period system. It only requires that inventory levels be checked at fixed periods of time. The amount that is ordered at a particular time point is the difference between the current inventory level and a predetermined target inventory level (also called an order up to level). If demand has been low during the prior time interval, inventory levels will be relatively high, and the amount to be ordered will be relatively low. If demand has been high during the prior time interval, inventory levels will have been depleted to low levels, and the amount to be ordered will be higher. (Source: http://www.effectiveinventory.com/article29.html)

2.15.3 *Min-max system*

This approach allows both the order size and the time between the placements of orders to vary. This method of monitoring inventory is sometimes referred to as an optional replenishment system. It is a hybrid system that combines elements of both the continuous review system and the periodic review system. It is similar to the periodic

review system in that it only checks inventory levels at fixed intervals of time, and it has a target inventory level. However, when one of those review periods arises the system does not automatically place an order. An order is only placed if the size of the order would be sufficient to warrant placing the order. This determination is made by incorporating the reorder point concept from the continuous review system. At the review period the inventory level on hand is compared to a reorder point for the item. If inventory has not fallen below the reorder point, no order is placed. However, if the inventory level has dropped below the reorder point, an order is placed. The size of the order is the difference between the inventory on hand and the target inventory level.

(Source: http://www.effectiveinventory.com/article29.html)

2.16 Benefits of Inventory Management

1) Inventory management can remove barriers between manufacturer and retailers and establish a closer relationship between them.
2) It helps in frequent analysis of purchases, sales and inventory records
3) It gets the complete information about the value of inventory.
4) It gives complete knowledge of the exact size of merchandizing inventory.
5) Organizations have full knowledge of their inventory.

(http://www.chandigarhcity.com/blog/2005/12/15/benefits-of-inventory-management/)

2.17 Purchasing/procurement:

According to Coyle et al (1992) purchasing and procurement is the process of obtaining goods and services for a firm. This goes beyond the simple acct of buying; it involves all

the activities necessary to perform the daily and long term functions of acquiring goods and services. These activities are accomplished by the purchasing manager determining the company's material needs, locate supply sources, evaluate and select one or more suppliers, choose a buying method, established an acceptable price and other terms of sale monitor the purchase's status until supplier delivers it and evaluate the suppliers' products and service.

The classic definition of purchasing/procurement is buying the right quality, in the right quantity, at the right price, from the right source, at the right time (Coyle et al., 1992).

This definition of purchasing addresses the major decision making areas of purchasing: how much to buy, what quality is needed, what the cost is, from whom the goods should be purchased and when and where should the goods be delivered.

Coyle et al (1992) outline the basic processes and activities of purchasing/procurement as follows:

Identify Needs: The purchasing manager initiates a procurement transaction in response to either a new or existing need of a user or a user department within the firm.

Define and Evaluate User requirement: The purchasing manager represents the requirements by some type of measurable criteria and communicates the user's needs to potential suppliers.

Deciding to Make or Buy: The buying firm must decide whether to make or buy the product or service the user needs.

Identify Type of Purchase: The type of purchase the user needs will determine the procurement process duration, a straight re-buy or routine purchase, a modified re-buy

which requires a change in an existing supplier or input and a new buy which results from a new user need.

Conduct Market Analysis: Knowing the market type will help the purchasing manager to determine the number of suppliers in the market whether negotiations, competitive bidding, or some other buying method might be most effective.

Identify All Possible Suppliers: This activity involves identifying all possible suppliers that might satisfy the user's need including those that the buying firm has not used previously.

Prescreen all possible sources: The purchasing manager must differentiate between demands and desires. Demands are critical to the user whiles desires are not as critical and could be negotiated. Differentiating reduces the pool of possible suppliers to those that can satisfy the user's demand.

Evaluate the Supplier base: The purchasing manager determines the supplier(s) that can best meet the user's negotiable requirements or desires.

Choose Supplier: This requires the purchasing manager to choose the supplier(s) and the choice of supplier(s) also determines the relationship that will exist between the buying and the supplying firm(s).

Performance service: This determines whether the supplier is able to satisfy the user's needs or has truly satisfied the user's needs. This also acts as a control activity. If supplier performance did not satisfy the user's needs, the purchasing manager must determine the causes for this inconsistency and implement proper corrective actions.

CHAPTER THREE

METHODOLOGY

3.0 Introduction

This chapter focuses on the research methods employed in collecting data for the study. The chapter covers the research design, study population and sampling procedure, data collection, survey instrument used, administration of survey instrument and the procedure adopted in analyzing the data collected. In addition the company's profile is considered in this chapter.

3.1 Research Design

The research approach adopted for this study was deductive in nature and its purpose is a descriptive one. The main objective of using descriptive research is to portray an accurate profile of events or situations. The choice of research strategy was an embedded case study as the researcher was interested in gaining a rich understanding of the context of this research and as such a sub-unit of Intravenous Infusions Limited was analyzed.

The researcher was interested in studying a particular phenomenon at a particular time and hence a cross sectional study was undertaken with regards to the time horizon for the study.

3.2 The scope and population of the study:

The study population was made up of primarily key staffs in charge of inventory management of Intravenous Infusions Limited Koforidua, Eastern region. The research targeted staff in department namely Finance, warehouse, production because of their connection with inventory management.

3.3 Sampling Technique

A purposive (non-probabilistic) sampling technique was employed. This sampling technique was adopted because of the small number of staff targeted in the departments mentioned earlier on. To properly examine inventory management practice at Intravenous Infusions Limited Koforidua, five key members of staff were interviewed.

3.4 Data collection Technique

The research choice employed in this study was mixed-method research. Primary as well as secondary sources of data were used for the study. The source dealt with information that was collected directly from staff by through discussions and reports from the company.

3.5 Primary Data

There was a structured interview conducted with staff. The interview was to collect data on the inventory management in the organization. The instrument was found to be useful because it was easy and convenient to answer hence, full coverage of staff.

3.6 Secondary Data

The secondary sources of data were collected from reports and documents of their operations with regards to the supplies, demand and production.

3.7 Data Analysis Procedure

Microsoft Excel was used in analyzing the data collected. Tables, frequency and column charts were also employed. Economic order quantity models were also used to analyze the data from the company.

Production Lot Size: It is the optimal order quantity that will minimize total inventory costs.

$$Q^* = \text{sqrt}\ (2DCo/\ (1- D/P)C_h)$$

Where:

C_h = holding cost

Co = setup cost

D = annual demand rate

P = annual production rate

Safety Stock: Safety stock is the extra units of inventory carried as protection against possible stock outs.

Maximum SSL = MHDU x (MHLT - ALT)

Where:

MHDU = Maximum historical daily usage

MHLT = Maximum historical lead time

ALT = Average lead time

The theory behind this safety stock calculation is that one will have just enough inventory in stock if two "catastrophic" events happen simultaneously:

1. Your supplier's lead time slips to the longest its ever been with that supplier;
2. Your supplier is late; your company uses the most inventories it has ever used. This was chosen because the company under study faces similar situations.

(Source: http://www.nextlevelpurchasing.com/articles/safety-stock-calculation.html?)

Reorder point (R):

R = (Average daily demand * lead time) + safety stock

(Source: http://books.google.com/books?=QseytErYggBoC&pg=PA//2&dp.)

3.8 The Study Site

The study area of this research is New Juaben Municipality; it is bounded by the East Akim District to the north-west, Akuapem North District to the east and south, Yilo Krobo District to the north-east and Suhum-Kraboa-Coaltar District to the west.

Intravenous Infusion Limited (IIL) is a private limited liability pharmaceutical company and a leader in the manufacture of intravenous infusions in the country. The company was incorporated under the companies Code 1963 (Act 179) on 12th December 1969 and issued with the certificate to commerce business on 22nd December 1969 of the same year under certificate number C-3828.

The IIL factory is duly registered under the Factories, Offices and Shops Act 1970 under certificate no 1/14/1019.

IIL is authorized to undertake the following business:

1. Manufacturing of infusions, drugs, medicines and other by-products.

2. Selling of pharmaceutical products on the local market and also for export.

The research was carried out in Intravenous Infusion Limited Koforidua.

The IIL factory and offices are located on 13.71 acres of land on Appenteng Street, Block L on plots 7-9 at Effiduase-Koforidua. This is off the Effiduase - Akwadum Road, some 86 kilometers from the capital city of Accra. Koforidua is the regional capital of the Eastern Region of Ghana. Only 25% of the total land area has been developed. Apparently, it is the only company manufacturing Intravenous Infusions in the town and in the region as well. In fact, there are only two of such companies in Ghana, the second one being situated at Tema in the Greater Accra Region and serving a very huge customer base. Intravenous Infusion Limited has four depots in the country, they can be found in Kumasi in the Ashanti region, Tamale in the Northern region, Accra in the Greater Accra region, and Takoradi in the Western region. It is the oldest and the giant among the two companies with a supporting staff strength of 125. The Company's vision is to be the leading manufacturer and supplier of pharmaceutical and medical products in Africa in the 21st century.

Mission

The mission of **IIL** is to produce with the highest standards, good quality products, meeting the health needs of valued African clients using cutting edge technology.

IIL will leverage its network of distribution agents in all countries within West Africa to ensure that its products are readily available to million of potential clients. A major characteristic of the company's operations will be its continuous efforts to provide efficiencies, quality and reasonably priced products to its clients. These key drivers will

be of significant importance for the growth of the company's business as the pharmaceutical industry in the sub-region becomes increasingly liberalized.

Over the next ten to fifteen years, the company intends to establish itself as the premier and preferred IVF and SVI pharmaceutical company in West Africa through the delivery of quality products at competitive prices and supported by an active and energetic marketing agenda.

Objectives:

- To dominate the IV Fluids and Small volume injectables market in West Africa through the delivery of high quality pharmaceutical products at competitive prices and supported by and aggressive marketing strategy.
- To produce cost effectively and important utilization by replacing obsolete equipment
- To increase production capacity to achieved increased growth targets
- To restruction the organization to public listing on the Ghana stock exchange
- To attain ISO 9000 quality standards
- To assemble a management team capability of realizing IILS' corporate vision and Mission
- To take maximum advantage of industry prospects and growth
- To modernize facilities and operations and improve upon existing quality standards
- Research and development

The Products:

The IIL product structure is heavily skewed towards IV Fluids. On a 5 - year average (2002- 2006) the broad product distribution (in units) is as follows (% of total sales in parentheses): Sodium Chloride Solutions (13%), Dextrose Solutions (16%), Dextrose - Saline Solutions (13%), Poly-Saline Lactate Solution (12%), Poly-Saline Lactate Dextrose Solutions (3%), SVI (32%) and others including giving sets (10%).

IIL pioneered the local production of a narcotic analgesic, Pethidine. The drug volume is however controlled by the Narcotics Control Board. The company is currently the sole producer of this drug within the sub-region. Pethidine is part of the SVI product range which also includes Chloroquine Phosphate and Quinine Dihydrochloride injections. Quinine is a relatively new addition to IIL's product line. It was initially targeted for the export market but has caught on well with the local market. Chloroquine Phosphate has, as of January, 2007 been discontinued on the advice of MOH.

The company's product portfolio can be grouped under 3 broad sections as follows:

- **IV Fluids (IVF)**
    - Sodium Chloride Solutions
    - Dextrose Solutions
    - Dextrose - Saline Solutions
    - Poly-saline Lactate Solutions
    - Poly - Saline Dextrose Solutions
    - Dextran Solutions
    - Special Solutions

- **Small Volume Injections (SVI)**
    - **Pethidine Injection**
    - Magnesium Sulphate Injection
    - **Quinine injection 600mg**
    - **Quinine injection 300mg**

- **Administrative (Giving) Sets**
    - Giving sets
    - Blood Giving sets
    - **Blood taking sets**

- Licenses and Other Relevant Permits

IIL has been granted all relevant licenses and certificates of quality including a certificate of Registration as a Pharmaceutical Manufacturer issued by the Food and Drugs Board **(FBD) and Ghana Standard Board (GSB) Certificate of Quality.**

The company intends to acquire ISO 900 quality certification within 5 years.

3.9 Location and Population of Study Area.

The municipal capital is Koforidua, and is about just 85km drive from Accra, the nation's capital. Koforidua serves as the seat of the Paramount Chief of New Juaben Traditional **Area. In the year 2000, census revealed that it has a population of one hundred and thirty** nine thousand, three hundred and seventy (139,370) people. The literacy rate in the **municipality is generally high due to the numerous educational institutions in the area.**

Theses include a University, a Polytechnic, a Teacher Training College, seven senior secondary schools and seven technical and vocational institutions. The health delivery system consists of three hospitals, seven private clinics, three maternity homes and two health centres. The municipality also has 120 primary schools and 65 junior secondary schools.

A number of banks and other financial institutions operate in the municipality. There are five (5) commercial banks, two development banks, and five (5) rural banks operating in the municipality. Source: Intravenous Infusions Limited.

CHAPTER FOUR

ANALYSIS AND INTERPRETATION OF DATA

4.0 Introduction

This chapter presents the analysis of the data collected and its interpretations. The data collected was statistically analyzed as well as personal interview conducted on key personalities involved with inventory in the company. It was aimed at finding out how inventory could be managed to avoid stock out, when to place orders for new stock and the improvement of inventory management in the company in order to reduce waste and increase profit. The analyses are presented in tables with explanations as follows.

4.1 Determination of Safety Stock Level

The safety stock level for the organization was also determined using the Economic Order Quantity (EOQ) model. The tables below give the detailed analyses per product produced by the company.

TABLE 4.1.1 PRODUCT: 100 ML

Month	Demand	MHDU	ALT	MHLT	SSL
JAN	1,678	76.27	30	40	762.7273
FEB	2,390	108.64	30	40	1086.364
MAR	430	19.55	30	40	195.4545
APR	11,428	519.45	30	40	5194.545
MAY	8,200	372.73	30	40	3727.273
JUN	1,340	60.91	30	40	609.0909
JUL	2,890	131.36	30	40	1313.636
AUG	20,300	922.73	30	40	9227.273
SEP	2,256	102.55	30	40	1025.455
OCT	4,569	207.68	30	40	2076.818
NOV	2,890	131.36	30	40	1313.636
DEC	2,975	135.23	30	40	1352.273
					27884.55
				Average	2323.712

Source: Author's Field Survey, 2009

Table 4.1.1 above shows the statistics on the demand and safety stock level for 100ML product. In the month of January, the demand was 1678pieces. Based on the EOQ model, the safety stock level of this demand is 763 pieces. This increased to 2390pcs in February and there was a corresponding Safety Stock Level (SSL) of 1086pcs. The SSL fell to 195pcs due to a fall in demand. In April, the demand went up to 11428pcs and the SSL also increased to5195. This followed in the next two months to the end of the first half of the year. It can therefore be deduced from the analysis that, when demand increases the safety stock level (SSL) of a product also increases.

For the second half of the year from July to December 2008, the analysis continued. A summary of the second half of the year demand and safety stock level revealed that whenever demand increases, there was a corresponding increase in the quantity of safety stock level to be kept.

It was discovered that the product 100ML was commonly demanded and therefore a safety stock level for the organization was vital. The estimation of monthly SSL for the year suggested that an average SSL of 2324pcs should be kept to save the company from stock out of 100ML product.

TABLE 4.1.2 PRODUCT: 250 ML

Month	Demand	MHDU	ALT	MHLT	SSL
JAN	102,919	4,678.14	30	40	46781.36
FEB	39,070	1,775.91	30	40	17759.09
MAR	128,780	5,853.64	30	40	58536.36
APR	14,087	640.32	30	40	6403.182
MAY	7,255	329.77	30	40	3297.727
JUN	139,960	6,361.82	30	40	63618.18
JUL	4,038	183.55	30	40	1835.455
AUG	18,040	820.00	30	40	8200
SEP	17,899	813.59	30	40	8135.909
OCT	19,765	898.41	30	40	8984.091
NOV	75,544	3,433.82	30	40	34338.18
DEC	13,566	616.64	30	40	6166.364
					264055.9
				Average	22004.66

Source: Author's Field Survey, 2009.

Table 4.1.2 indicates the demand and safety stock level (SSL) of product 250ML. In January the demand was 102,919 pcs which was greater than demand for 100ML in the same month with a corresponding SSL of 46,781 pcs. This decreased to 39,070 with a corresponding decrease in SSL of 17759 pcs in the month of February. There was an increase in March compared to the month of February. This continued in that manner till the end of the first half of the year. Again, increase in demand caused a corresponding increase in the safety stock level.

In the second half of the year, the month of July experienced 4038pcs of demand and a corresponding SSL of 1835 pcs. In August the demand for 250ML was 18040 pcs and a SSL of 8200 pcs. This continued to December where demand was 13566 pcs and SSL was also 6166 pcs respectively.

TABLE 4.1.3 PRODUCT: 500 ML

Month	Demand	MHDU	ALT	MHLT	SSL
JAN	109,650	4984.09091	30	40	49840.91
FEB	212,540	9660.90909	30	40	96609.09
MAR	150,090	6822.27273	30	40	68222.73
APR	174,875	7948.86364	30	40	79488.64
MAY	199,132	9051.45455	30	40	90514.55
JUN	185,114	8414.27273	30	40	84142.73
JUL	131,432	5974.18182	30	40	59741.82
AUG	145,640	6620	30	40	66200
SEP	287,089	13049.5	30	40	130495
OCT	148,532	6751.45455	30	40	67514.55
NOV	267,542	12161	30	40	121610
DEC	211,484	9612.90909	30	40	96129.09

Source: Author/s Field Survey, 2009

The monthly distribution of demand and SSL of product 500ML is given above. From table 4.1.3, 109650 pcs demand were recorded in the month of January and based on the EOQ model, the estimated safety stock level calculated was 4984 pcs. This increased to 212540 pcs and 96409 pcs for demand and SSL respectively. There was a fall in demand in March, an increase in April, sustained in May and a fall in June. These increases reflected a similar trend in the safety stock level.

The second half of the year began with 131432 demand pcs and 59742 pcs of SSL for July. There was an increase in August and September. However, in October there was a fall in demand whilst the month of November experienced an increase of the same product. Demand for 500ML finally decreased to 211484 pcs in December. The analysis revealed that 500ML products were highly demanded by customers compared with the other products. Therefore the average safety stock level of the company for 500ML products was estimated at 22005 per month to avoid stock out situations.

TABLE 4.1.4 PRODUCT: 5000 ML

Month	Demand	MHDU	ALT	MHLT	SSL
JAN	860	39.09	30	40	390.9091
FEB	996	45.27	30	40	452.7273
MAR	2	0.09	30	40	0.909091
APR	2	0.09	30	40	0.909091
MAY		-	30	40	0
JUN	93	4.23	30	40	42.27273
JUL	113	5.14	30	40	51.36364
AUG	1,466	66.64	30	40	666.3636
SEP	441	20.05	30	40	200.4545
OCT	554	25.18	30	40	251.8182
NOV	457	20.77	30	40	207.7273
DEC	159	7.23	30	40	72.27273

Source: Author/s Field Survey, 2009

Table 4.1.4 above illustrates the statistics on product 5000ML. In January, 860pcs of the product was demanded and the estimated safety stock level by the EOQ model for safety stock level calculation was 391pcs. This increased in the next month to 996pcs and 453pcs demand and SSL respectively. Meanwhile in March and April it fell to 2 and to 0 in May. It then increased to 93pcs of demand and 42pcs of SSL in June to complete the first half of the year.

In the second half of the year, there was an increase in demand in July and August but a fall in September. The months of October and November also experienced increases in both demand and SSL till a final decrease in December 2008. Its worth noting that whenever demand increased, quantity of safety stock level also increased. This means that there is a possible relationship between demand and the SSL.

TABLE 4.1.5 PRODUCT: 10000 ML

Month	Demand	MHDU	ALT	MHLT	SSL	
JAN	10,097	458.95	30	40	4589.545	
FEB	10,465	475.68	30	40	4756.818	
MAR	8,159	370.86	30	40	3708.636	
APR	14,770	671.36	30	40	6713.636	
MAY	17,655	802.50	30	40	8025	
JUN	17,372	789.64	30	40	7896.364	
JUL	10,985	499.32	30	40	4993.182	
AUG	17,340	788.18	30	40	7881.818	
SEP	15,320	696.36	30	40	6963.636	
OCT	6,544	297.45	30	40	2974.545	
NOV	14,095	640.68	30	40	6406.818	
DEC	15,655	711.59	30	40	7115.909	
					6002.159	=Average

Source: Author's Field Survey, 2009

The table 4.1.5 above shows the analysis of product 10000ML. The analysis shows that in January there was a demand of 10097pcs and SSL of 4590pcs. This increased to 10465 in February and a fall of 8159pcs in March. In April and May the demand increased and a small fall in June to complete the end of the first half of the year.

In the second half of the year, demand was 17372pcs with a corresponding estimate of 4993pcs based on the EOQ model as safety stock level. There was a fall in August, an increase in September and a fall in October, November and December witnessed increases. According to the EOQ model used, the average safety stock level was 6002pcs. It could be observed that whenever demand increases there was a corresponding increase in the level of safety stock to avoid stock out situations.

TABLE 4.1.6 PRODUCT: ADMINISTRATIVE SETS

Month	Demand	MHDU	ALT	MHLT	SSL
JAN	9,525	432.954545	30	40	4329.545
FEB	4,845	220.227273	30	40	2202.273
MAR	28,600	1300	30	40	13000
APR	8,022	364.636364	30	40	3646.364
MAY	13,375	607.954545	30	40	6079.545
JUN	11,881	540.045455	30	40	5400.455
JUL	25,450	1156.81818	30	40	11568.18
AUG	37,212	1691.45455	30	40	16914.55
SEP	5,300	240.909091	30	40	2409.091
OCT	7,673	348.772727	30	40	3487.727
NOV	1,763	80.1363636	30	40	801.3636
DEC	1,560	70.9090909	30	40	709.0909

Source: Author's Field Survey, 2009

The table 4.1.6 above shows the distribution of the product Administrative sets. In January, the demand for Administrative sets was 9525pcs and the corresponding SSL according to the model was 4330pcs. Demand fell in February and March, and increased in the month of April up to the end of the first half of the year.

In the second half of the year, July witness an increased demand of 37212pcs which was the highest demand throughout the whole year with a corresponding SSL of 16915pcs. There was a fall in August and an increase in demand in the month of September. November and December witnessed a fall in demand. It must be noted that a fall or increase in demand reflected a smaller fall or increase in the safety stock level of the company. It could be seen that the level of demand for the Administrative Sets were low compared with the other products. Therefore, the annual average demand for the year was estimated to be 5879piece to avoid stock out situations.

TABLE 4.1.7 PRODUCT: SMALL VOLUME INJECTIONS

Month	Demand	MHDU	ALT	MHLT	SSL
JAN	135,665	6166.59091	30	40	61665.91
FEB	18,100	822.727273	30	40	8227.273
MAR	1,700,111	77277.7727	30	40	772777.7
APR	18,060	820.909091	30	40	8209.091
MAY	53,100	2413.63636	30	40	24136.36
JUN	155,766	7080.27273	30	40	70802.73
JUL	36,890	1676.81818	30	40	16768.18
AUG	85,565	3889.31818	30	40	38893.18
SEP	87,875	3994.31818	30	40	39943.18
OCT	48,500	2204.54545	30	40	22045.45
NOV	49,900	2268.18182	30	40	22681.82
DEC	32,600	1481.81818	30	40	14818.18

Source: Author's Field Survey, 2009

Table 4.1.7 shows the demand and safety stock level (SSL) of the product Small Volume Injections (SVI). The product SVI was also analyzed based on demand and SSL. It was observed that in January, the demand was 135665pcs and the corresponding SSL was 61666pcs. There was a decreased in February to 18100pcs and a corresponding decrease of 8227pcs in the same month. In a March, the demand increased significantly with a corresponding increase in SSL. There was a rise and fall in demand and SSL for the first half of the year.

In the second half of the year, the demand for July was 36890pcs and the SSL was 16768. There was an increase in August to 85565pcs and SSL of 38893pcs. There was an increment in quantity demanded up to September. In October, a fall occurred. In November, there was an increase and finally, a fall in December. The statistics showed that whenever there was a decrease in demand, a corresponding decrease in safety stock level occurred indicating the relationship between demand and the safety stock level.

4.2 THE REORDER POINT (ROP) LEVEL

The reorder point in inventory determines when a company needs to refill its inventories. The Economic Order Quantity (EOQ) model was again used to determine the Reorder point of the organization.

TABLE 4.2.1 RE ORDER POINT

PRODUCT	ANNUAL DEMAND	LOT SIZE(Q*)	ROP
100ML	61,346	7,385	9,299
250ML	580,923	22,989	88,019
500ML	2,223,120	44,378	336,837
1000ML	0	0	0
5000ML	5,143	1,660	779
10000ML	158,457	3,580	24,009
ADMIN. SETS	155,206	17,871	23,516
SML.VOL. INJ.	2,422,132	69,707	366,989

Source: Author's Field Survey, 2009

The table 4.2.1 above shows the reorder point at which the organization needs to refill inventories to avoid stock outs. According to the model data used for the calculations of reorder point in respect of the 100ML products, the estimates revealed that the annual demand for the product was 61,346pcs and the lot size which was the quantity produced which will yield a minimum annual total cost for the company. Thus, it was estimated that for annual demand of 61,346pcs, the optimum quantity to order is 7385pcs. The point at which such an order was to be made was at 9299pcs. This meant that when stock levels depleted to 9299pcs an order of 7385pcs needed to be made. This invariably corrected the stock out situations.

The 250ML products gave the annual demand of 580,923pcs. The quantity which would have given a minimum total cost was 22,989 and a reorder point of 88,019. To avoid stock out situation a reorder point of 88,019 needed to be observed and adhered to.

Table 4.2.1 above also revealed annual demand of 2,223,120pcs, a lot size of 44,378pcs and a reorder point of 236,837pcs. This showed that any time the 500ML product reached a level of 336,837pcs an order of 44,378pcs had to be placed while the daily depletion went on gradually without stock out occurring.

It was again discovered that there was a zero (0) annual demand for 1000ML products, lot size and reorder point. This means that no demand was made for the products but to guard against uncertainty there was the need to have some percentage of stock based on the discretion of the company due to the life saving nature of their products.

The analysis revealed that an annual demand of 5143pcs of the 5000ML, lot size of 1660pcs and a reorder point inventory of 779pcs. Thus at level 779pcs of inventory, a quantity of 1660pcs needed to be ordered.

The table 4.2.1also gave the statistics of 10000ML products. The statistics revealed that when the level of inventory reached 24,009pcs, a quantity of 3589pcs needed to be ordered and by the time the lead time elapses the stock would have been available for use by customers.

Again the table revealed statistics for Administrative Sets which indicated that an annual demand of 155,206pcs needed to be produced to customers and since all those stocks could not be used at the same time, there had to be a quantity of stock to serve the gradual depletion of the total demand. The lot size which is the quantity which minimizes the total stock was 17,871pcs when the level at which there was the need to make an order is 23,516pcs. Thus any time the stock depletes to 23,516pcs there is the need to reorder 17871pcs till all demand was supplied. This model of calculation eliminates stock out situation.

The last but not the least on the table is the Small Volume Injections. The annual demand for the SVI was 2,422,132pcs, the lot size, 69,707pcs and the reorder level 336,989pieces, this meant that it was necessary to reorder at the point when the inventory of small volume injections reached 336,989pcs. For all the products, the reorder point inventory forms 15% each of the annual demand for the various products on the table above. It could also be observed that higher demand required higher reorder point level. Finally, to avoid stock outs, there was the need to hold at least 15% of the annual demand at reorder point level.

4.3 Analyzing the Activities of Purchasing/Procurement

In order to achieve the objectives of this study, the researcher conducted personal interviews with the persons in charge of inventory to touch the root of the problem so that the necessary recommendations for improving inventory management could be made. In view of that, a summary of interview response by managers of inventory and procurement in the organization were analyzed as follows.

1. A procurement department in the company: This interview question was to find out whether the company has a procurement department which takes care of all procurement activities. The interview conducted revealed that there is no such department but the finance department takes care of all procurement activities of the company. There are some lapses which need to be addressed.

2. Personnel responsible for purchase: This question was to find out whether there is a person in charge of purchases even though there was no department for procurement. It was revealed that some one in the finance department had been assigned to do all the purchases.

3. Procedure for purchases: This was to find out whether there were certain procedures followed to do purchases for the company. It was revealed that, there were procedures but it was not rigidly followed.

4. Raw materials order: This question was to find out whether their raw materials were ordered only when there was a demand for a finished product. The interview revealed that it does happen but not all the time.

5. Supplier Evaluation. This question was to find out whether they performed evaluation on their suppliers to know the ones that are doing well and the ones that were not. It was discovered that they did not and this had resulted in some inconsistencies in delivery time.

4.4 Analysis of Stock Out Situation

1. Higher levels of safety stock: The question was to find out whether there was the need to have higher levels of inventory than what already existed due to the higher demand these days. The interview revealed that, there was the need for higher inventories due to the high demand and inconsistencies in the lead time.

2. Stock out situation. This question was to find out whether they do experienced stock out. The interview revealed that, stocks out situations did occur and it was due to unexpected increases in demand over the past year. Another contributing factor had been the company's inability to meet supplier's debt payment requirement which in turn extended the lead time.

3. Stages of stock out situation. This question was to find out the stages in production where stock out did occur. The interview revealed that stock out did occur mostly on finished goods.

4. Stock out rate. This question was to find out how frequently stock out occurred. The interview revealed that stock out occurred at low rate.

5. Causes of stock out. This question was to find out what brings the stock out situation in the company. The interview revealed that, the drastic increase in demand had been one of the major causes of stock out for finished goods. The company inability to pay suppliers on time tended to delay the delivery and consequently caused the company to deplete all its stocks, resulting in a stock out.

The National Health Insurance scheme was also a major contributor to the delay in payment to their suppliers. This also extended the receiving date. This is due to the fact that the Ministry of Health (MOH) is the major consumer of their finished products and operates under the National Health Insurance.

6. Measures of stock out situation. This question was to find out the measures put in place to combat the stock out situation. The interview revealed that whenever the stock out was in relation to raw materials, the company borrowed from their competitor but with a finished product situation; the customers were informed to look elsewhere for the rest of the products to make up the number they needed and sometimes they had to import make up the differences.

7. Reduced lot size. This question was to find out whether they preferred smaller lot sizes as a result of reduced inventories. The interview revealed that they preferred bigger lot sizes in order to have enough inventories to meet variations in demand.

8. Improving the quality of machines and part. This question was to find out whether condition of machines affected their production strength. The interview revealed that the present condition of some major equipment affected the production speed.

9. Quantity delivered. This question was to find out whether orders placed by the company were delivered in full when inventory, get to zero. The interview reveals that it did not occur often.

10. Delivery time. This question was to find out whether goods were accepted when the delivery date was before the schedule date. The interview revealed that goods were accepted even when the delivery date exceeds the scheduled date.

4.5 ANALYSIS OF OTHER RELEVANT FACTORS FOR INVENTORY IMPROVEMENT:

1. Physical inventory tracking. This question was to find out how the company tracked their physical inventory. The interview revealed that physical counting was done quarterly on inventory but it did not help inventory management since some items needed frequent counting due to their nature.
2. Frequency of counting. This question was to find out whether they had different frequencies of counting for different items. The interview revealed that there were no such frequencies of counting.
3. Types of warehouses in the company. This question was to find out whether the company had warehouses for all the stages of production i.e. raw materials, work in process and finished goods. The interview revealed that the company had different ware houses for the different stages of production.
4. Inter- warehouse transfer of goods. This question was to find out whether inter-warehouse transfers did occur during situation where there was demand for a particular product. The interview revealed that the company does perform inter-warehouse transfers.

5. Control of expired stock. This question was to find out whether the company had expired product in stock, and if they did, how did they controlled it. The interview revealed that, any time they had expired stock they gave them to quality control for proper disposal.
6. Major and Manageable problems. This question was to find out the major and infrequent problems facing the company in the area of inventory management. The interview revealed that some events were major and others were occasional problems.

Manageable problems	Major problems
Seasonal demand	Insurance
Lead time	Inaccuracy of stock records
Break downs	Material handling
Obsolescence	Transportation
Excess stock investment	

7. Inventory review. This question was to find out whether they did review their inventory over time. It was revealed that evaluation on inventory is done occasionally.
8. Inventory review. This question was to find out whether they did review their inventory over time. It was revealed that evaluation was done occasionally.

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATION

5.0 Introduction

This chapter deals with a summary of the findings, conclusion and recommendations of the study on "Improving Inventory Management at Intravenous Infusions Limited, Koforidua" which are based on the secondary data analysis from the company, views, opinions and feelings expressed by the respondents.

5.1 Summary of Findings

The research on the topic: *"Improving Inventory Management at Intravenous Infusions Limited"* by the researcher came out with the following major findings with respect to the objectives:

5.1.1 *Research objective 1*: "To examine the safety level"

The researcher found out that demand had a relationship with safety stock, thus as demand increased safety stock also increased. Therefore there was the need to have large safety stock when demand for a product increases. There was also the need to vary the order quantity or lot size for each level of demand. This made it necessary to adopt the production lot size model which enabled one to choose the order which gave the minimum cost.

5.1.2 *Research objective 2*: "To find out how stock reorder point can be determined"

The researcher found out that the model for determining reorder point was appropriate to mitigate the inability to meet customers demand.

The researcher again found out that the model used predicted 15 percent of the annual demand as the level at which a reorder could be made for various products.

5.1.3 *Research objective 3*: "To analyze the process of purchasing raw materials"

The researcher found out that the principles and procedures of procurement were not followed. The researcher again realised that no department has been established purposely for procurement and supply chain management, whose activity was so critical to the entire operations of the company.

The researcher found out that there was lack of qualified personnel to handle procurement and supply chain activities. This had had an effect on the company's procurement and supply chain activities. There has been poor procurement procedures and poor relationship with suppliers. Products and raw materials were not ranked in order of importance to enable them identify which of them should be given priority, which them to procure more and which one's are to be procure less so that money was not tied up in inventory.

5.1.4 *Research objective 4*: "To examine how stock out can be managed"

The researcher found out that the drastic increase demand caused the stock out situation in 2008. It was also found out that the unavailability of a proven model to determine reorder was another cause. Again, the inability to pay suppliers on time caused delay in

delivery of materials for production. Smaller lot sizes have also contributed to the stock out situation and this was due to some machine and a part which needs to be maintained properly and others replaced.

5.2 OTHER FINDINGS:

5.2.1 The study also revealed that transportation was one of the impediments in meeting demand. This had become a major area of increasing cost to inventory. Even though the company outsourced transportation, it was not properly done. They negotiated with individual drivers rather than deal with a transport company and this resulted in situations where those drivers occasionally failed them. When such a situation happened, it delayed delivery. The unreliable nature of transportation led to arrangements with new transporters at a higher cost to the company.

5.2.3 Another discovery was that proper records were not kept for proper reconciliation. Training of warehouse managers was not undertaken and for that matter only traditional methods were being employed in managing the warehouse. The result of this has been inaccurate records and some information unavailable.

5.3 CONCLUSION

On the basis of the study conducted at Intravenous Infusions Limited, Koforidua on "Improving Inventory Management at Intravenous Infusions Limited" the following general conclusions were made.

From the research conducted, it is quite obvious that inventory management is very important to any company in this era of credit crunch and increasing competition. The entire business operations rely on proper management of inventory to meet customer demands in order to increase profit. On the whole it is an area within the business entity where the entire operations rest.

The researcher found that there are various benefits which the model used will bring to the company. It will solve the problem of stock outs in order to meet their customers' demand. The company under study seemed to attach little importance to inventory management. The company only paid attention to serving customers and not the quality of the services they provided.

As to the benefit to be derived from the setting up of a procurement department and the training of the requisite personnel, the interviewees were of the view that it was an essential element in the performance of their job with a direct bearing on inventory management and ultimately leading to better efficiency and cost reduction and increased revenue.

5.4 RECOMMENDATIONS

In view of the difficulties that a company without a proper inventory management sector faces in this increasingly competitive business world, the following are recommended to the management of Intravenous Infusions Limited to help improve upon their operations in order to give the company a competitive edge over its competitors.

They should adopt a model for the setting up of safety stock level and the reorder point level. The company should understand that shortages are very expensive and undesirable to them due to the life saving nature of their products. Therefore, it should choose a relatively large value of reorder point. This leads to a relatively large safety stock. Therefore, the researcher recommends the model for safety stock calculation as was used in the data analysis for calculating safety stock.

There should be a constant communication between customers and the company in order to reduce the stock out situation. There should be a collaborative planning and forecasting, thus the company should involve the major customers during forecasting and this will help solve the problem of Stock outs of critical products. Of course there are many instances in which customers cannot predict their future product needs but whenever they can, collaborative forecasting promises to increase productivity and profitability throughout the supply chain.

Concerning procurement, there should be a department established with people with the right qualification and skills to handle procurement and supply chain activities. That department should see to the effective and efficient coordination and collaboration of all the players in the supply chain and build a very good relationship with both suppliers and

customers. Warehouse staff should ensure that stock balances are accurate and will remain accurate. A comprehensive cycle counting program should be implemented. A good cycle counting program *can replace* the traditional quarterly physical inventory.

The ABC analysis which was discussed in the literature should be adhered to in order to group the products in order of importance and demand level so that stock out does not occur. This method will allow the company to identify the small number of products that usually account for much of its sales (that's 80/20 rule) Here's one quick method for determining the ABC ranking based on Annual Sales Volume:

1. Calculate the 12 month cedis usage for all of your products (volume X cost).
2. Rank the items in descending order by the cedis usage.
3. The "A" items are the top 80% of the total annual usage cedis.
4. The "B" items make up the next 15% of total annual usage.
5. The "C" items are the remaining items are the remaining 5% with >0 usage in the past 12 months
6. Label zero-usage items can be labeled as "D".

There are also other considerations, such as "critical items" that may have low usage, but need special monitoring because you can't run out of stock due to a customer agreement. So the company's definition of items may need to be customized.

(http://www.supplychainmetric.com/inventoryABC.htm)

Improving performance on transport:

Transportation is one of the most significant areas of logistics management because of its impact on customer service levels and the firm's cost structure. Inbound and outbound transportation can account for as much as 10 to 20 percent of product prices, and sometimes even more. Effective management of transportation can result in significant improvements in profitability. (Stock et al. 2001).

The company needs to make critical decision as regards the best choice of transport with regards to terms of speed, availability, dependability, capacity and flexibility for effectiveness and efficiency. The company should obtain commitment from all the transporters to improve service level. They should renegotiate rates with the transporters, placing more value on efficiency and commitment.

Adopt preventive maintenance strategy:

The cost of maintenance in industrial facilities has been estimated as (20-35) % of total production costs. The money spent can be as large as net income. The machine receives regular maintenance in order to avoid breakdown of machines which causes delay in delivery.

Top management commitment:

Top management must appreciate the importance of inventory control from raw material stage to when the products get to the customer. The top management should understand the impact and importance of inventory management to their job and the entire company so that they can give full consent to it

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APPENDIX 1

PERSONAL INTERVIEW QUESTIONS

1. Is there a procurement department in the organization?
2. Do you have personnel in charge of procurement?
3. Do you have any procedure for the purchases you make?
4. Do you agree that higher levels of safety stock are required by the company?
5. Do you experience stock out?
6. Which stages of the production process do often experience this stock out?
7. What is the rate of stock occurrence?
8. What has been the cause of stock out situation in the company?
9. How do you take care of stock out situation?
10. Do you think the best way to reduce inventory is by improving the quality of machines and parts?
11. Is a new order delivered in full when the inventory reaches zero?
12. Do you accept goods if the delivery date is before the scheduled date?
13. How do you keep track of physical inventory?
14. Does the company achieve a reduction in inventory by building a good relationship with suppliers?
15. Do you have warehouse for raw material, intermediaries and finished goods?
16. Do you perform inter-warehouse transfers?
17. How do you control expired stocks?
18. Which of the following are manageable problems and which of them are major problems in the company

a. Excess stock investment

b. Inaccuracy of stock records

c. Obsolescence

d. Transportation costs

e. Break downs

f. Material handling

g. Regular lead time

h. Classification of Products

APPENDIX II

PROFILE OF PRODUCTION, DEMAND AND PRODUCTION & INVENTORY (i.e. Total production) for 2008

PRODUCTION - 2008												
	JAN."08	FEB."08	MAR.08	APR. 08	MAY. 08	JUN.08	JUL.08	AUG.08	SEPT.08	OCT.08	NOV.08	DEC.08
100 ML PRODUCTS	-	-	-	17,511	-	-	8,835	11,034	9,781	-	-	-
250 ML PRODUCTS	43,085	33,592	124,116	5643	13533	147,428	47,432	18,463	5,750	6,669	43,460	3,977
500 ML PRODUCTS	128,478	214,966	141,305	200,566	186,568	117,975	157,386	162,422	258,601	231,385	222,591	159,424
1000 ML PRODUCTS	14,407	3,189	3,546	16,271	23,332	7,064	21,331	6,988	7,183	6,809	11,007	11,855
5000 ML PRODUCTS	860	624	0		0	93	276	870	547	799	632	0
10000 ML PRODUCTS	35	44	24	25	25	43	49	25	74	75	47	0
ADMNISTRATION SETS	0	0	0	0	0	0	0	0	0	0	0	0
SMALL VOLUME INJECTIONS	0	0	13,248	39,384	109,193	37,080	0	66,366	0	0	0	267,874

Source: Intravenous Infusions Limited

DEMAND - 2008												
	JAN."08	FEB."08	MAR.08	APR. 08	MAY. 08	JUN.08	JUL.08	AUG.08	SEPT.08	OCT.08	NOV.08	DEC.08
100 ML PRODUCTS	1,678	2,390	430	11,428	8,200	1,340	2,890	20,300	2,256	4,569	2,890	2,975
250 ML PRODUCTS	102,919	39,070	128,780	14,087	7,255	139,960	4,038	18,040	17,899	19,765	75,544	13,566
500 ML PRODUCTS	109,650	212,540	150,090	174,875	199,132	185,114	131,432	145,640	287,089	148,532	267,542	211,484
1000 ML PRODUCTS												
5000 ML PRODUCTS	860	996	2	2		93	113	1,466	441	554	457	159
10000 ML PRODUCTS	10,097	10,465	8,159	14,770	17,655	17,372	10,985	17,340	15,320	6,544	14,095	15,655
ADMNISTRATION SETS	9,525	4,845	28,600	8,022	13,375	11,881	25,450	37,212	5,300	7,673	1,763	1,560
SMALL VOLUME INJECTIONS	135,665	18,100	1,700,111	18,060	53,100	155,766	36,890	85,565	87,875	48,500	49,900	32,600

Source: Intravenous Infusions Limited

Total Production (prod & Invent) 2008												
	JAN."08	FEB."08	MAR.08	APR. 08	MAY. 08	JUN.08	JUL.08	AUG.08	SEPT.08	OCT.08	NOV.08	DEC.08
100 ML PRODUCTS	4,065	3420	3,395	26,544	3,138	1,251	17,670	11,737	19,954	3,243	403	2,144
250 ML PRODUCTS	61,229	52,244	145,395	21,461	36,409	177,009	119,817	93,975	71,034	61,194	69,970	22,879
500 ML PRODUCTS	211,284	303,838	243,201	327,960	303,925	185,647	264,076	281,901	361,089	412,873	356,088	261,567
1000 ML PRODUCTS	34,923	16,282	18,520	30,732	47,749	19,742	47,893	24,033	18,166	18,428	24,936	22,719
5000 ML PRODUCTS	959	648	118	49	99	274	439	960	648	1,155	1,042	251
10000 ML PRODUCTS	10,800	244	17,009	43,998	12,783	143	23,098	25	6,711	478	32,880	15,875
ADMNISTRATION SETS	106,293	172,826	144,365	134,565	121,714	102,703	85,368	44,955	42,769	35,541	33,264	31,642
SMALL VOLUME INJECTIONS	102,293	103,392	1,400,494	1,442,147	1,590,217	1,240,426	1,438,768	1,505,134	1,360,369	1,319,869	1,272,869	1,597,651

Source: Intravenous infusions Limited