AN APPLICATION OF A MILK RUN DELIVERY SYSTEM FOR TRANSPORTING RAW MATERAIL TO A FACTORY: A CASE STUDY OF HDD PRODUCTS ASSUMBLING COMPANY Co., Ltd.

By
SASINAN LAOCHAICHAROENPHON

A Final Report of the Six-Credit Course
SCM 2202 Graduate Project

Submitted in Partial Fulfillment of the Requirements for the degree of
MASTER OF SCIENCE IN SUPPLY CHAIN MANAGEMENT

Martin de Tours School of Management
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Master of Science in Supply Chain Management

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declare that this thesis/project and the work presented in it are my own and has been generated by me as the result of my own original research.

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APPLICATION OF A MILK RUN DELIVERY SYSTEM FOR TRANSPORTING RAW MATERAIL TO A FACTORY: A CASE STUDY OF HDD PRODUCTS ASSUMBLING COMPANY Co., Ltd.

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ABSTRACT

This paper presents a model of transportation and raw material for management by using the Milk Run model of the Hard Disk Drive Product. Previous process used the warehouse center to stock and manage raw material in Vendor Management Inventory process and is controlled by third party logistics team.

The main question of this research is how to improve and manage cost of inventory keeping the goal of the company. This paper focuses on the methods of reducing cost of inventory and decreasing the transportation cost and applying new method to the real process.

This paper endeavors to contribute to better management and performance comparisons with the cost of transportation and raw material with Milk Run model which could provide the right solutions and improve processes.

In addition, this paper explores the collaboration of Supply Chain with suppliers. The 5 suppliers are a company's internal planning competency, capabilities, and the types of end products. A company's trading partners' capabilities and the market in which supply chains operate. The point is that each company will have an approach adopting supply chain collaboration in a different way by using different steps in the process to create a model in order to improve and manage cost of inventory and transportation management.

ACKNOWLEDGEMENTS

First of all, I would like to express sincere appreciate to my advisor Dr. Peeratarat Ittarattanachoke who has always given guidance, assistance, encouragement and kindness along the way to complete this paper. Without his support, it would have been impossible to complete this paper.

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Sasinan Laochaicharoenphon
Assumption University
November, 2009

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CHAPTER I

GENERALITIES OF THE STUDY

1.1 Background of the Study

Supply Chain Management is a current concern of many persons who wish to success in improving waste from the various chains. The company will receive greater benefits by reducing waste in all these chains. These benefits are speed and responsiveness to customers, reduced inventories costs and increased customer satisfaction.

As a result of exposure to all operations for the means of transportation, from sales of raw materials to delivery products to end customers and communication can improve. Development processes and management skills can be leveraged in other areas such as inventory and procurement. One of the advantages is that many chains will be given more attention and be accepted in the market since it is part of a package that includes both Warehouse Management System (WMS) and Transportation Management System (TMS). Increasing performance is one of the principles of supply chain management. This shows that transportation is a key commitment in the upstream and downstream links in any supply chain.

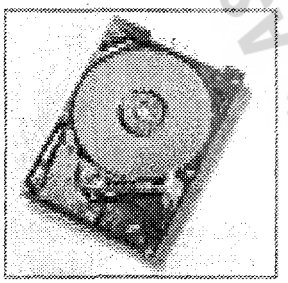
Milk Run is one way of transportation strategy and tactics which support lean inventory strategies. The transportation strategies must be developed to meet expectations with optimal inventory levels. This will undoubtedly change the transportation methods of the organization. Lean transportation means proactively reviewing transportation modes, customer expectations and matching mode to inventory strategies.

Background of the Company

This Computer Company was founded in 2003 and was formed by combining IBM's strategy, business strategy and computer technology. The company's vision is to enable users to include full digital lifestyle by providing large capacity storage in formats suitable for the office on the road and at home. It is positioned to immediately advance the role of hard disk drives beyond computing environments to consumer electronics and other emerging applications.

The Computer Company takes a customer-focused approach and a full service marketing solutions for hard disk drives. The company has set up standard products and service excellence with world-class operational and technical knowledge, extensive customer support infrastructure coverage.

The Computer Company offers customers a comprehensive product portfolio unsurpassed in the industry - including 1 inch, 1.8 inch, 2.5-inch and 3.5 inch hard disk storage drives and solutions for a variety of market segments.



More and more companies are delivering leading-edge consumer electronics based on HDD technology. They are taking the next step and displaying the *Hard Drive by* The Computer Company logo on their products to leverage The Computer Company's reputation for quality, reliability and technological leadership by gaining wider brand recognition and reinforcing their competitive advantage. Great products from The Computer Company paired with great innovations from customers means exciting solutions for the marketplace.

Source: www.hitachi.com

The market share of HDD during the Third of Quarter of the year 2009

- Baselines can be submitted from anywhere therefore these are global statistics.
- This chart only includes Hard Drives used with Windows x86 processor platforms and therefore does not include any statistics on drives these manufactures may produce for other hardware platforms.

Figure 1.1: Market Share during the first of Quarter of the year 2009

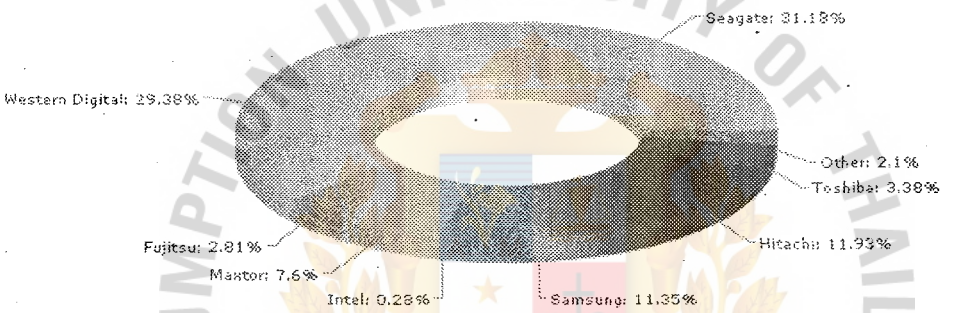


Table 1.1: Market Share during first of Quarter Year 2009

Company Name	Market share (%)	Units
Seagate	31.18	2778
Western Digital	29.38	2618
Hitachi	11.93	1063
Samsung	11.35	1011
Maxtor	7.6	677
Toshiba	3.38	301
Fujitsu	2.81	250
Other	2.1	187
Intel	0.28	25

Source: www.harddrivebenchmark.net

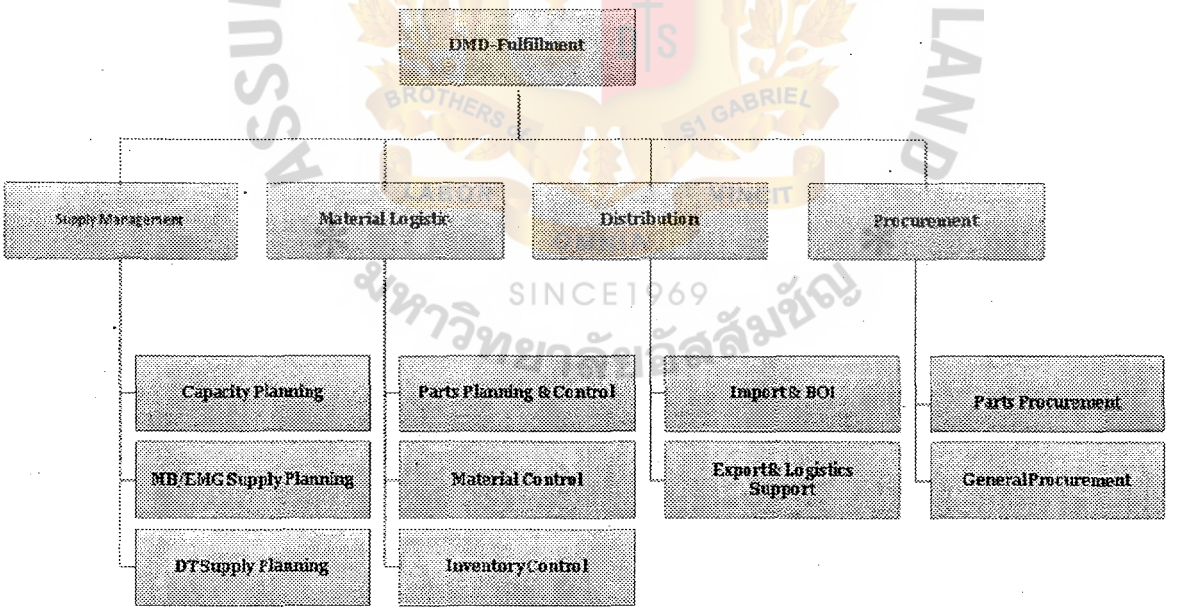
Structure of Fulfillment of the Organization

The Structure of Fulfillment of the Organization is the team who manages and controls the supply chain process. They also follow through with the strategy and solve daily operation problems. DMD fulfillment is separated into 4 departments. They are Supply Management, Material Logistic, Distribution and Procurement.

Supply Management and Material Logistic have 3 separate teams for each department. Capacity Planning, MB/EMG Supply Planning and DT Supply Planning are under the Supply Management departments and Parts Planning& Control. Material Control and Inventory Control are under the Material Logistic department.

Distribution and Procurement have 2 separate teams for each department; Import & BOI and Export & Logistics Support are under the distribution department. Parts Procurement and General Procurement are under the procurement department.

Figure 1.1.1: Structure of Fulfillment of the Organization



1.2 Statement of the problem

Globalization plays an important role in today's business because it affects the lifestyle of people rapidly. It changes the way business done and help us became more effective and efficient. Due to new technology, people can share information easily. Supply Chain Management is the significant system for manufacturers to do business more professionally. In order to satisfy the customers' requirements and maximize outcomes, the supplier, the producer, and the distributor have to be integrated and work together. The price also is of main importance in working a decision. The Computer Company will have social responsibility and manifest itself by contributing technology, resources and expertise to benefit serving communities in the areas where they work and live. The detail of the company chosen is as follows the location of the company at Prchinburi, Thailand Established: 1996 Focus: Entry server and mobile HDD (Hard Disk Drive), the company head stack assembly, HSA manufacturing.

Currently, The Computer Company uses warehouses (VMI 304) as the center to stock the raw materials for manufacturing. The Computer Company engages third party logistics (3PLSP) to manage and support the transportation from VMI304 to mini VMI's. The cost of the Company's logistic management is very high and the most of operating cost are inventory management cost and transportation cost (from suppliers to VMI 304 and from VMI 304 to factory plant). At present, suppliers have to keep the stock for 3 days to supply (DOS) at VMI 304. The Manufacturing teams (MFG) will update the pull a process to 3PLSP. Then, 3PLSP will transport it to mini VMI's at the computer company 4 times a day. This process can be shown in **Figure 1.2 and Table 1.2**

Figure 1.2 Transportation Process between VMI 304 to Mini VMI

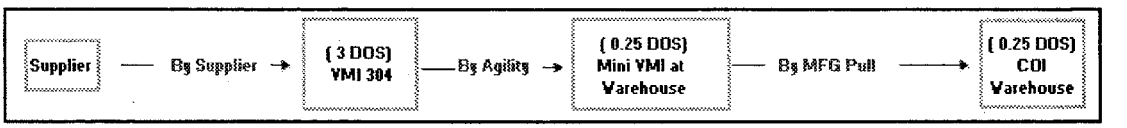


Table 1.2 Time Table of Transportation Process between VMI 304 to Mini VMI

Site	MFG send pull requested	3PLSP Confirmation to The computer Company	The computer Company Shipment Received Plan (Mini VMI) (ETA)	MFG Production Used Up Plan
PRB	08:00 PM (Key part)	If inventory at JIT aren't enough to support site, Agility will confirm back with 1 hr.	11:00 PM>>wait to used up 8 hr (+ RH/Kitting/Cleaning)	07:00 AM - 12:00 AM (Round D1)
	02:00 AM (Key part & DNF part)		05:00 AM>>wait to used up 7 hr (+ RH/Kitting/Cleaning)	12:00 AM - 07:00 PM (Round D2)
	08:00 AM (Key part)		11:00 AM>>wait to used up 8 hr (+ RH/Kitting/Cleaning)	07:00 PM - 12:00 PM (Round E1)
	02:00 PM (Key part)		05:00 PM>>wait to used up 7 hr (+ RH/Kitting/Cleaning)	12:00 PM - 07:00 AM (Round E2)

The total around of raw materials to produce HDD is 98 pieces, not including DNF Parts (Do Not Find parts) which are 19 parts and 79 Key parts from 16 suppliers. That can be shown as **Table 1.2.1**

Table 1.2.1 Total list of suppliers and parts supply

Supplier	No of Suppliers	Supplier	Total Key p/n	Supplier	Total DNF p/n
Rojana	5	Rojana	40		
Bangpain	2	Bangpain	17	Bangpain	7
Hitech	1	Hitech	3		
Navatanakorn	1	Navatanakorn	9		
Amatanakorn	1	Amatanakorn	6	Amatanakorn	5
Amata City	1			Amata City	7
Wellgrow	1	Wellgrow	2		
Prachinburi	1	Prachinburi	2		
		Total	79	Total	19
Total suppliers	16	Total Part Numbers (p/n)		98 items	

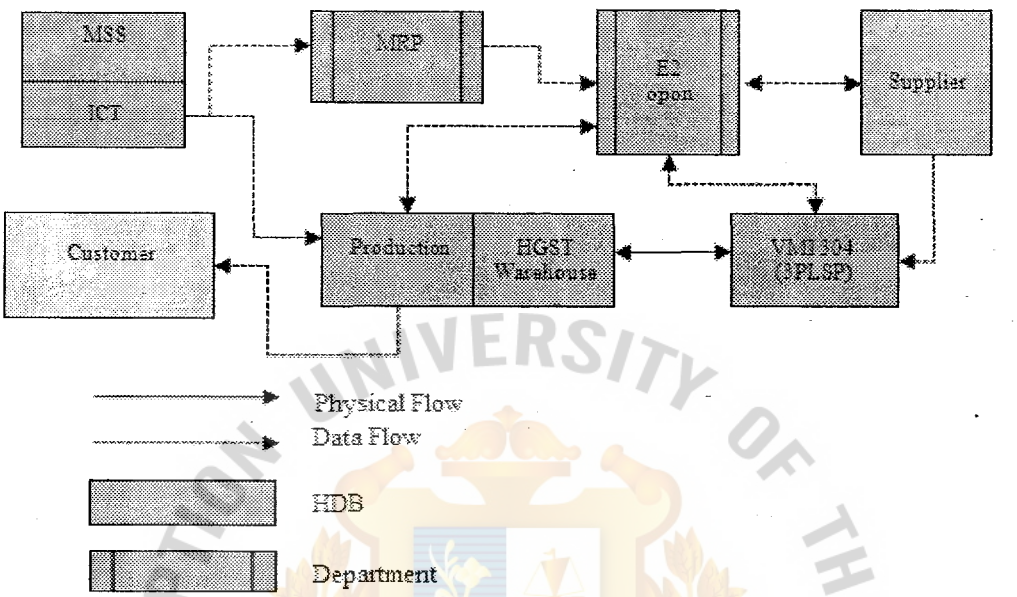
As of now, the storage cost at VMI 304 is very high. Besides this the shipping cost from Suppliers to VMI 304 and from VMI 304 to The Computer Company is also expensive. The company has realized of these important costs, and there join does experiment adjustment by using a new model called Milk run process for the products use truck runs for materials or goods from and to many suppliers. Without having to go through the central warehouse (VMI 304) to save holding cost and transportation costs, including oil fee thing is the source of modeling scenarios of Milk-Run.

In this project, the computer company created new processes of receiving and transporting by using the Milk Run process and selecting the 5 available suppliers to support this research. The location of 5 suppliers is at Rojana industrial Park, Ayutthaya.

The 25 components of raw materials are received from 5 suppliers but the 25 components of raw materials are uncertain each day. The computer company has an institute to plan the volume for the main process is the process will start from the MSS (Master Schedule Shipment) conducted a long-term production plans and sent to parties to make ICT (Imprecation Capacity Tool) plan on a weekly and daily production level basic. Thereafter the faction, ICT will send quantity data that wants to be produced daily through MRP (Material Requirement Planning) system to create BOM (Bill of Materials) to calculate the amount of materials used in daily data. The demands of raw materials will up-load new forecast on a weekly basis.

Suppliers will know the amount of demand and raw materials covered in 13 weeks daily and covered in 9 months through the E2open website. After that, suppliers have to commit the daily shipment cover 6 weeks daily and 6 months monthly through the E2open website. Moreover, suppliers have to arrange and deliver, follow up their commitment to support production requirement and detail the planning process. This is shown in **Figure 1.2.1**

Figure 1.2.1 Previous Details of factors working

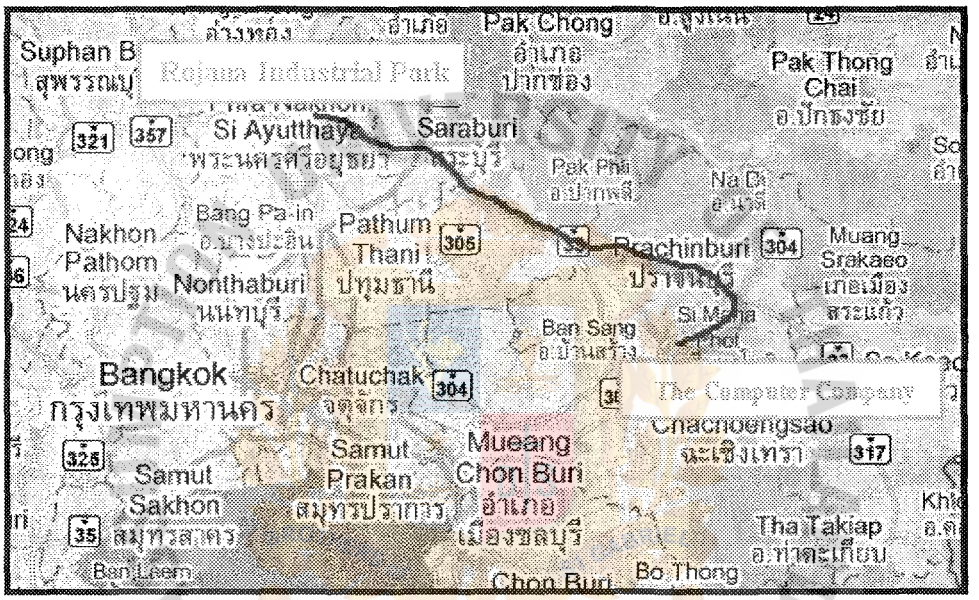


In the planning section, the raw materials from suppliers are prepared. Within 6 / 13 weeks complaints are reloaded and an outlook at The Computer Company's planning department sends information to determine at which level in the 3 Days DOS (Day of Supply) of volume. The part of materials received from the supplier will be in accordance with the 6 / 13 week outlook combined with the added ability to load the full capacity. In the truck section, the trucks will reload the tray return before receiving materials. When the truck reaches the supplier's location, the raw materials will be transported in each vehicle that has been received after the tray return. Thereafter, the vehicle will transport materials sent back to the warehouse facility approximately 4 hours after receiving the raw materials. Finally, process monitoring and cleaning of the W / H section will be done, before the Department PLM will trigger pull of materials (Pull request) to produce the hard disk.

The new model of receiving and transport under Milk Run process will adapt 25 parts of The Computer Company. All parts will be separated in the 7 groups follow up

pallet management. Furthermore, the trucks will go to receive parts on harmonious working days. The total lead time between The Computer Company and the first supplier to the and last supplier and back to The Computer Company is about 4 hours. This is shown in **Figure 1.2.2 – 1.2.3**

Figure 1.2.2 Distances between Rojana Industrial Park to The Computer Company

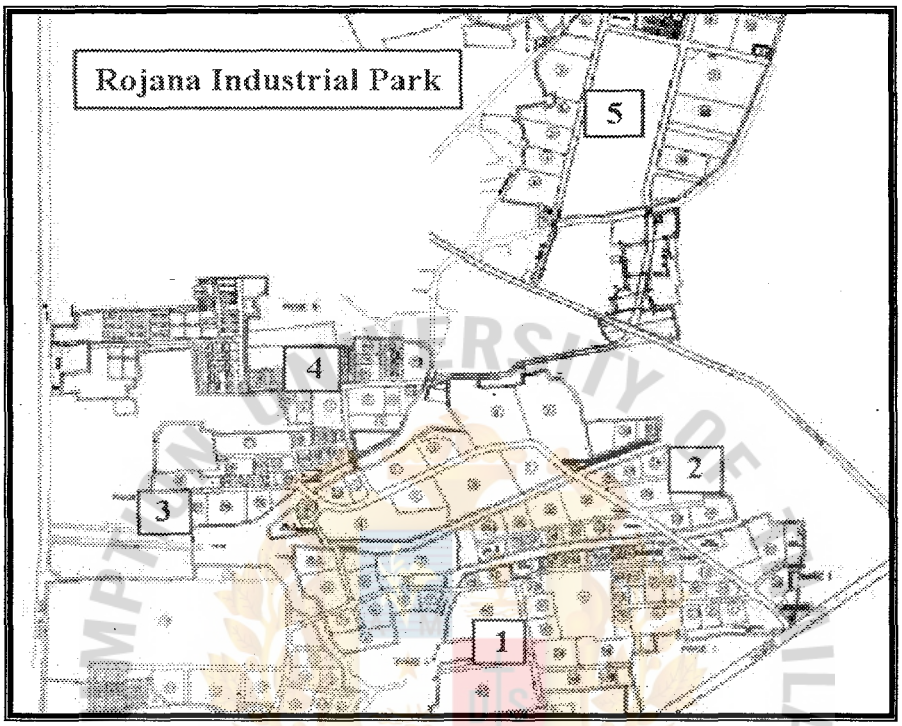


Source: http://maps.google.co.th

Table 1.2.2 Distances between The Computer Company

Lead Time of distance	Distance (km)	Time (hour)
Rojana - The Computer Company	200	4

Figure 1.2.3 Lists of Suppliers and Their Locations



Source: www.rojana.com

Table 1.2.3 Lists of Suppliers and Their Locations

No.	Index	Supplier	Part
1	A	TOTOKU (Main)	Carriage
2	B	NEO MAX (Main)	VCM
3	C	Z KURODA (Main)	Lever, Label, Seal, Acoustic, Ramp
4	D	KATAYAMA (DNF)	Pivot Nut, Screw
5	E	KOKOKU TH (DNF)	Seal Connector

1.3 Research Objectives

(1) To create a model in order to improve and manage cost of inventory and transportation management.

(2) To apply a new strategy in order to minimize the inventory and transportation cost which under the target company.

(3) To explore the collaboration of Supply Chain with the suppliers.

1.4 Limitations of this research

This research limitation as is follows,

(1) This research cannot identify the process of receiving and transporting all suppliers since the location of suppliers in different areas.

(2) This research cannot identify the process is of how to plan the raw materials requirements and the logistics processes between The Computer Company's factory plants and all suppliers 'capacity because the location of suppliers is in different area.

1.5 Research Questions

There are 3 main questions in this project.

(1) Is it possible to improve and manage cost of inventory and transportation under the company target?

(2) What is the new strategy of inventory and transportation management?

(3) By how much is the inventory and transportation cost reduced?

1.6 Definition of Terms

I. **Vendor Managed Inventory**: is a distribution channels such as the nature of the operating system by offering products that are reviewed and managed by the manufacturer and vendors.

II. **Material Requirement Planning**: is concerned with customer demand, production schedules, inventory levels, and available capacity at work centers within a plant.

III. **Just In Time**: system is concerned with customer demand, production schedules, inventory levels, and available capacity at work centers within a plant

IV. **Supplier Relationship Management**: is a comprehensive approach of managing companies who supply: goods and or services for consumption or resale.

V. **Supply Chain Collaboration**: the challenge faced by supplier companies in the supply chain industrial for implementing collaborative planning, forecasting and replenishment.

VI. **Milk Run:** is one of the most popular and efficient ways of improving truck-load ration and refers to the means of transportation by which a single truck cycles around multiple suppliers to collect or deliver transport.

CHAPTER II

LITERATURE REVIEW

With increased globalization, complexity in global supply chains and competition, there are many companies who have realized that supply chain and Inventory management is critical to their organizations and critical to overall operations. In the past, many companies didn't manage their supply chains but left it to their suppliers. It is not be just the responsibility of logistics director and the warehouse manager. Almost all the supply chain planning, inventory management and marketing production operates as separate departments. Businesses need effective and efficient supply chains in operations management and recognition of the strategic importance. This paper will deal with quality issues, the importance of operations management collaborating with supply chains, and inventory management.

Information technology and coordinating with the transport of supplies, services and products between suppliers and partnering businesses within an organization is what supply chain management is all about. Nowadays, the customers are more demanding and businesses are working hard to meet those demands worldwide. The customers need more styles, better quality, longer lasting products and shorter delivery time. The only way that organizations can delivery this is by insuring that their supply chains are aligned with their operations of the organizations.

Configuration of the supply chains with the business strategy will allow an organization to be more efficient and effective. It also provides the business with a competitive advantage. In order to align the supply chains with the organizations operation the supply chain should be surely included in the strategic decisions processes along with the senior executives in the organization.

Source: www.oppapers.com

2.1 Inventory

Ballou (1999) described proposed a definition of supply chain management as the flow of goods or flow of materials from the source of raw materials to the ultimate end use or end customer. Whether at the level of the production line, the plant, the company, or the entire supply chain there are inventories that may be necessary to achieve operational and strategic objectives of the organization involved in production and distribution. Inventories provide a means to combat uncertainties in component product supply and demand, takes advantage of scale economies in processes used to transform and transport components and products, and targets specific levels of component products available which are necessary to meet customer expectations. Inventories assets tie up capital that might be invested more effectively in other areas of the organization. These assets are also represented as expense to the organization and the cost of capital necessary for their maintenance.

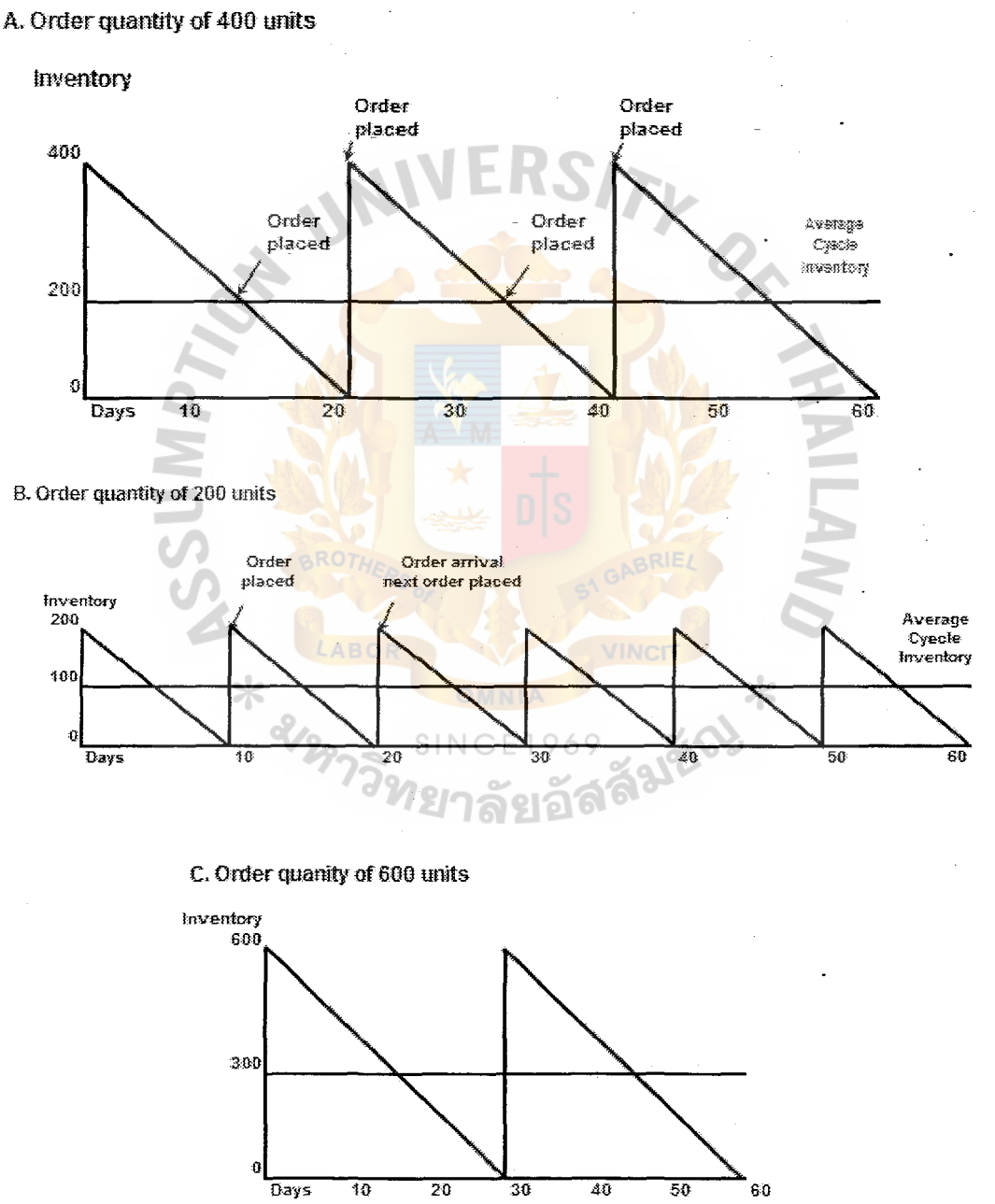
2.1.1 Types of Inventory

Douglas M. Lan & James R. Stock (1995) explain about inventories which can be group into the following types, signifying the reasons for which they are accumulated: cycle stock, in-transit inventories, safety or buffer stock, speculative stock, seasonal stock and dead stock.

Cycle Stock is inventory which results from the replenishment process and is required in order to meet demand under conditions of certainty. Specially, when the firm can predict demand and lead times completely. For example, if the rate of sales for a product is a constant 20 units per day and the lead time is always 10 days, no inventory beyond the cycle stock would be required. Assumptions of constant demand and lead time remove the complexities involved in inventory management. Let's look at this example to clarify the basic inventory principles. The example is shown in Figure 2.1.1. It shows three alternative ways to reorder. Since demand and lead time are constant and known, orders are scheduled to arrive just as the last unit has sold out. Thus, no inventory beyond the cycle stock is required. The average cycle stock in all three examples is equal to half of the order quantity. However, the average cycle

stock will be 200, 100, 300 units depending on whether management orders in quantities of 400 (Part A), 200 (Part B), or 600 (Part C), respectively.

Figure 2.1.1 The Effect of Reorder Quantity on Average Inventory Investment with Constant Demand and Lead time



Source: Douglas M. Lan & James R. Stock

In-Transit Inventories. In-transit inventories are the items that are en route from one location to another. They are considered part of cycle stock even though they are not available for sale until after they arrive at the destination. For the calculation of inventory at carrying costs, in-transit inventories should be considered as inventory at the origin since the items are not available for sale.

Safety or Buffer Stock. Safety or buffer stock is held in excess of cycle stock because of uncertainty of the demand or lead time. The concept is that some of the inventory should be available to cover short-range variations in demand and lead time. Average inventory at stock-keeping locations means that demand and lead time variability is equal to half the order quantity plus the safety stock.

Speculative Stock. Speculative Stock is inventory that is held for reasons other than satisfying current demand.

Seasonal Stock. Seasonal Stock is a form of speculative stock that involves the accumulation of inventory before a season begins in order to maintain a stable production runs.

Dead Stock. Dead Stock is the set of the items that has no demand and has been registered for some specified period of time. It is kept at one stock location or it might be obsolete and have no demand in the market. If it is the latter, the items may be transshipped to another location to avoid the obsolescence price or it can be marked down and sold at its current location.

2.1.2 Inventory Costs

Lambert (1976) descried four major components of inventory cost that are, capital cost, storage cost, inventory service cost, and inventory risk cost. Sometimes, capital costs called interest or opportunity cost. Capital cost is the largest component of inventory cost and focuses on the value of capital tied up to inventory.

Capital investment:

1) Value of stockholding
2) Warehouse investment
3) Equipment that is used in the warehouse investment
4) ICT system investments

Plus…product holding costs, such as

1) Storage/ handing (if not in above)
2) Obsolescence
3) Deterioration/demand of stocks
4) Insurance.

Stuart Emmett (2006) described that all the reasons below, are added to the total cost of inventory, which can be calculated as follows:

Total capital investment = Cost of borrowing money per annum

+ Holding total costs per annum

+ Ordering costs per annum

+ Any other specific, annual costs

Source: Stuart Emmett (2006)

Storage space cost includes handling costs associated with moving products into and out of inventory as well as storage costs such as rent, heating, and lighting. Storage costs are relevant to the increase or decrease as inventory levels rise or fall. A company should include variable expense rather than fixed expenses. When a company uses public warehousing, virtually all handling and storage costs vary directly with the amount of inventory stored but when a company uses private

warehousing, many storage space costs, such as depreciation on the facility, are fixed and are not relevant to inventory carrying cost.

Inventory service cost includes insurance and taxes. Depending on the product value and type, the more risk of loss and damage the more high insurance premiums is required. In addition, many locations or areas may impose a tax on inventory value, on a monthly basis. These factors affect carrying costs as well as inventory location decisions.

Inventory risk costs include the costs associated with obsolescence, damage, pilferage, theft, and dramatic losses of quality and market value. Particularly vulnerable to this cost are products with short life cycles such as personal computers, semiconductors, and fashion goods.

2.1.3 Inventory Management

Stuart Emmett (2006) describe a good way to manage the product flow in a supply chain, to achieve the required service level at a reasonable cost is the main target of inventory management. The movement and product flow are the key concepts of inventory management in the whole supply chain.

The management of inventory historically concerned two fundamental questions:

1) How much to reorder?

2) When to reorder?

Soonhong Min & James S. Keebler (2002) indicated that describe the complexity of inventory management has increased because of consideration of where inventory should be held and what specific line items should bc available at specific locations. These questions challenge the analytical capabilities and creativity of inventory decision makers.

According to Okoye (1997:39-40) any management team that is eager to succeed, must pay special attention to material. Material management involves material planning and control. The objective of material planning and control is mainly to avoid economic consequences of stock-out and overstocking.

Inventory managers must determine how much inventory to order and when to place the order. In order to get the idea of the principles of reorder policy, it is important to consider inventory management under conditions of certainty and uncertainty. This latter case is the rule rather than the exception.

The four major approaches to inventory management often found in the literature are economic order quantity (EOQ), materials requirements planning (MRP), distribution requirement planning (DRP), and just-in-time (JIT). However, it may be useful to understand the circumstances best suited to the use of each approach. Those circumstances have to do with the nature of the demand, the type of system and the level of solution.

2.1.4 Inventory Management under Conditions of Certainty

Douglas M. Lan & James R. Stock (1995) state that the ordering costs and inventory carrying cost of replenishment policy under conditions of certainty need to be the balanced. For example, a policy of ordering large quantities infrequently may result in inventory carrying costs in excess of the savings in ordering costs. Ordering costs for products that need to be purchased from an outside supplier typically include

1) The cost of transmitting the order

2) The cost of receiving the product

3) The cost of placing it in storage

4) The cost associated with processing the invoice for payment

In the case of restocking its own field warehouse, a company's ordering costs typically include:

1) The cost of transmitting and processing the inventory transfer

2) The cost of handling the product if it is in stock or the cost of setting up production to produce and handle cost of the product which is not in the stock

3) The cost of receiving stocks at the field location.

2.2 Economic Order Quantity

Coyle (1996) states that EOQ is an appropriate approach in a pull system involving independent demand items for a single facility solution.

EOQ makes a supposition that there will be zero lead times, no stock outs and safety orders when at zero stocks. This is not realistic when faced with uncertain demand, supply lead times with variability and the need for variable order quantities.

Stuart Emmett, 2006 state that is effectively an accounting formula. EOQ requires much data that may not be readily available such as order costs, holding the different line items and the demand and product unit costs.

Although EOQ is not utilized in every situation, it does give indications for reorders levels and point. It also significant and importance in calculating order costs as show in Figure2.4

The reason of the holding, carrying or replenishment is the order costs, inventory or cost of capital tied up, fall with the number of orders. The formula is as follows:

$$EOQ = \frac{\sqrt{(2RS)}}{CI}$$

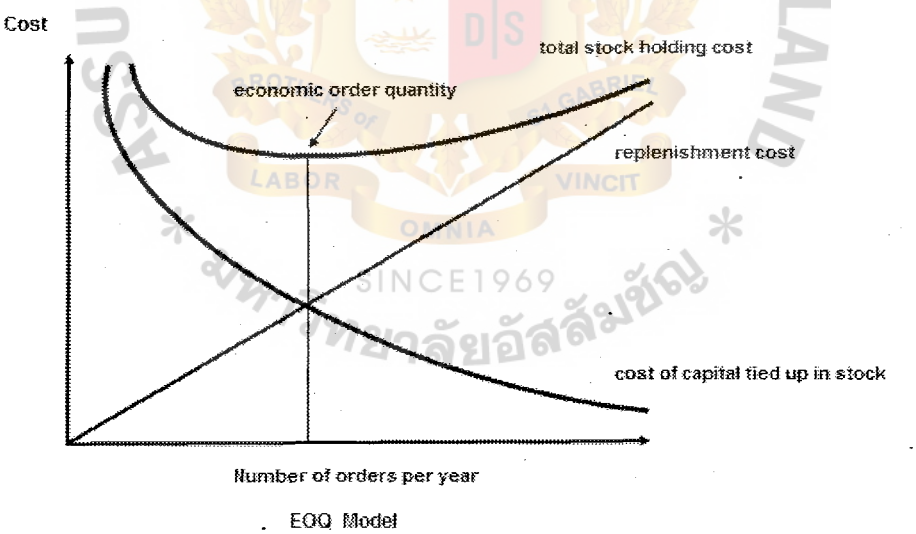
Where R = Annual demand

S = Order cost

C = Product unit cost

I = Holding cost

Figure: 2.4 EOQ Model



EOQ Model

Source: Stuart Emmett (2006)

2.3 Material Requirement Planning (MRP) system

Joel D. Wisner (2005) indicated that Material Requirement Planning (MRP) systems have been used widely by manufacturing firms for computing dependent demand. With the advent of the computer and information technology, the span of MRP evolved to include aggregate production planning, master production scheduling and capacity requirement planning to become closed-loop MRP.

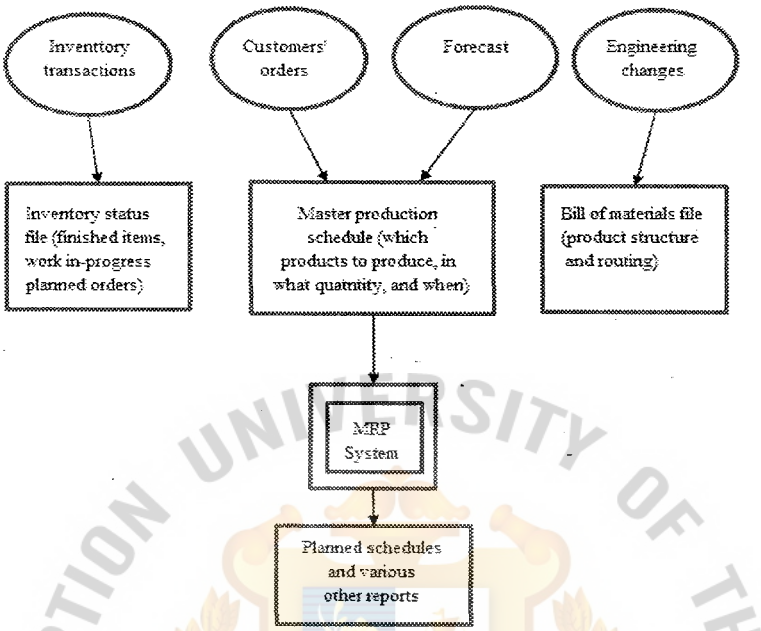
Donald, David and Lamer (1990) said that MRP systems are concerned with customer demand, production schedules, inventory levels, and available capacity at work centers within a plant. The scope of ERP is broadened by customer demand, available capacity at company plants worldwide, production schedules and inventory levels along its supply chain as well as throughout the company. Before ERP can plan worldwide, however, it must have accurate data from within each plant.

The material requirements planning module is an integral part of a Production Planning System. Through its bill of materials (BOM) explosion and aggregation process, this element of the system generates on a weekly basis the projected materials requirements for all the finished products included in a firm's undated master production schedule for the coming one to two month periods.

The projected gross requirement for a given material during the planning is required period. The MRP module calculates the net requirement by subtracting on-hand inventories and any scheduled receipts of the item, as production is scheduled to progress through the planning period. This produces a "time-phased" purchase order requirement to be released at a calculated future date.

MRP system is designed for dependent demand items that are production materials. The only way to handle independent demand items is by tying such an item's use into bill of materials (BOM) as shown in Figure 2.3

Figure: 2.3 Elements of the MRP System



Source: MCB University Press Limited, Amrik Sohal and Keith Howard, "Trends in Materials Management," *International Journal of Physical Distribution and Materials Management 17*, no.5 (1987), p.11

2.4 Just In Time

Womack (1990) said JIT is the concept by which parts are produced at each step in a process only to supply the immediate demand of the next step. (Womack et al., 1990) By using the container to carry parts to the next step and signal up the production requirements it is possible to coordinate the process. As each container is emptied, it is sent back to the previous step, which becomes the automatic signal to make more parts. Each step in the process is makes only enough parts to fill the container and wait for the container to be empty. JIT, however, is very difficult to implement because inventories are practically eliminated, so if one small part is not available, the entire production line has to be shut down.

McGrath (1997) discussed about a process-based JIT, instead of a functionally based, management system. JIT clearly defines the manufacturing process and terminology, along with a clear set of associated metrics.

The most basic from of JIT means to produce only the right items, at the right quality and in the right quantities as accurately as they are needed. The goal of this concept is not to reduce inventory, although that is as appealing side benefit but rather, to streamline the production process.

2.5 Vendor Managed Inventories

Daniel L. Gardner (2004) discussed about Vendor Managed Inventory (VMI), a fairly new practice for global operations, borrows from the past, benchmarks Efficient Consumer Response, Quick Response and employs new ways to bring inventory benefits to suppliers, manufacturers and, ultimately, the end user.

VMI is essentially a distribution channel operating system whereby the inventory at the distributor is monitored and managed by the manufacturer (MFG) and vendor (VEND). It includes several tactical activities including, determining appropriate order quantities, managing proper product mixes, and configuring appropriate safety stock levels. The rationale, it is all about pushing the decision making responsibility up to the supply chain, The manufacturing (MFG) and vendor (VEND) will be in a good position to support the objectives of the entire supply chain resulting in a sustainable competitive advantage. By centralizing the replenishment decision, it helps to reduce the distortion in ordering, introduced when there are several intermediaries that place orders in a supply chain.

In 2004, Daniel L. Gardner said the original application of VMI was limited to a raw materials and production environment. While recognizing the various iterations of VMI, the fundamentals of the concept are as follows:

1) Many suppliers set up a facility in close proximity to the manufacturer's site, keeping inventories until they are consumed and run out of production.

2) Since suppliers are keep and responsible for the inventory, the shipping terms (Inco Terms) are in many cases either delivered duty paid or delivered duty unpaid.

3) The supplier is responsible for replenishment and in some cases also has to determine the level of inventory (max/min).

4) The manufacturer does not have to issue purchase orders but "self-bills" based on actual consumption.

5) In an international model, raw materials are kept and stored in a bonded warehouse close to the production facility in order to help eliminate customs duties and not delay delivery.

6) Daily pull on inventory that are based on actual demand are the norm.

The histories of improvements in supply chain effectiveness have been achieved through efficiency gains. These include spending less time on actual inventory counts, less time finding misdirected inventory, and less time entering data into large customized systems. There are many innovations like cross-docking, bar coding, advance shipping notices (ASNs), that were essentially ways of accelerating the distribution system and reducing the cost of intermediate steps. ASNs, bar coding and other electronic enhancements systems brought savings by decreasing supply chain inventory, speeding up the distribution process and saving handling costs for both shipper and receiver. VMI is not only includes these concepts but also is the first approach which allows information to be used more intelligently. Strategic element and technological competency are the two primary mechanisms necessary for gaining benefits from VMI.

- **Problems with VMI**

Fernando Del Cid (2000) descried what makes VMI different from EDI: VMI passes control of the supply chain as far up the supply chain as possible to support production pooling and minimize inventory. In this case, VMI should only be implemented where the manufacturer and vendor can forecast demand more accurately than the distributor/retailer (dist/ret). As pointed out earlier, the capability to forecast and determine order levels is quite difficult and is a learned capability. This indicates that supply chain partners should decide strategically who should be the one to own such responsibility, and then let that entity develop the competency. Making inaccurate decisions in this area can cause more problems. Change must be quickly adopted as "tweaking" will become the norm not the exception.

One more fundamental, problem with making vendors responsible for retailers' inventories is the fact that manufacturer and vendor traditionally want to push products (i.e., maximize inventory), while retailers want to minimize inventory (i.e., optimize sales). Overcoming this dichotomy requires trust that both parties are seeking long term profitability. The distributor/retailer (dist/ret) should also assure itself that the interests of the manufacturer and vendor salesperson are associated with themselves. Elements that need to be considered are:

- How will the mfg/vends' salesperson be compensated?
- How will special pricing and promotions be handled?
- How will the benefits of VMI be split?
- What dist/ret sales and volume data should be kept confidential?
- What are the mfg/vends' other channels?

As distribution systems become more complicated, the mechanical aspects of providing outstanding service whether its next day delivery or access to a broad network of manufacturers will become more accessible to all firms. On a distribution aspect, service may not translate into a sustainable competitive advantage, however knowing which products, in what quantities, and where to store them, will beneficial.

2.6 Supplier Relationship

Denis Wojcik (2007) state that Supplier Relationship Management (SRM) is a comprehensive approach of managing companies who supply: goods and or services for consumption or resale.

The ultimate goal of SRM is to streamline processes and increase effectiveness of the interaction between a company and its suppliers.

There are Four Key Themes of Supplier Relationship Management (SRM)

1) You must have a strategy.

Companies must have a comprehensive strategy about how it will use suppliers to meet long-term goals. Companies will not achieve optimal performance without a well-planned and integrated supplier strategy.

2) Supplier Relationship governance is the single most important factor in determining success.

In spite of the importance of strategy, Good governance is surprisingly even more important. Good governance can help achieve positive outcomes from supplier relationships and keep the supplier in a very good control of the relationship. No matter how good a company strategy is if you don't have supplier governance in place, to enforce it, change it, or adjust it to market changes, the strategy will be nothing but a failure.

3) SRM is built on a network of relationships – not transactions.

To achievement via SRM, the company must understand that you are entering ongoing relationships with service and product suppliers that will in large part become partners in delivering business outcomes. You must be concerned about what happens today and about ensuring a positive environment for working with your suppliers tomorrow. This approach needs to dominate the companies thinking of how to deal with suppliers.

4) SRM requires creating measures that matter.

Far too many relationships flounder, not because of lacking measurements but lacking of measurements of things that really matter. Service level agreements often measure incidental items that have no bearing on business outcomes. With every step you take in SRM, from strategy to governance, a company needs to keep in mind how imperative it is to create meaningful measurements that help managers drive toward critical business outcomes.

2.7 Supply Chain Collaboration

In 1998, Ronald Ireland & Colleen Crum said that in today's world, economic pressures are forcing companies to change the way they are doing business. Competition is tougher and for companies operation in many industries, competition is global. The executives are increasingly thinking of supply chain collaboration as a corporate transformational strategy. This is causing executives to examine how to develop and enable people, processes and technology to support supply chain collaboration.

In developing the CPFR standard, it was fascinating to see how a group of competitor worked together very productively. The fact that customers and suppliers, technology providers and consultants formed such an effective team illustrates the strong belief that the effort was right for the industry. A passion for the purpose of supply chain collaboration remains as the VICS CPRF work continues, particularly in documenting the results from CPRF efforts and providing a forum for developing more detailed definitions and models for supply chain collaboration. The VICS efforts are guidelines for implementing CPFR. These guidelines address process flow as well as roles and responsibilities involved in each of the nine steps in the CPFR process.

Step 1: Front – End Arrangement

- Agree to confidentiality and dispute resolutions
- Develop scorecard to track supply chain metrics
- Establish incentives

Step 2: Joint Business Plan

- Partners develop plans for promotions, inventory policy changes, new products introductions, store openings and closings

Step 3 to 5: Sales Forecast Collaboration

- Trading partners share demand forecasts and identify exceptions. Collaboration on causal factors to reach consensus on a single forecast number.

Steps 6 to 8: Order Forecast Collaboration

- Trading partners share replenishment plants and identify and resolve exceptions.

Step 9: Order Generation / Delivery Execution

- Execution results data are shared and forecast accuracy problems are reviewed. Performance metrics are reported and communicated.

As a result, some companies utilize all nine steps of the process. Others adopt only a few steps. Still other will start by adopting a few steps and take an evolutionary approach to employing all of the supply chain collaboration process.

Other factors in determining how to implement supply chain collaboration are a company's internal planning competency and capabilities, the types of end products and a company's trading partners' capabilities and the market in which supply chains operate. The point is that each company will have an approach adopting supply chain collaboration in a different way and different steps of the process.

2.8 Milk Run

Satoh (1998) said the milk-run approach, which is one of the most popular and efficient ways of improving truck-load ratios, refers to the means of transportation in which a single truck cycles around multiple suppliers to collect or deliver transport.

Also in 2007, Jamie Flinchbaugh & Andy Carlino shared the same opinion about Milk Runs and stated that that it can be an effective tool to reduce transportation costs and excessive material storage and handling.

Appropriateness of the Tool

1) To create more efficient flow paths for materials and information through frequent.
2) To move closer to a one-piece flow environment by reducing batch deliveries.

Inappropriateness of the Tool

1) To institute milk runs without first setting up strong, capable and in-control processes. As with any attempts to cut inventories and move to one-piece flow, excessive downtimes from material shortages will be incurred without the correct foundation in place.
2) To create process around milk runs to support customer requirements instead of designing processes around customer requirements served by milk runs.
3) If the volume produced is so high that frequent runs of full truck-loads can be made from a supplier or to a customer, and then Milk runs do not make sense.

Description of Tool & How-to

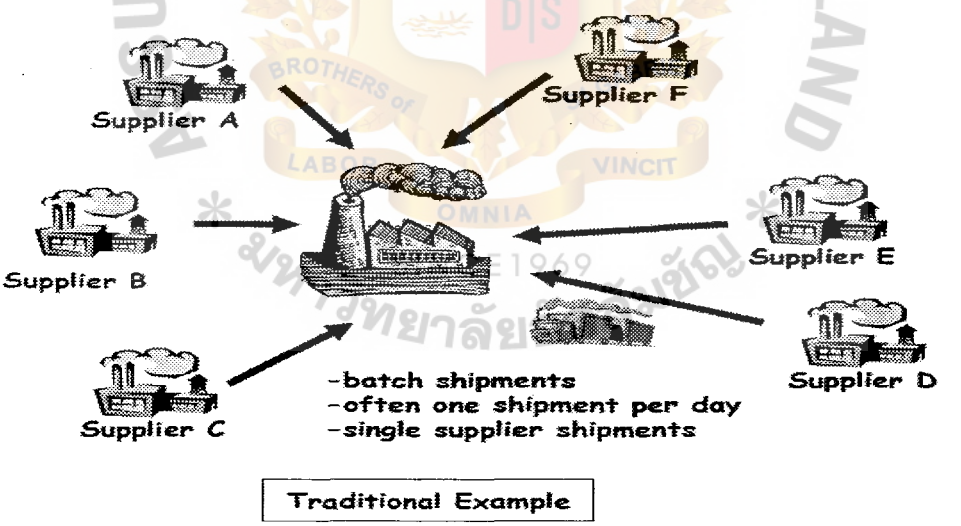
Jamie Filnchbaugh (2007) stated that Milk runs are a version of a tool from name-sake. Before electricity and later, supermarkets became prevalent, it was impossible to store milk for long periods of time in any one location. Thus, those in the milk production and delivery business learned to produce the right amount of product and deliver it on time to multiple customers. See **Figure: 2.8.1**

A milk run establishes a simple material flow system (though it can be used for more than just material flows) to leverage logistics costs and enable reduced inventories. The traditionally stem of material logistics called for the product to be moved in large batches directly from a stores area such as a warehouse, the suppliers who would know the destination point. The advantage of doing so, it was believed was to

capitalize on the economies of scale in transportation costs. The more parts that were being transported, translated to a reduction in transportation cost per part.

Milk Run utilizes frequent, regular and timed deliveries that stop at multiple locations to transport material. Instead of shipping directly from suppliers to customers, usually in large lot size to keep shipping density high, multiple suppliers are connected to a warehouse or factory. Among the process of push to drive toward one-piece flow to reduce inventories and lead time of delivery, milk runs are an effective way to achieve these imperatives and at the same time reduce the transportation costs. Thus the part density for any one shipment remains high saving transportation costs, and at the same time, multiple parts in smaller lot sizes are received significantly cutting inventories. The diagram as Figure 2.8 illustrates a traditional material logistics system.

Figure: 2.8 Traditional Transportation

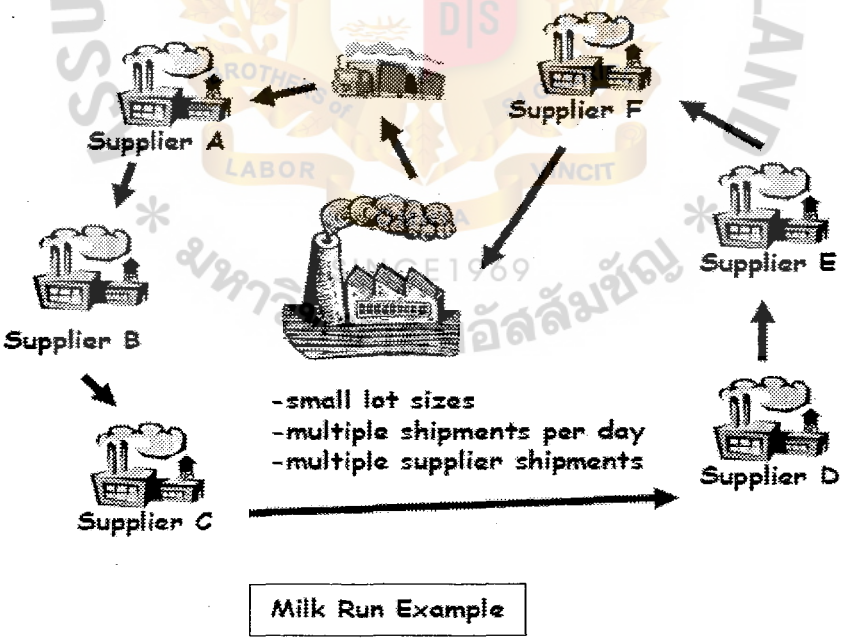


Source: www.leanlearningcenter.com

The diagram shown in as Figure 2.8.1 above shows how milk runs can be applied to a supplier network. In this case, multiple suppliers shipping to one common location will use a milk run; the milk run truck will show up at the location with any returnable containers and sometimes even order information. Once new material is picked up, it will go on to the next supplier and only when full will it return to its destination site. In this case likely owned and surely coordinated by the delivery point.

In addition to receiving materials you can also ship material in this way. If you are shipping parts to multiple factories, retailers or distribution centers, you can use a milk run that will be timed to distribute that material. This is commonly done in the specialized logistics business, and some third-party logistics handlers will provide the benefits of milk runs for multiple customers. See **Figure: 2.8.1**

Figure: 2.8.1 Milk Runs Transportation



Source: www.leanlearningcenter.com

In 2007, Jamie Filnchbaugh shared this opinion about the similar to many lean tools; the concept is rather straightforward; however, rushing into implementing a milk run procedure can create problems.

- First, someone experienced in logistics should be included to avoid adding unnecessary and excessive costs to material transportation and handling.
- Second, as with any initiative that enables operations to run with reduced Inventories, processes that are not capable can crate excessive downtime and excessive strain on the system. Make sure the foundational elements of production are in place before instituting milk runs.
- Third, packaging may benefit from altering the system.

This might result in smaller delivery trucks instead of trailers or modular packaging systems that allow for easy mixed-load loading and unloading of a truck. For these reasons, a company should not just start milk runs without thinking through the barriers and options first.

The differences on the Tool

Smaller companies or those lacking logistics experience will often out source this process instead of forgoing its benefits, resulting in the significant growth in third party logistics providers. The downside to this is that in order to coordinate with the individual company, multiple companies, might not benefit as significantly as least in terms of lead time reduction to the end customer.

How Tool Relates to Rules and Principles

The instrument of milk run concept illustrates the application of simplify and specify every flow path. Milk runs create standardized and synchronized flow paths for materials and information. By implementing milk runs, the flow path is also simplified as large batch sizes are reduced thereby eliminating the need for additional steps in storing and handling the material.

Milk runs enable smaller batch sizes reducing the waste of inventory. With smaller inventories, waste of transportation can also be reduced as the need for material handling equipment and the need to add material handling steps (storage, transportation) is mitigated. In general, as with any lean tool that takes aim at reducing inventories, the reduction of every other type of waste is potentially realized.

In 2006, Nisakorn L. shared her opinion about the process of bringing the materials to the Milk Run facilities. This covered be used to recover the data set of individual sellers and suppliers to break out the suppliers into groups based on space and make routing truck transportation to receive raw materials from each of the suppliers. The truck route is to the appropriate location of the supplier's area. The trip is to get each raw material in large amounts. The truck route each way is to be most effective. The paths of the truck have to minimal travel waste and not crate unnecessary costs. The case study of materials to be used as Milk Run 3 Victor Department found that the 3 methods are technically possible. Each method has Pros and Cons. The transportation company is hiring more flights and paying a monthly rental. It can support the company of no bearing on the risk of trucks. If there is obstruction, then a free bus Transportation Company must immediately replace the car. In case of a monthly package the office has advantages over the use of the car has lost just over 24 hours overtime and fuel costs, driver and staff vehicles only.

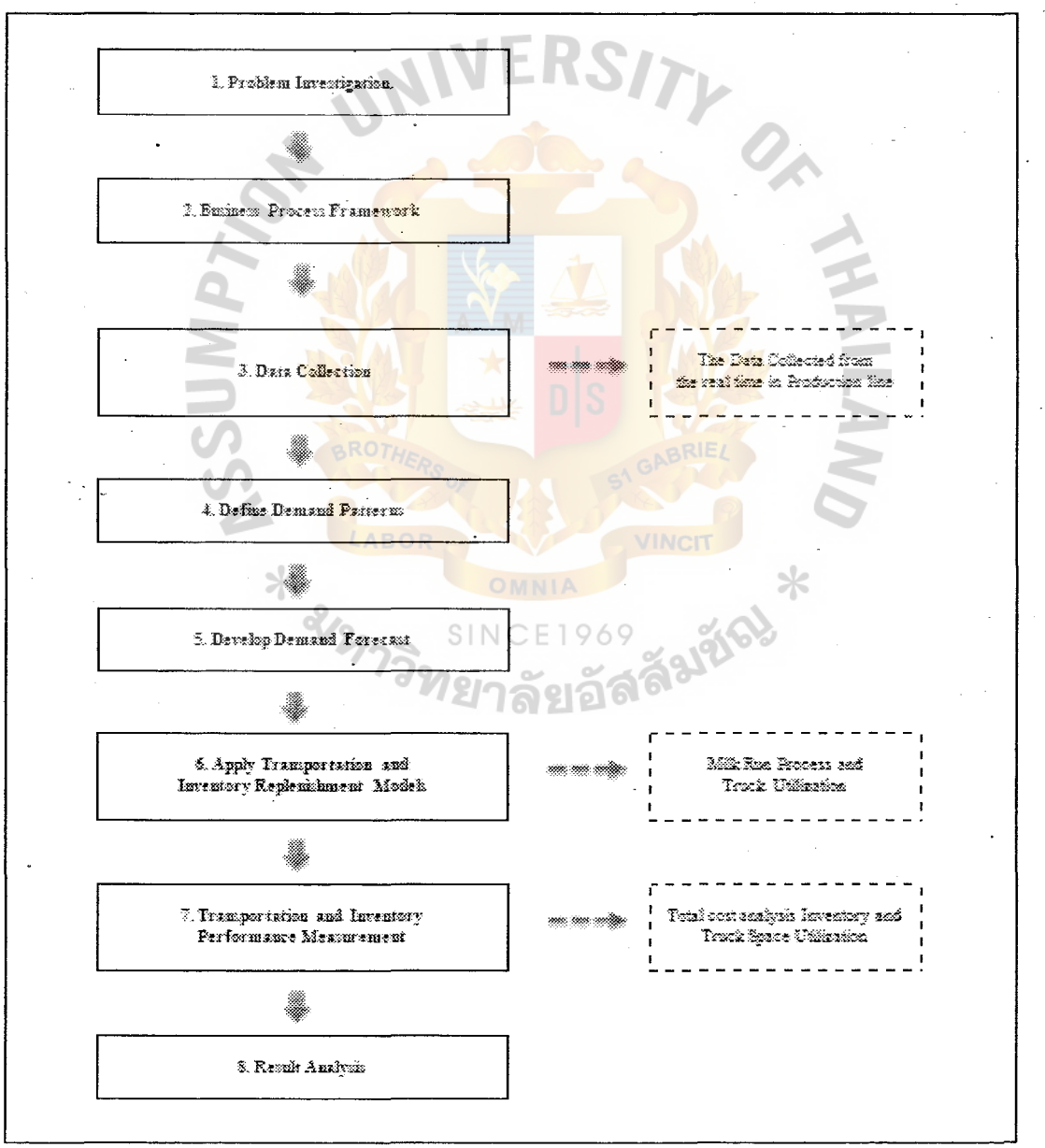
The driver may be delayed due to work overtime. Inability to hire car in case a trip does not occur often because of a delay penny paid a visit of usually try to work fastest.

CHAPTER III

RESEARCH FRAMEWORK

This chapter presents a research design, a theoretical framework, a conceptual framework as illustrated in figure 3.1

Figure 3.1 Research Method Flowcharts



3.1 Problem Investigation.

From at present, below management and inventory costs are very high. Become of the reasons given below.

1) The transportation cost from suppliers to warehouse VMI304.

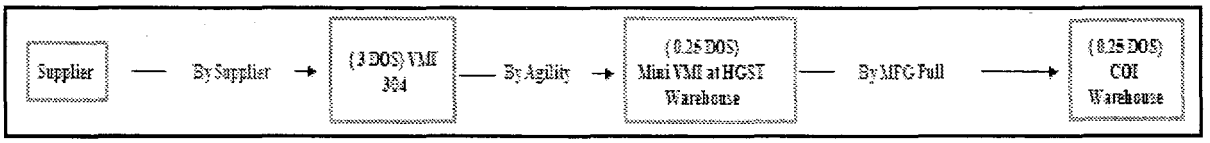
2) The storage cost of raw materials which supply to manufacturing and warehousing VMI 304.

3) The transportation cost of raw materials from warehousing VMI 304 to subsidiary plants (Mini VMI at The Computer Company warehouse)

4) The handling cost of the end product if it is in stock or the cost of setting up production and handling cost of the product is not in stock.

All of the cost that is managed by 3PLSP is held by executives in the treasury of VMI304. However, 3PLSP is responsible for shipping raw materials to mini warehouses in manufacturing, supplier shall maintain or keep the inventories of raw materials for manufacturing at VMI304 for 3 days (3 DOS) and transport the raw materials from warehouses to VMI and mini warehouses for manufacturing around, 4 times per day. The period of transition, of raw materials extraction to manufacturing to retail warehouses will be calculated when the material goes through the review process. As shown in **Figure 3.1.1**

Figure 3.1.1 The previous diagram showing distribution of raw materials



The inefficacies of Vendor Managed Inventories are:

1) The production line is the one key part of the total supply chain process. With the above issues, this area may cause low performance in the total company supply chain
2) Expensive advanced technology is required.
3) Supplier trust must be developed.
4) Supplier responsibility is increased.
5) Medium / Small producers do not have the capacity to deliver at the expected frequency because of retail at cheap transport conditions, strong increase of transport costs and, delivery queues at supplier's warehouse.

In this research, The Computer Company can be operated in one of the two ways: one way is the traditional way, in which the downstream decides the inventory level and keeps the inventory. The other way is the new way, in which inventory-keeping responsibility and stock level decision switch upstream. By comparing the expected costs in these two cases, the company found out that transferring demand-uncertainty risk from downstream to upstream does not necessarily lead to a higher expected costs for downstream or a lower one for down streaming. In general, we find that the critical fraction used in inventory management problem is to determine the optimal stock level which can often be used as a measure quickly assess the merits of adopting the new method. Furthermore, the company shows that when the critical fraction of upstream is greater than that of downstream, adopting the new method always makes both better off, provided some kind of risk-sharing rule could be implemented. In addition, the company tries to develop and adopt process Milk Runs to improve and reduce cost of transportations and inventories stock level.

In addition, the principle of Systematic Waste Elimination can be applied through Milk Runs. Milk Runs enable smaller batch sizes reducing the waste of inventory. In the midst of smaller inventory and waste transportation can also be reduced as the need for material handling steps is mitigated.

3.2 Business Process Framework

This project shows details of all operations, both information about current delivery systems and usage of the new simulation data to determine the distribution component of collaboration between suppliers and The Computer Company teams. The objective is also to discover the optimal point of saving cost and reducing inventory. However, this process will be developed by manipulating variables. For example, Planning section in this part consists of planning materials, Truck Section in this part consists of organizing trucks, Supplier Section in this consists of the ship raw material suppliers, COI Warehouse Section in this consists of the collected materials, including various inspections, PLM Pull request section in this consists of the extraction of raw materials from warehouse to the production. Therefore, as the feature of Milk Run approach, managing these variables is allowed. In conclusion the business process frame work is as follows.

(1) To show details of all operations, both information and the current delivery systems

(2) Using the new process to determine the distribution component of Milk Run by the appropriate team of researchers and collaborating between the five suppliers. and The Computer Company teams

(3) To find new solutions to improve the quality of supply chains

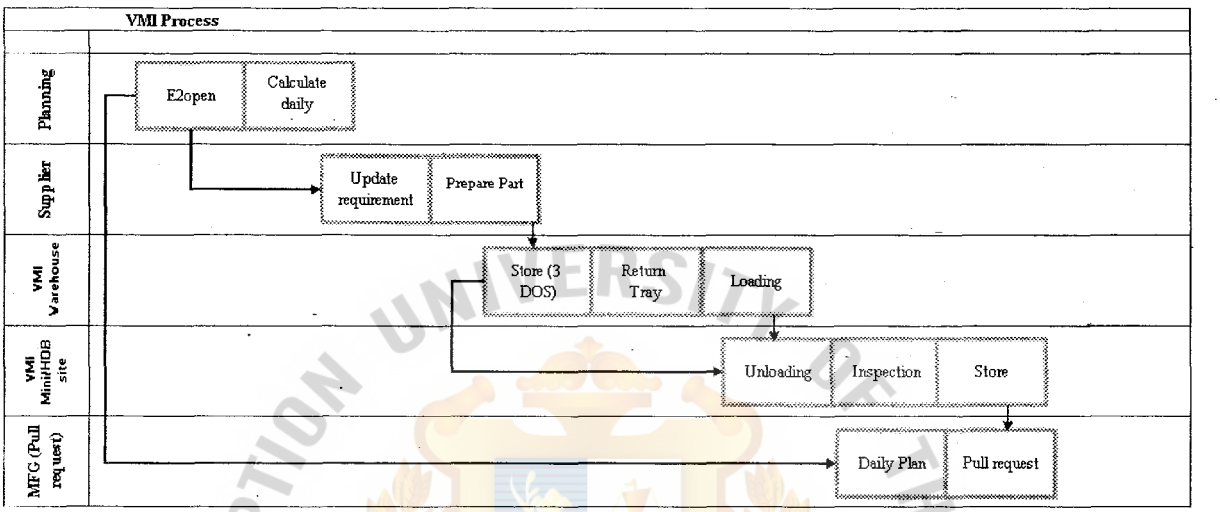
(4) To discover optimal point of saving cost and reduce inventory.

3.2.1 Previous VMI Process Framework

Currently, the logistics of raw materials at The Computer Company is usage of the warehouse (VMI) as the center to stock raw materials for manufacturing process. The Computer Company engage is in third party logistics (3PLSP) to manage and support the transportation between VMI304 to mini VMI's The Computer Company. By doing that, the cost of The Computer Company logistic management is very high. Most of operating costs are management of inventory cost and transportation cost between suppliers to VMI and VMI to factory plant. At present, suppliers have to keep the stock for 3 days of supply (DOS) at VMI. Manufacturing teams (MFG) will

update the pull process to 3PLSP. Then, 3PLSP will transport it to mini VMI's The Computer Company 4 times per day. That is shown in **Figure 3.2.1**

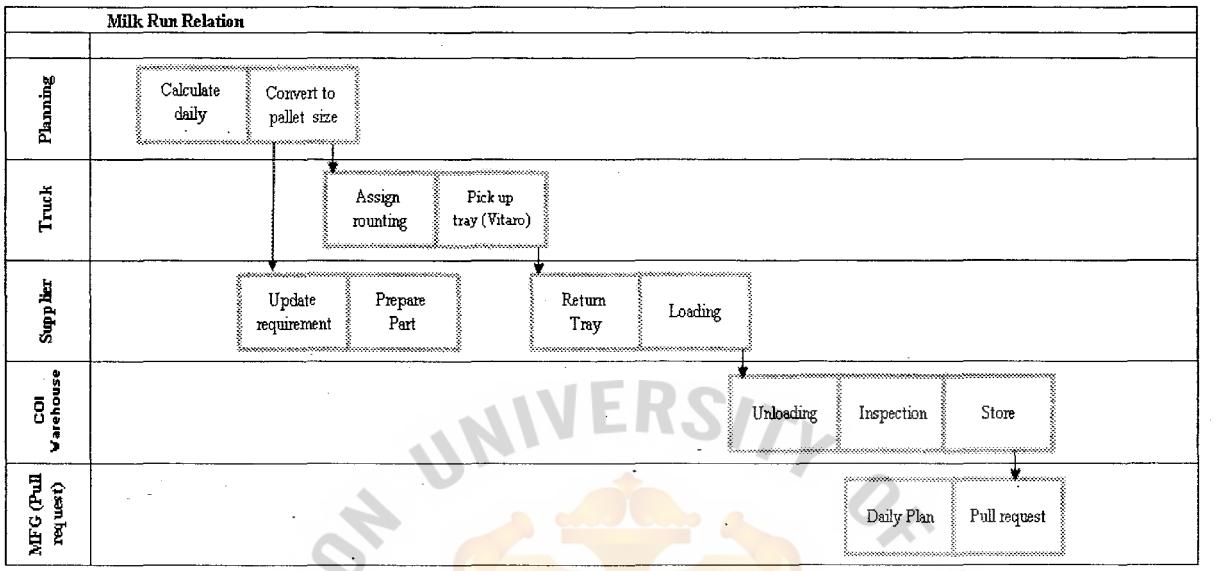
Figure 3.2.1 Previous VMI Process Framework



3.2.2 Milk Runs Process Framework

In the Planning Section the Suppliers of raw materials are to produce complaints within 6 / 13 week to outlook at The Computer Company. The planning department sends information to determine which level in the 3 Days Dos of volume. Materials received from the supplier will be in accordance with the 6 / 13 week outlook combined with the added ability to load the full pallet. In the truck section, the trucks will take Tray returns prior to receiving the materials. When the truck reaches supplier's location, raw materials will be transported in each vehicle that is received after the tray returns. After that, the vehicle will transport materials sent back to the warehouse facility approximately 4 hours after the raw materials enter. Thereafter, Process monitoring and cleaning of the W / H section it has done before the Department PLM will trigger pull of materials (Pull request) to produce hard disk. That is be shown in **Figure 3.2.2**

FIGURE 3.2.2 Research Processes of the Project



3.3 Collection of Data / Gathering Procedures

The main goal of this project is to analyze the appropriate processes, including Milk run, for delivery of raw materials, an analysis for space in warehouses and factories wherever suppliers need to keep raw materials to supply to the production line as well as to of trucks on a daily basis.

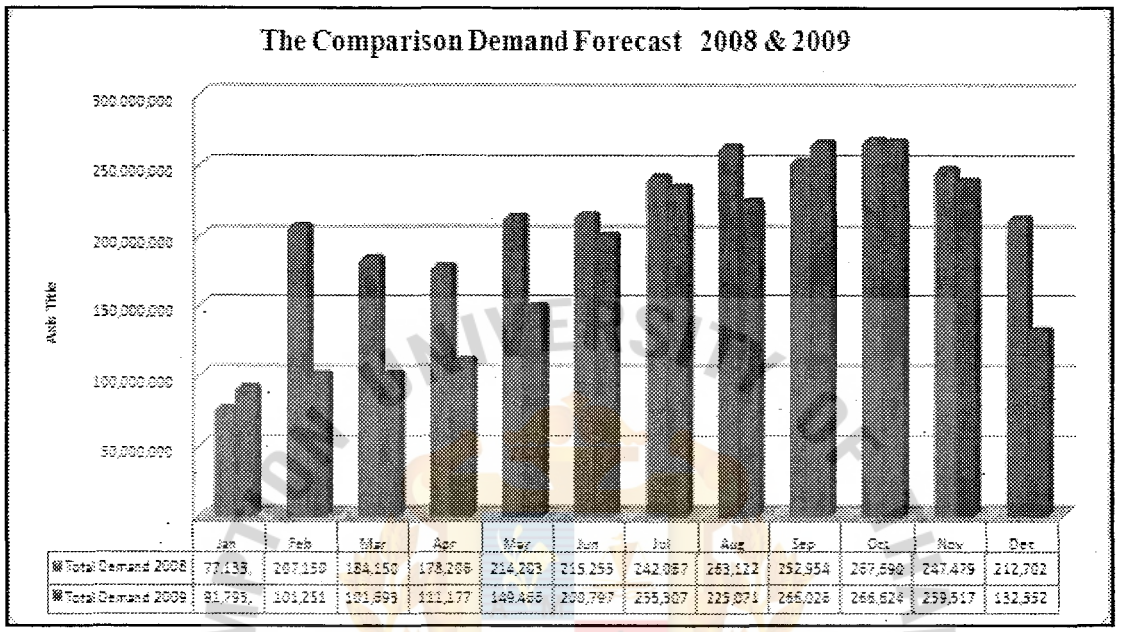
Data of the inventory is obtained from the history of demand forecast data base on a monthly basis from February until August 2009 (total 7 months). The company can define the scope of this processes associated assumptions and performance metrics. This is shown in **Table 3.3**.

Table 3.3 Factions considered in deciding the form of delivery Milk Run and appropriate set of metrics as the basis and data collection.

Group	Description
Cost	Inventory : the cost of raw material as Table
	Truck: the cost of transportation Milk Run
Truck	Total amount run by total truck and required each day
	Truck Space Utilization
Pull	The impact of raw materials from suppliers to the mini
	warehouse under Pull process
Suppliers	Raw materials or storage; suppliers must maintain the level of
	days of supply under 6 weeks forecast and the number of actual
	daily plan to 6 weeks a day of supply consistent with the policies
	set by The Computer Company.

3.4 Develop Demand Forecast

Figure 3.4, it indicates that the demand forecasts of each item are not of the pure



demand type and there is a tradition of the seasonal and random demands that are shown in the graph. Moreover, the company will update the demand forecasts to suppliers on a weekly basis. Then, suppliers can check and prepare their raw materials to supply the company demand on time. **FIGURE 3.4 The Comparison Demand Forecasts 2008 & 2009**

3.5 Apply Transportation and Inventory Replenishment Models

Currently, the company engages in third party logistics (3PLSP) to manage and support the transportation as well as inventory replenishment. Nevertheless, the company manages to apply new transportation and inventory replenishment under milk run process shown in as **Figure 3.2.2** Moreover, the company will apply inventory replenishment processes base on Economic Order Quantity (EOQ)

EOQ makes the supposition that there will be zero lead times, no stock outs and safety order when at zero stocks. This is not realistic when faced with uncertain demand,

supply lead times with variability and the need for variable order quantities by Coyle (1996)

For transportation, the company compares the cost of transportation between VMI and Milk Run as shown in **Table 3.5**.

Table 3.5: The cost of transportation between VMI and Milk Run cost

VMI	Milk Run
Cost = 6500 / 1 each Cost of Fuel Cost of maintenance Cost of Operator Cost of licenses Cost of insurance Other necessary payments (Toll fee, Bribe fee and other fees) 1 week cost * time per week cost * 3 times per week / 1 supplier (6500*3) = 19500 Total 19500 baht per 1 supplier	Cost = 5000 / 1 each Cost of Fuel Cost of maintenance Cost of Operator Cost of licenses Cost of insurance Other necessary payments (Toll fee, Bribe fee and other fees) 1 week cost * time per week cost * 5 times per week / 5 suppliers (5000*5/5) = 5000 per 1 supplier Total 5000 baht per 1 supplier *** Especial requirement from suppliers** Cost = 2500 / 1 each (cost * time) by Pick Up Car

3.6 Transportation and Inventory Performance Measurement

At this step of the project is a comparison of the results is made from the current transportation and inventory performance to the better solution from Milk Run process. Expectations that are possible are given below.

3.6.1 To find a better process for logistics (Receiving and Transportations processes) that will not affect the production line.

3.6.2 Appropriate inventory levels for manufacturing hard disk, for each Supplier.

3.6.3 The optimal point of saving cost and reducing inventory.

3.6.4 Prototype of 5 suppliers with collaborative planning, including the process for forecasting demand, communicating order schedules and collaborating on exceptions.

3.6.5 Sharing information between Businesses to Businesses (B2B).

3.4.6 More effective contact with supporting institutions and facilitated access to suppliers and specialized employees.

CHAPTER IV

RESULTS AND ANALYSIS

This chapter presents an overview of research methodology used in is study and summaries the result from the current state. In order to realize the objectives of the research a study design is selected to determine the appropriate methods of measurement data and research involved in the success.

4.1 Results of Evaluation and Analysis

As stated in the Chapter IV, the transportation and inventory measurements were based on Milk Run method. The approaches of this study are the follows.

4.1.1 Transportation Cost Measurement

In this step, the company applies Milk Run method to 5 suppliers who are multiple shipping suppliers, at one common location. The truck will then pick up raw materials from suppliers 1 or 2 times per day. (The round trips of transportation depend on production requirement). The pickup round depends on specific requirement from suppliers that is shown in as Figure 4.1.1 The following table shows the results of the number of Round Trips and Cost of Milk Run Transportation from February to August 2009.

Figure 4.1.1 Milk Run Transportation

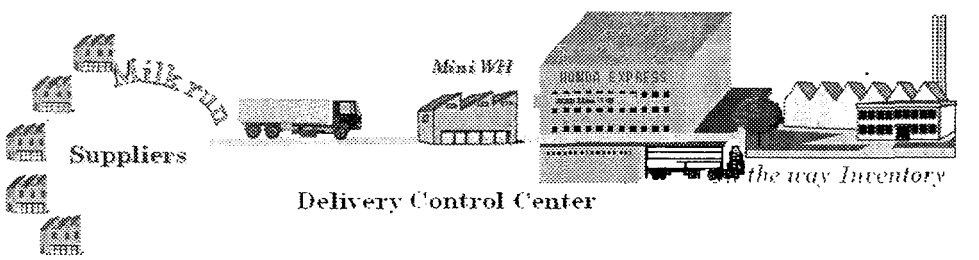


Table 4.1.1 Round Trips and Cost of Milk Run Transportation since February to August 2009.

Milk Run / Round Trips	February	March	April	May	June	July	August
Truck	16	23	27	33	27	41	43
Pick up	6	11	10	4	7	8	3
Cost of Milk Run	**February**	**March**	**April**	**May**	**June**	**July**	**August**
Truck	16,000	23,000	27,000	33,000	27,000	41,000	43,000
Pick up	15,000	27,500	25,000	10,000	17,500	20,000	7,500
Total cost	**31,000**	**50,500**	**52,000**	**43,000**	**44,500**	**61,000**	**50,500**

Table 4.1.1 indicates that the number of round trips in May and July are high because the working time of production is 5 weeks per month but during other months is only 4 weeks per months per the company's calendar. In the month of August, since the requirement of production is increased, the numbers of round trips increase too.

The previous process will pick up the raw materials 3 times per week as the traditional transportation and the cost of transportation is shown in as **Table 4.1.2**

Table 4.1.2 Summary of Round Trips and Transportation Cost of previous process

VMI T/O	February	March	April	May	June	July	August
Roundtrips / month	4	4	4	5	4	5	4
Transportation Cost							
Truck 6500 Baht / week	78,000	78,000	78,000	97,500	78,000	97,500	78,000
Total Cost 6 month							**507,000**

4.2 Transportation Cost Comparison

After applying Milk Run Method, the total cost of transportation in 7 months is 332,500 baht but the previous cost is 585,000 baht. The transportation cost is decreased 252,000 baht or 43% from the previous cost. Table 4.2 shows the comparison of cost between the Previous Transportation Cost and Milk Run Transportation Cost for each month.

Table 4.2 Comparison of the Previous Transportation Cost and Milk Run Transportation cost.

Month	Previous Transportation Cost	Milk Run Transportation Cost	Saving Cost (Baht)	Save (%)
February	78,000.00	31,000.00	47,000.00	60%
March	78,000.00	50,500.00	27,500.00	35%
April	78,000.00	52,000.00	26,000.00	33%
May	97,500.00	43,000.00	54,500.00	56%
June	78,000.00	44,500.00	33,500.00	43%
July	97,500.00	61,000.00	36,500.00	37%
August	78,000.00	50,500.00	27,500.00	35%
Total	**585,000.00**	**332,500.00**	**252,500.00**	**43%**

4.3 Truck Space Utilization

In previous process, the company engages a third party logistics (3PLSP) to manage and support the transportation by using transportation from VMI304 to mini VMI's of The Computer Company. 3PLSP used the traditional transportation way to support suppliers' shipment by picking up raw materials from one supplier per day per batch. Moreover, 3PLSP managed the transportation by single supplier shipments. By doing this, the result of previous process did not utilize the space of truck since 3PLSP picked up the raw materials as per suppliers' requirements. They did not manage the space in the truck properly.

Therefore, the company applies Milk Run method to improve this process and get the result from 5 suppliers. After summarizing the results from 5 suppliers during February to August 2009, the result shows that the utilization of truck space is up to 84%. This is shown in **Table 4.3**

Table 4.3 Summary result of truck space utilization

%truck Space Utilization-PRB	February	March	April	May	June	July	August
A	3%	6%	9%	4%	8%	6%	7%
B	16%	12%	9%	17%	11%	14%	14%
C	42%	35%	34%	30%	47%	37%	35%
D	3%	7%	9%	6%	8%	7%	7%
E	19%	17%	14%	10%	10%	13%	13%
Total	**84%**	**79%**	**75%**	**66%**	**84%**	**76%**	**76%**

4.4 Inventory Cost Measurement

In this step, the company summaries the results of the inventory cost measurement from February – August, 2009. That is shown in **Table 4.4 -4.4.6**

Table 4.4 Summary-Inventory Cost of Saving in February

Group	Forecast	Price - VMI ($)	Price- Milk Run ($)	Delta ($)	Total Cost VMI ($)	Total Cost Milk Run ($)	Delta VMI – Milk Run Save Cost ($)
A	1,920,000	0.0550	0.0548	0.0002	52,800	52,608	192.00
B	600,000	1.4364	1.4349	0.0015	426,840	425,940	900.00
C	8,544,791	7.9231	7.7970	0.1261	676,886	675,482	1,404.49
D	9,970,000	0.1240	0.1238	0.0002	194,055	193,751	304.00
E	450,000	11.4890	11.4434	0.0456	460,128	457,563	2,565.00
Total					**1,810,709**	**1,805,343**	**5,365.49**

During the month of February Milk Run-Inventory cost, it can be reduced by 5,365.49 ($). Table 4.4 shows Inventory cost between the Previous Process (VMI Transportation cost) and Milk Run Process.

Table 4.4.1 Summary-Inventory Cost of Saving in March

Group	Forecast	Price - VMI ($)	Price- Milk Run ($)	Delta ($)	Total Cost VMI ($)	Total Cost Milk Run ($)	Delta VMI – Milk Run Save Cost ($)
A	2,980,000	0.0550	0.0548	0.0002	81,950	81,652	298.00
B	748,000	1.4364	1.4349	0.0015	532,127	531,005	1,122.00
C	19,393,915	7.9231	7.7970	0.1261	873,571	871,760	1,810.48
D	19,760,000	0.1240	0.1238	0.0002	350,160	349,628	532.00
E	618,702	11.4890	11.4434	0.0456	658,785	655,258	3,526.60
Total					**2,496,592**	**2,489,303**	**7,289.08**

During the month of March, Milk Run-Inventory cost can be reduced by 7,289.08 ($). Table 4.4.1 shows the different Inventory cost between the Previous Process (VMI Transportation) and Milk Run Transportation Process.

Table 4.4.2 Summary-Inventory Cost of Saving in April

Group	Forecast	Price - VMI ($)	Price- Milk Run ($)	Delta ($)	Total Cost VMI ($)	Total Cost Milk Run ($)	Delta VMI - Milk Run Save Cost ($)
A	3,543,000	0.0550	0.0548	0.0002	97,433	97,078	354.30
B	816,000	1.4364	1.4349	0.0015	581,155	580,003	1,152.00
C	18,485,166	7.9231	7.7970	0.1261	926,883	924,973	1,910.36
D	21,048,663	0.1240	0.1238	0.0002	376,566	375,991	575.73
E	548,004	11.4890	11.4434	0.0456	572,802	569,679	3,123.62
Total					**2,554,840**	**2,547,724**	**7,116.02**

During the month of April, Milk Run-Inventory cost can be reduced by 7,116.02 ($). Table 4.4.2 shows the different Inventory cost between the Previous Process (VMI Transportation) and Milk Run Process.

Table 4.4.3 Summary-Inventory Cost of Saving in May

Group	Forecast	Price - VMI ($)	Price- Milk Run ($)	Delta ($)	Total Cost VMI ($)	Total Cost Milk Run ($)	Delta VMI - Milk Run Save Cost ($)
A	2,010,000	0.0550	0.0548	0.0002	55,275	55,074	201.00
B	924,872	1.4364	1.4349	0.0015	658,733	657,431	1,301.40
C	15,347,186	7.9231	7.7970	0.1261	906,897	905,022	1,875.45
D	17,270,000	0.1240	0.1238	0.0002	273,690	273,266	424.00
E	307,276	11.4890	11.4434	0.0456	328,954	327,202	1,751.47
Total					**2,223,549**	**2,217,995**	**5,553.32**

During the month of May, can be reduced by 5,535.32 ($). Table 4.4.3 shows the different Inventory cost between the Previous Process (VMI Transportation) and Milk Run Process.

Table 4.4.4 Summary-Inventory Cost of Saving in June

Group	Forecast	Price - VMI ($)	Price- Milk Run ($)	Delta ($)	Total Cost VMI ($)	Total Cost Milk Run ($)	Delta VMI - Milk Run Save Cost ($)
A	3,735,000	0.0550	0.0548	0.0002	102,713	102,339	373.50
B	984,000	1.4364	1.4349	0.0015	700,018	698,542	1,476.00
C	21,659,050	7.7191	7.5934	0.1257	1,055,803	1,053,599	2,204.45
D	24,580,000	0.1240	0.1238	0.0002	357,014	356,342	672.00
E	506,314	11.4890	11.4434	0.0456	538,481	535,595	2,885.99
Total					**2,754,028**	**2,746,416**	**7,611.94**

During the month of June, Milk Run-Inventory cost can be reduced by 7,611.94 ($) Table 4.4.4 shows the different Inventory cost between the Previous Process (VMI Transportation) and Milk Run Process.

Table 4.4.5 Summary-Inventory Cost of Saving in July

Group	Forecast	Price - VMI ($)	Price- Milk Run ($)	Delta ($)	Total Cost VMI ($)	Total Cost Milk Run ($)	Delta VMI - Milk Run Save Cost ($)
A	4,570,000	0.0550	0.0548	0.0002	125,675	125,218	457.00
B	1,614,000	1.4364	1.4349	0.0015	1,148,200	1,145,779	2,421.00
C	32,008,378	7.9231	7.7970	0.1261	1,507,985	1,502,917	5,067.19
D	39,120,000	0.1240	0.1238	0.0002	561,650	560,626	1,024.00
E	828,399	11.4890	11.4434	0.0456	904,805	900,083	4,721.87
Total					**4,248,315**	**4,234,623**	**13,691.06**

During the month of July can be reduced by 13,691.06 ($). Table 4.4.5 shows the different Inventory cost between the Previous Process (VMI Transportation) and Milk Run Process.

Table 4.4.6 Summary-Inventory Cost of Saving in August

Group	Forecast	Price - VMI ($)	Price- Milk Run ($)	Delta ($)	Total Cost VMI ($)	Total Cost Milk Run ($)	Delta VMI - Milk Run Save Cost ($)
A	5,062,052	0.0550	0.0548	0.0002	139,206	138,700	506.21
B	1,863,600	1.4364	1.4349	0.0015	1,325,765	1,322,970	2,795.40
C	34,248,725	7.9231	7.7970	0.1261	1,670,980	1,667,514	3,465.80
D	42,471,666	0.1240	0.1238	0.0002	555,999	554,963	1,035.78
E	1,015,898	11.4890	11.4434	0.0456	1,125,763	1,119,973	5,790.62
Total					**4,817,714**	**4,804,121**	**13,593.81**

During the month of August, Milk Run-Inventory cost can be reduced by 13,593.81 ($). Table 4.4.6 shows the different Inventory cost between the Previous Process (VMI Transportation) and Milk Run Process.

In summary the results of Milk Run transportation from February to August, 2009, indicates that the inventory cost can be reduced by 60,220.73 ($). This is shown in **Table 4.4.7**

Table 4.4.7 Summary Inventory Cost of saving on February – August, 2009

Month	Supplier A	Supplier B	Supplier C	Supplier D	Supplier E	Total 5 suppliers
February	192.00	900.00	1,404.49	304.00	2,565.00	5,365.49
March	298.00	1,122.00	1,810.48	532.00	3,526.60	7,289.08
April	354.30	1,152.00	1,910.36	575.73	3,123.62	7,116.02
May	201.00	1,301.40	1,875.45	424.00	1,751.47	5,553.32
June	373.50	1,476.00	2,204.45	672.00	2,885.99	7,611.94
July	457.00	2,421.00	5,067.19	1,024.00	4,721.87	13,691.06
August	506.21	2,795.40	3,465.80	1,035.78	5,790.62	13,593.81
Total	**2,382.01**	**11,167.80**	**17,738.23**	**45,67.52**	**24,365.18**	**60,220.73**

4.5 Suppliers collaboration.

Most people know VMI as a better way for manufacturing this is not suitable to suppliers, since suppliers have to hold their inventory cost. Suppliers also have to take care of the hidden cost of the high risk of transportation and warehousing. Therefore it does not reach with collaboration and down streaming of supply chain.

In this case, the company tried to develop and adopt Milk Runs Processes to improve and reduce transportations cost and inventory cost. This is shown in **Table 4.2 and 4.5**

Table 4.5 Price Comparison between VMI and Milk Run

Group	VMI Price ($)	Milk run Price($)	Saving Price ($)
A	9.1590	9.1248	0.0342
B	1.4364	1.4349	0.0015
C	6.2231	6.2070	0.0161
D	0.1240	0.1238	0.0002
E	0.0275	0.0274	0.0001
Total	**16.9700**	**16.9179**	**0.0521**

Compared to the VMI price, Milk Run price for group A is lower by 0.0342 ($), group B is lower by 0.015 ($), group C is lower by 0.0161 ($), group D is lower by 0.0002 ($) and group E is lower by 0.0001 ($). In summary, the total price of 5 groups is lower by 0.0521 ($)

CHAPTER V

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary of Findings and Conclusions and Recommendations

The objective of this paper was to create a new model to improve and manage cost of inventory and transportation management. The company can apply the new strategy in order to minimize an inventory and transportation cost which is the target for the company. The company than explores the collaboration of Supply Chain with these suppliers

1) In this paper, the company would like to manage and improve cost of inventory and transportation to meet the company's target by using the Milk Run method. Using this method helps the company to reduce the cost of inventory total by 0.0521 ($) from 5 suppliers. The company also gets the benefit of truck space utilization up to 84 % from the summary of data of truck utilization from February to August, 2009.

2) After applying Milk Run transportation, the company can reduce the cost of inventory by 0.0521 ($) from 5 suppliers and the cost of transportation from February to August, 2009 by 252,000 baht or 43% from the previous cost.

3) The company explores the collaboration of supply chain with 5 suppliers by Milk Run process. Also the Company has to develop and adopt the Milk Runs process to improve and reduce the hidden cost which suppliers have to take care of.

- Reduces cost of the Product.
- More collaboration and authority enforcement.
- Reduces total cost of the supply chain (WIN WIN strategic)

5.2 Recommendations and future research.

1) In the future, the company will have to explore Milk Run transportation in order to apply it to other industrials for improving and managing cost of inventory and transportation.

2) To explores the collaboration of supply chain with other suppliers and to share the information with suppliers for accuracy forecast and production capacity.

3) To apply supply chain management from the internal team, such as procurement department or production planning, to the suppliers and to understand the requirement between suppliers and the company.

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APPENDICES

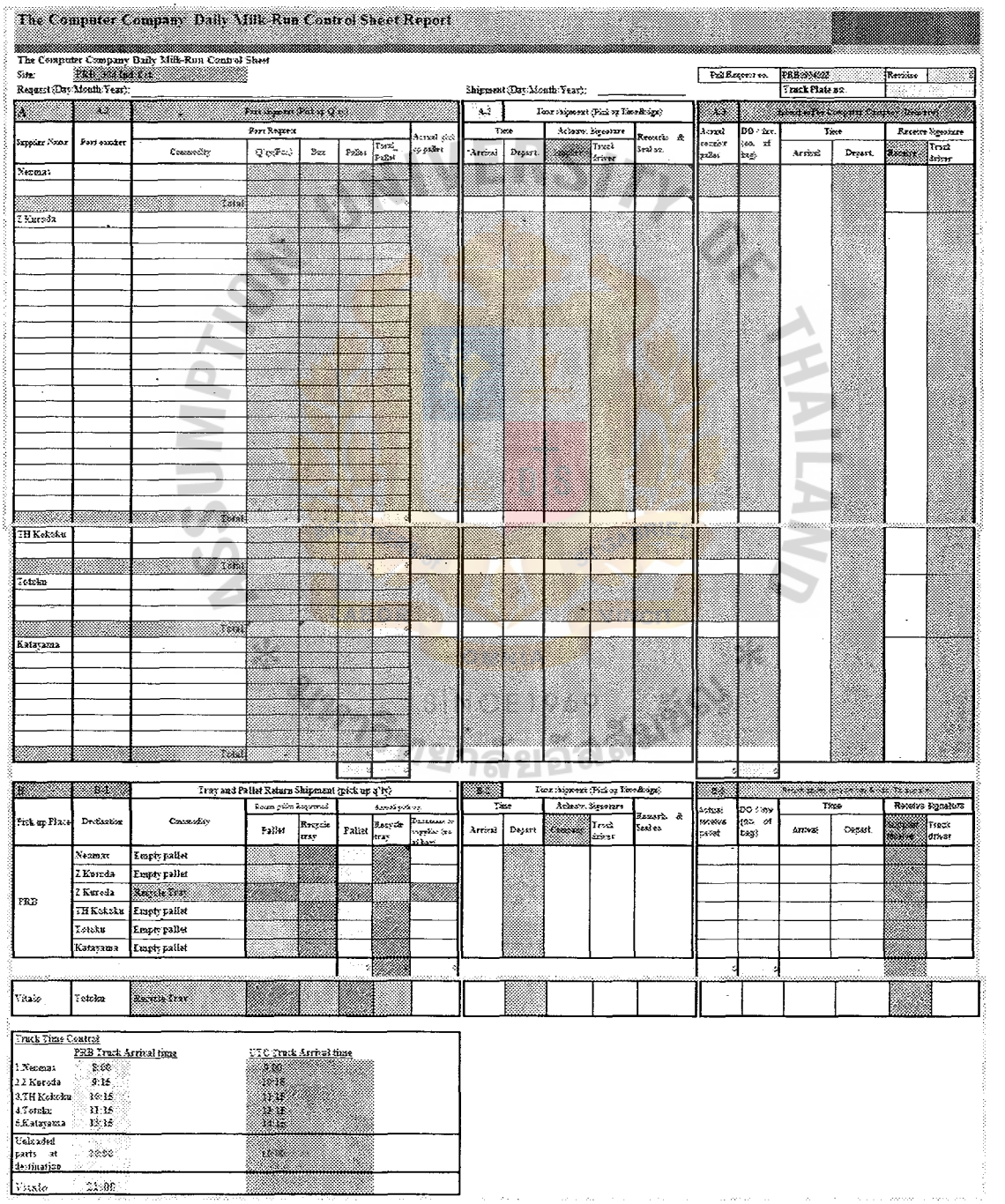
APPENDIX A

PRICE OF MATERIAL UNDER MILK RUN MODEL

Group	Supplier	Parts Name	P/N	Model	Qty / box(pcs)	Box/pallet	Qty / pallet(pcs)	JIT price (USD)	Milk run price(USD)	Delta
B	Neomax	VCM ASM	0A54477	FLB 1D	400	60	24,000	0.7114	0.7099	0.0015
B	Neomax	VCM ASM	0A54320	SRB 1D	400	60	24,000	0.7250	0.7250	0.0000
C	Z.Kuroda	LONG LEVER	0A50976	BRB 1D,2D /	3000	24	72,000	0.2040	0.2036	0.0004
C	Z.Kuroda	SHORT BAR	0A52218	DPC 1D,2D /	6400	24	153,600	0.1010	0.1008	0.0002
C	Z.Kuroda	SHORT BAR	0A53746	BRB 1D,2D	6400	24	153,600	0.1000	0.0998	0.0002
C	Z.Kuroda	SINGLE LATCH	0A57007	FB5	3600	24	86,400	0.2000	0.1996	0.0004
C	Z.Kuroda	LONG LEVER	13G1484	SRB / FB-4	3600	24	72,000	0.2060	0.2056	0.0004
C	Z.Kuroda	SHORT LEVER	13G1485	SRB / FB-4	6400	24	153,600	0.1010	0.1008	0.0002
C	Z.Kuroda	SINGLE LATCH	0A54422	FLB , FLC	3600	24	86,400	0.0880	0.0878	0.0002
C	Z.Kuroda	SINGLE LATCH	0A58454	PTB	3600	24	86,400	0.2000	0.1996	0.0004
C	Z.Kuroda	LABEL (MFG-S/N 30MI	03L2019	SRB,FB4,BR	80000	32	2,560,000	0.0022	0.0022	0.0000
C	Z.Kuroda	LABEL	0A28338	FB4	2250	32	72,000	0.1750	0.1747	0.0003
C	Z.Kuroda	LABEL	0A33236	VNF, GMK	2500	64	160,000	0.0490	0.0489	0.0002
C	Z.Kuroda	LABEL (MODEL LABEL	0A35828	JPK	2400	32	76,800	0.0120	0.0120	0.0000
C	Z.Kuroda	LABEL (BLANK LABEL	0A54440	FLB	40000	32	1,280,000	0.0040	0.0040	0.0000
C	Z.Kuroda	LABEL (BLANK LABEL	25L1522	SRB,FB4,BR	80000	32	2,560,000	0.0022	0.0022	0.0000
C	Z.Kuroda	SEAL LEAK	08K0228	SRB,FB4,BR	180000	16	2,880,000	0.0039	0.0039	0.0000
C	Z.Kuroda	PARTICLE SEAL	08K0237	SRB,FB4,BR	42,000	48	2,016,000	0.0120	0.0120	0.0000
C	Z.Kuroda	SEAL B-FILTER	0A23819	KRV,VNF,GM	16000	48	768,000	0.0370	0.0369	0.0001
C	Z.Kuroda	SEAL POSITIONER	13G0656	KRV,GMK	7,500	84	630,000	0.0450	0.0449	0.0001
C	Z.Kuroda	ACOUSTIC PLATE	13G0718	KRV,GMK	100	48	4,800	0.7378	0.7360	0.0018
C	Z.Kuroda	LABEL (BLANK LABEL	08K0831	SRB,DPC,BR	2250	32	72,000	0.1750	0.1747	0.0003
C	Z.Kuroda	LABEL (BLANK LABEL	07N7160	FLB	6100	32	193,200	0.0680	0.0679	0.0001
C	Z.Kuroda	CASE DN (SECURE)	0A58120	VEGA-	200	18	3,600	0.4000	0.3992	0.0008
C	Z.Kuroda	CASE UP (160GB) (SE	0A70305	VEGA-SS	200	18	3,600	1.1000	1.0967	0.0033
C	Z.Kuroda	CASE UP (320GB) (SE	0A70306	VEGA-SS	200	18	3,600	1.1000	1.0967	0.0033
C	Z.Kuroda	CASE UP (SECURE)	0A70307	VEGA-SS	200	18	3,600	1.1000	1.0967	0.0033
A	Thai Kokoku	SEAL CONNECTOR	25L1398	SRB,FB4,BR	10000	24	240,000	0.0275	0.0274	0.0001
E	Totoku TH	Carriage	0A37243	JPK	500	18	9,000	3.5510	3.5453	0.0057
E	Totoku TH	Carriage	0A50831	DPC 2D	1000	18	18,000	1.2400	1.2343	0.0057
E	Totoku TH	Carriage	0A51443	SRB 2D	1000	18	18,000	1.1480	1.1423	0.0057
E	Totoku TH	Carriage	0A52203	BRB 2D	1000	18	18,000	1.1900	1.1843	0.0057
E	Totoku TH	Carriage	0A54375	FLB 2D	1000	18	18,000	0.9400	0.9343	0.0057
E	Totoku TH	Carriage	0A55456	PTB 2D	1000	18	18,000	1.0900	1.0843	0.0057
b	Kateyama	NUT	07N9079	MPB,MPC,S	80000	24	1,920,000	0.1000	0.0998	0.0002
D	Kateyama	SCREW	0A54705	BRK,FLB,FLC	100000	30	3,000,000	0.0050	0.0050	0.0000
D	Kateyama	SCREW	13G0732	KRV,GMK	50000	30	1,500,000	0.0049	0.0049	0.0000
D	Kateyama	SCREW	13G1584	SRB,SRB,DF	100000	30	3,000,000	0.0048	0.0049	0.0000
D	Kateyama	SCREW	79F4148	GMK	50000	30	1,500,000	0.0047	0.0047	0.0000
D	Kateyama	SCREW	82H4850	SRB,FB4,BR	100000	30	3,000,000	0.0046	0.0046	0.0000
								16.9700	16.9179	0.0521

APPENDIX B

THE COMPUTER COMPANY DAILY MILK-RUN CONTROL SHEET REPOORT



The Computer Company Daily Milk-Run Control Sheet Report

The Computer Company Daily Milk-Run Control Sheet

Site: PRB and Ind Est

Request (Day Month Year):

Shipment (Day Month Year):

Pull Request no. PRB0934622

Truck Plate no.

Revision

A	A-2	Part request (Pick up Q'ty)					A-3	Time shipment (Pick up Time&Sign)				A-4	Arrival to The Computer Company Industrial			
Supplier Name	Part number	Part Request				Actual pick up pallet	Time		Acknow. Signature		Remarks & Seal no.	Actual receive pallet	DO / Inv. (no. of bag)	Time		Receive Signature
		Commodity	Q'ty(Pcs)	Box	Pallet	Total Pallet	Arrival	Depart.	Supplier	Truck driver				Arrival	Depart.	Receiver	Truck driver
Nezmax																
		Total														
2 Kureda																
		Total														
TH Kokoku																
		Total														
Totoku																
		Total														
Katayama																
		Total														

B	B-1	Tray and Pallet Return Shipment (pick up q'ty)						B-2	Time shipment (Pick up Time&Sign)					B-3				
Pick up Place	Destination	Commodity	Return plan Required		Actual pick up			Time		Acknow. Signature		Remark & Seal no.		Actual receive pallet	DO / Inv. (no. of bag)	Time		Receive Signature
			Pallet	Recycle tray	Pallet	Recycle tray	Maintenance by supplier (pcs of tray)	Arrival	Depart	Supplier	Truck driver					Arrival	Depart	Receiver	Truck driver
PRB	Nezmax	Empty pallet																	
	2 Kureda	Empty pallet																	
	2 Kureda	Recycle Tray																	
	TH Kokoku	Empty pallet																	
	Totoku	Empty pallet																	
	Katayama	Empty pallet																	
Vitalo	Totoku	Recycle Tray																	

Truck Time Control	PRB Truck Arrival time	UTC Truck Arrival time
1.Nezmax	8:00	1:00
2.2 Kureda	9:15	2:15
3.TH Kokoku	10:15	3:15
4.Totoku	11:15	4:15
5.Katayama	13:15	6:15
Unloaded parts at destination	20:00	13:00
Vitalo	21:00	

APPENDIX C

DATA COLLECTION OF TRUCK SPACE UTILIZATION

February

Summary Round-Trip

	Feb 02	Feb 03	Feb 04	Feb 05	Feb 06	Feb 10	Feb 11	Feb 12	Feb 13	Feb 14	Feb 16	Feb 17	Feb 18	Feb 19	Feb 20	Feb 23	Feb 24	Feb 25	Feb 26	Feb 27	Feb 28
By Truck	1	0	1	1	1	1			1	1		1	1	1	1	1		1	1	2	
By Pickup							1	1	1		1						1				1
%Truck Space Utilization-PRB																					
A	8%		8%	0%	8%	8%	0%	0%	0%	0%	0%	17%	0%	8%	0%	0%	0%	0%	8%	0%	0%
B	8%		25%	8%	17%	17%	50%	0%	14%	17%	0%	0%	17%	17%	8%	0%	0%	17%	0%	8%	100%
C	75%		42%	33%	58%	42%	50%	50%	57%	50%	0%	42%	42%	33%	58%	25%	50%	33%	25%	71%	0%
D	8%		0%	0%	0%	8%	0%	0%	7%	0%	0%	17%	8%	8%	8%	0%	0%	0%	0%	4%	0%
E	0%		17%	25%	17%	17%	0%	50%	14%	0%	100%	17%	0%	25%	0%	17%	50%	8%	17%	17%	0%
Total	**100%**		**92%**	**67%**	**100%**	**92%**	**100%**	**100%**	**93%**	**67%**	**100%**	**92%**	**67%**	**92%**	**75%**	**42%**	**100%**	**58%**	**50%**	**100%**	**100%**

March

Summary Round-Trip

	Mar 2	Mar 3	Mar 4	Mar 5	Mar 6	Mar 7	Mar 9	Mar 10	Mar 11	Mar 12	Mar 13	Mar 14	Mar 15	Mar 16	Mar 17	Mar 18	Mar 19	Mar 20	Mar 21	Mar 23	Mar 24	Mar 25	Mar 26	Mar 27
By Truck	1	1	1	1	2		1	1	1	1	2			1	1	1	1	2		1	1	1	1	1
By Pickup						1	1	1		1	1	1	1		1				1				1	1

%Truck Space Utilization-PRB

A	8%	8%	0%	0%	4%	0%	7%	7%	8%	0%	4%	0%	0%	8%	0%	8%	0%	0%	50%	8%	0%	8%	7%	7%
B	0%	17%	8%	8%	8%	50%	14%	7%	17%	0%	12%	50%	0%	17%	21%	8%	0%	13%	0%	8%	17%	17%	7%	0%
C	25%	25%	17%	25%	67%	0%	36%	64%	42%	43%	58%	0%	0%	50%	43%	33%	42%	58%	0%	58%	33%	25%	50%	57%
D	8%	8%	0%	8%	4%	50%	0%	14%	8%	7%	4%	0%	0%	8%	7%	0%	8%	4%	0%	8%	0%	8%	7%	14%
E	8%	8%	8%	17%	17%	0%	14%	7%	17%	21%	12%	50%	50%	8%	14%	25%	17%	13%	50%	8%	8%	17%	14%	14%
Total	**50%**	**67%**	**33%**	**58%**	**100%**	**100%**	**71%**	**100%**	**92%**	**71%**	**88%**	**100%**	**50%**	**92%**	**86%**	**75%**	**67%**	**88%**	**100%**	**92%**	**58%**	**75%**	**86%**	**93%**

April

Summary Round-Trip

	Mar 28	Mar 30	Mar 31	Apr 1	Apr 2	Apr 3	Apr 4	Apr 6	Apr 7	Apr 8	Apr 9	Apr 10	Apr 11	Apr 12	Apr 13	Apr 14	Apr 16	Apr 17	Apr 18	Apr 19	Apr 20	Apr 21	Apr 22	Apr 23	Apr 24
By Truck		1	1	1	1	2	1	1	1	1	1	2	1	1		2		2	1		1	1	1	1	3
By Pickup	1	1						1				2			1		1			1		1		1	

%Truck Space Utilization-PRB

A	0%	7%	8%	8%	8%	4%	8%	7%	8%	8%	8%	4%	8%	8%	0%	0%	50%	4%	8%	50%	8%	0%	0%	7%	0%
B	0%	7%	33%	0%	25%	4%	25%	14%	0%	0%	17%	7%	17%	0%	0%	17%	0%	21%	0%	0%	0%	7%	0%	29%	8%
C	0%	29%	33%	33%	42%	42%	42%	14%	25%	50%	33%	64%	0%	42%	50%	42%	0%	38%	58%	0%	25%	64%	25%	36%	69%
D	0%	7%	8%	8%	8%	4%	8%	7%	8%	8%	17%	11%	0%	8%	0%	13%	50%	4%	8%	0%	8%	7%	8%	7%	6%
E	100%	14%	8%	17%	17%	4%	8%	7%	8%	17%	8%	11%	0%	25%	0%	13%	0%	8%	8%	0%	17%	14%	17%	14%	6%
Total	**100%**	**64%**	**92%**	**67%**	**100%**	**58%**	**92%**	**50%**	**50%**	**83%**	**83%**	**96%**	**25%**	**83%**	**50%**	**83%**	**100%**	**75%**	**83%**	**50%**	**58%**	**93%**	**50%**	**93%**	**89%**

May

Summary Round-Trip

	Apr 25	Apr 27	Apr 28	Apr 29	Apr 30	May 2	May 4	May 6	May 7	May 8	May 9	May 11	May 12	May 13	May 14	May 15	May 16	May 18	May 19	May 20	May 21	May 22	May 23	May 25	May 26	May 27	May 28	May 29
By Truck	1	1	1	1	2		2	1	3		1	1	1	1	1	1	1	1	1	1	1	2	2	1	1	1	1	2
By Pickup			1			1				1																	1	

%Truck Space Utilization-PRB

A	8%	0%	0%	0%	4%	0%	4%	0%	3%	0%	8%	8%	0%	0%	8%	8%	0%	8%	0%	0%	8%	4%	4%	0%	8%	8%	7%	8%
B	25%	0%	7%	8%	17%	100%	8%	0%	11%	0%	42%	25%	0%	17%	25%	17%	17%	25%	0%	17%	25%	13%	8%	8%	17%	8%	14%	13%
C	0%	17%	21%	8%	58%	0%	42%	33%	44%	0%	0%	42%	25%	8%	33%	42%	58%	17%	33%	33%	50%	54%	38%	25%	33%	33%	57%	33%
D	0%	8%	7%	8%	8%	0%	8%	0%	6%	0%	0%	8%	8%	8%	8%	17%	0%	8%	8%	8%	8%	4%	4%	0%	8%	8%	7%	4%
E	8%	0%	0%	8%	13%	0%	4%	17%	11%	50%	0%	17%	8%	0%	8%	0%	0%	0%	0%	0%	17%	21%	4%	0%	25%	17%	21%	29%
Total	42%	25%	36%	33%	100%	100%	67%	50%	75%	50%	50%	100%	42%	33%	83%	83%	75%	58%	42%	58%	108%	96%	58%	33%	92%	75%	107%	88%

Jun

Summary Round-Trip

	May 30	Jun 1	Jun 2	Jun 3	Jun 4	Jun 5	Jun 6	Jun 8	Jun 9	Jun 10	Jun 11	Jun 12	Jun 13	Jun 16	Jun 17	Jun 18	Jun 19	Jun 20	Jun 22	Jun 23	Jun 24	Jun 25	Jun 26
By Truck	1	1	1	1	2	1	1		1	1	2	2	1	1	1	2	2	1	1	1	1	1	1
By Pickup						1	1	1										1				2	1

%Truck Space Utilization-PRB

A	8%	8%	8%	8%	4%	7%	7%	50%	0%	8%	4%	4%	8%	8%	0%	8%	4%	7%	8%	8%	8%	6%	7%
B	0%	0%	25%	17%	8%	7%	14%	0%	8%	8%	13%	17%	0%	0%	33%	17%	17%	0%	25%	17%	17%	19%	0%
C	33%	50%	33%	33%	46%	36%	64%	50%	42%	58%	54%	29%	50%	50%	42%	46%	33%	79%	50%	42%	58%	44%	57%
D	17%	8%	17%	17%	4%	7%	7%	0%	0%	8%	4%	4%	8%	8%	17%	8%	4%	0%	8%	8%	8%	6%	7%
E	0%	8%	0%	25%	17%	43%	0%	0%	0%	17%	8%	4%	25%	0%	8%	8%	8%	7%	0%	8%	8%	19%	14%
Total	58%	75%	83%	100%	79%	100%	93%	100%	50%	100%	83%	58%	92%	67%	100%	88%	67%	93%	92%	83%	100%	94%	86%

July

Summary Round-Trip

	Jun 27	Jun 29	Jun 30	Jul 1	Jul 2	Jul 3	Jul 4	Jul 6	Jul 7	Jul 8	Jul 9	Jul 10	Jul 11	Jul 13	Jul 14	Jul 31
By Truck	2	1	1	2	1	1	2	1	1	1	1	2	2	1	1	1
By Pickup					1	1	1				1	1				

%Truck Space Utilization-PRB

B	8%	8%	8%	13%	21%	7%	12%	17%	17%	17%	21%	8%	13%	8%	17%	25%
C	33%	8%	50%	21%	50%	43%	42%	67%	0%	0%	29%	42%	33%	8%	50%	58%
A	4%	8%	8%	4%	7%	7%	4%	8%	0%	8%	7%	4%	4%	8%	0%	8%
E	21%	8%	8%	8%	29%	29%	0%	8%	8%	8%	14%	15%	17%	0%	8%	8%
D	13%	8%	8%	4%	14%	0%	0%	8%	0%	0%	7%	4%	8%	8%	17%	0%
Total	**79%**	**42%**	**83%**	**50%**	**121%**	**86%**	**58%**	**108%**	**25%**	**33%**	**79%**	**73%**	**75%**	**33%**	**92%**	**100%**

July

	Jul 15	Jul 16	Jul 17	Jul 18	Jul 20	Jul 21	Jul 22	Jul 23	Jul 24	Jul 25	Jul 27	Jul 28	Jul 29	Jul 30	Jul 31
By Truck	1	2	2	2	1	2	1	2	2	1	1	1	1	1	1
By Pickup							1					1		1	

B	25%	8%	13%	21%	17%	17%	7%	0%	25%	0%	0%	29%	8%	21%	25%
C	42%	50%	42%	38%	50%	29%	36%	25%	29%	67%	17%	36%	50%	57%	58%
A	8%	4%	0%	4%	8%	4%	7%	4%	4%	0%	8%	14%	8%	7%	8%
E	17%	13%	8%	13%	8%	4%	21%	25%	21%	25%	0%	14%	8%	7%	8%
D	8%	4%	4%	8%	8%	8%	7%	8%	4%	8%	8%	7%	8%	14%	0%
Total	**100%**	**79%**	**67%**	**83%**	**92%**	**63%**	**79%**	**63%**	**83%**	**100%**	**33%**	**100%**	**83%**	**107%**	**100%**

August

Summary Round-Trip

	Aug 1	Aug 3	Aug 4	Aug 5	Aug 6	Aug 7	Aug 8	Aug 10	Aug 11	Aug 13	Aug 14	Aug 15	Aug 16	Aug 17	Aug 18	Aug 19	Aug 20	Aug 21	Aug 22	Aug 24	Aug 25	Aug 26	Aug 27	Aug 28	Aug 29
By Truck	2	1	2	1	2	2	2	2	2	2	1	2	1	2	1	2	1	2	2	2	2	1	2	2	1
By Pickup		2											1												

%Truck Space Utilization-PRB

A	8%	6%	8%	8%	4%	4%	8%	8%	8%	4%	8%	8%	7%	8%	8%	8%	8%	4%	4%	8%	8%	8%	4%	4%	8%
B	21 %	19%	13%	17%	17%	8%	13%	13%	8%	17%	8%	17%	14%	21%	25%	13%	17%	17%	8%	13%	13%	17%	17%	8%	17%
C	46 %	50%	29%	17%	21%	42%	29%	33%	29%	33%	33%	46%	57%	46%	67%	29%	17%	21%	42%	29%	29%	17%	21%	42%	83%
D	0%	13%	8%	8%	4%	4%	8%	4%	8%	8%	8%	4%	7%	0%	17%	8%	8%	4%	4%	8%	8%	8%	4%	4%	8%
E	8%	13%	8%	25%	13%	13%	17%	13%	21%	8%	8%	8%	7%	8%	17%	8%	25%	13%	13%	17%	8%	25%	13%	13%	25%
Total	**83 %**	**100%**	**67%**	**75%**	**58%**	**71%**	**75%**	**71%**	**75%**	**71%**	**67%**	**83%**	**93%**	**83%**	**133%**	**67%**	**75%**	**58%**	**71%**	**75%**	**67%**	**75%**	**58%**	**71%**	**142%**