



INVENTORY REDUCTION AND COST SAVING THROUGH  
LOGISTICS POSTPONEMENT

By  
MALLIKA MANAKITJONGKOL

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  
Assumption University  
Bangkok, Thailand

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Master of Science in Supply Chain Management  
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Examination Committee:

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Bangkok, Thailand

November 2012

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I, MALLIKA MANAKITJONGKOL \_\_\_\_\_

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.

INVENTORY REDUCTION AND COST SAVING THROUGH LOGISTICS  
POSTPONEMENT \_\_\_\_\_

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I confirm that this thesis/project has been carried out under my supervision and it represents the original work of the candidate.

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(A. Thanapat Panthanapratez)

Date 1<sup>st</sup> NOV 2012

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Mallika Manakitjongkol

Assumption University

November 2012

## ABSTRACT

The purposes of this study are to enhance knowledge and understanding of available supply chain strategies and discover the most appropriate strategy that can minimize inventory days and cost in a fast moving consumer goods company. The fierce competition in the industry generates the need for effective and efficient management in all supply chain aspects, including inventory target and cost. In 2011, an analysis revealed that inventory days at the Japan market distribution center were off target. The study proved that push replenishment based on full speculation strategy is the root cause of the inventory problem. Logistics postponement was selected as a solution for the ABC Company supply chain. It proposes inventory storage relocation and replenishment based on logistics postponement. By restructuring the ABC supply chain, the central warehouse in Thailand is utilized as the inventory storage location, and replenishment is based on aligned inventory days. The inventory days for the Japan market reduced to 940 days with cost savings of 2.4 million USD. Furthermore, the logistics costs for the new supply chain structure have no negative impact on the total supply chain cost.

As a result, the researcher proposed that the ABC Company planning department should adopt logistics postponement to improve its replenishment and inventory storage execution, to improve inventory days at the Japan distribution center, and to achieve cost saving for the ABC Company supply chain.

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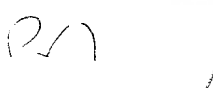
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# CHAPTER I

## GENERALITIES OF THE STUDY

The ultimate goal of business is to make money. Inventory is one of the most important elements for every supply chain. The right level of inventory greatly contributes to business performance. It identifies the effectiveness and efficiency of the supply chain management as well as the competitive advantage and capability of the company as a whole. Having the optimal level of inventory also indicates the health of the business, financially and economically, which impacts on the stakeholders' perspective of how they should invest money in a specific business. Therefore, most supply chains face the need to continuously improve their inventory situation to preserve their profit, market share, and customer satisfaction.

Supply chain activities such as forecast or demand uploading, customer ordering and replenishment pattern, are critical criteria that determine inventory level for the company. The right concept of replenishment and inventory storage can help minimize inventory level and cost throughout the supply chain. The successful business needs an appropriate supply chain strategy to optimize its inventory situation. Logistics postponement is a strategy that helps reduce the risk of service loss and customer dissatisfaction by providing a flexible implementation plan for the company (Bartels, 2010). The right supply chain strategy also helps the company to achieve competitive advantages by defining the optimal inventory level which prevents sunk cost and inventory obsolescence. More importantly, it helps minimize the cost of the whole supply chain by recommending the optimal location for inventory storage.

This study explores the root cause of the inventory problem for a fast moving consumer goods (FMCG) business, and provides a solution for inventory and cost reduction. A proposed model based on the literature review is created for sustainable supply chain management.

## 1.1 Background of the Research

The researcher uses "ABC Company" as the name of the company for this study as the real name of the company has to be kept confidential. ABC Company is one of the world's leading FMCG manufacturers. It was founded in the United State of America in 1837. ABC currently operates in 80 countries with approximately 35 manufacturing plants to touch the lives of consumers in over 180 countries around the world. ABC headquarter is located in the United State of America and has expanded its trading companies to Asia, North America, Europe, the Middle East, Africa and Latin America. For Asia, the regional headquarters are in Singapore. ABC established a numbers of manufacturing plants in many Asian countries, such as Japan, China, India, Vietnam, and Thailand, to serve the growing number of consumers. The Thailand manufacturing plant is located at an industrial estate area in Chachoengsao province. It produces four product categories: hair care, skin care, feminine care, and color & professional care. ABC Company Thailand has more than 700 employees with total net of sales 1,695 million USD in 2011. It manufactures more than 1,000 different stock keeping units (SKUs) mainly to support the requirement from Asia and Australia regions.

ABC Thailand manufactures four product categories; hair care, skin care, feminine care, and color & professional care. Hair care is the biggest in terms of production volume and sales value to ABC Company. It produces hundreds of shampoo, conditioner and treatment products under six different brands; A, B, C, D, E and F. The products are sold to of nine country market sectors: 1.Korea, 2.Japan, 3.Australia and New Zealand, 4.India, 5.Vietnam, 6.Philippines, 7.Malaysia and Singapore, 8.Indonesia and 9.Thailand. Hair care category generated 1,321 million USD to ABC Company in 2011, which was the highest net sales figure among all categories. Skin care was the runner up with 255 million USD. Its products are mainly moisturizer, cream and lotion SKUs, to be sold to the same country sectors as hair care except for the big customers of Japan and Korea. This is one reason for smaller net sales compared to hair care. Next is feminine care, originally called paper category, which manufactures sanitary napkins and baby diapers using paper as the main ingredient. It

only created 17 million USD in 2011 due to small production volume and high overhead cost. Moreover, as the expense for producing both sanitary napkins and baby diapers at ABC Thailand is not competitive enough when weighed against other plants in the same region, the production lines are scheduled to close down in 2012. Lastly, the color & professional care category, which was recently established in 2010 to support the hair coloring and treatment requirement for both end consumers and salon professionals. Hair coloring products delivered 102 million USD to ABC Company in 2011 and are expected to generate more in the future as these products are sold to all market sectors, as are hair care products. However, this new product category is not yet standardized in term of process and system measurement. For the situation of feminine care, ABC Thailand ensures that it adopts all possibilities to maintain production volume, and launches new product innovation to reduce its overhead cost and set the benchmark for the Asia region.

#### **1.1.1 Innovation, quality and productivity**

Internal benchmarking in ABC regional manufacturing plants requires ABC Thailand to always stay competitive and to continuously improve. It is important for ABC manufacturing plants to deliver cost efficient, high productivity and quality in production, and deliver products to customers to meet the stretch target aligned with the regional headquarters. Furthermore, innovation excellence or the ability to produce new initiative products with flawless quality is another criterion to attract production volume to each manufacturing plant. Therefore, ABC Thailand focuses on maximizing its productivity by constantly improving production process and logistics activity as well as upholding the ability to launch new initiative products to markets flawlessly and on time. Lean strategy and total productive maintenance (called integrated work system) are being used at ABC Company to minimize total supply chain lead time and inventory together with resource utilization. The combination of product innovation, manufacturing cost efficiency and equipment utilization promote competitive advantages for ABC Thailand.

### **1.1.2 Cost saving projects as a competitive advantage**

The fierce war among firms in the FMCG industry and the internal competition for volume allocation between ABC manufacturing plants, drive the need for cost saving and supply chain activities utilization, including production, shipment and inventory storage. ABC management team has established many cost saving and loss elimination projects. Besides cost minimizing, ABC Company greatly emphasizes inventory performance. Inventory is considered to be money or cash, and having excess inventory is a loss of money which could be invested in other productive activities and is critical to stakeholder decisions. Holding inventory over the aligned target is a sunk cost which is not desirable for this leading FMCG firm. There are a number of inventory measurement tools being used to assess whether ABC supply chain holds the right level of inventory. More importantly, there are teams dedicated and tools designed to achieve the optimal inventory level. Some examples of ABC cost saving and loss elimination projects are distribution centers consolidation, SKUs simplification, direct shipment from manufacturing plant to market, replacing wooden pallets with plastic slip sheets, inventory task force, and air freight shipment minimization. Furthermore, to stay at the top of the FMCG industry, ABC Company needs to offer various kinds of trade promotions and discounts to its customers. This is to stimulate sales and enhance competitive advantage. All well-known FMCG companies are required to support modern trade campaigns, such as seasonal bundled pack, buy-one-get-one-free, and special discount. Therefore, all manufacturers including ABC Company continue to strive for the lowest manufacturing to support all trade sales activities and still be able to gain profit.

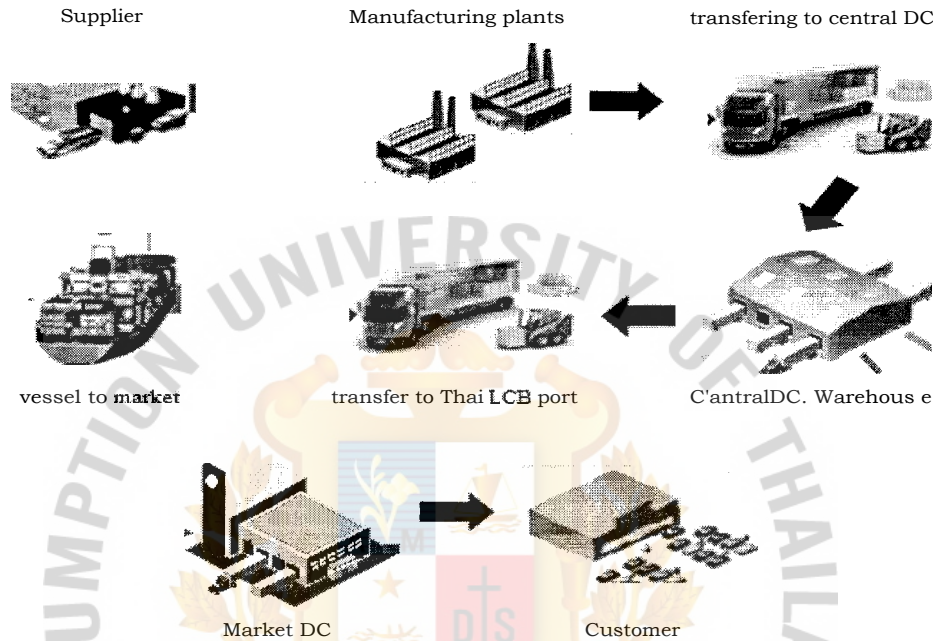
### **1.1.3 Supply chain planning process**

There are two manufacturing locations for the four product categories at ABC Thailand. Hair care, skin care and feminine care SKUs are being produced in the main manufacturing plant, while color & professional care products are manufactured in their own location. Figure 1.1 demonstrates ABC supply chain mapping. Each facility has its own warehouse space to receive raw material from suppliers, and store it to



serve production. There are mixing and filling machines, and production lines are located separately for each product category.

Figure 1.1: Supply chain mapping



Source: ABC Planning Manager

After production, the finished goods are transferred to ABC's central warehouse or Thailand distribution center by truck. The central warehouse, located in the same industrial estate, is the storage facility for common SKUs produced and sold to more than one market country. The excess stock after allocation to meet each market requirement is kept in this location. It is also used to hold stock under quality inspection for unique SKUs, which are products produced for specific market countries like Japan and Korea which require Japanese and Korean language on product label artwork. Once the quality assurance result is passed, the stock is loaded into a container and sent to Lamchabang port. There, the container is loaded to the vessel and shipped to ABC's market distribution center to serve different customers in each country distribution center.

## 1.2 Statement of the Problem

Having the right level of inventory is critical to the success of every supply chain. At the end of December 2011, ABC Company found that 49 out of 115 hair care SKUs selling to Japan had inventory days over the aligned target at 5,597 days which was worth 7.39 million USD. Table 1.1 demonstrates ABC inventory performance at the end of December 2011. Total 115 SKUs ended up with 5,982 inventory days with a value of 12.64 million USD. However, around 5,600 days, or 94 percent of total inventory, were driven by those 49 SKUs inventory days over target which generated 7.39 million USD. Replenishment practice was found to be the root cause of this problem. ABC planners used push replenishment based on full speculation strategy to prevent supply interruption, and ended up with excess inventory, obsolescent stock and sunk cost at the Japan market distribution center.

**Table 1.1: Inventory days and value for total 115 SKUs and 49 SKUs over target**

Brand	Total 115 SKUs (SKU) <sup>a</sup>	Target inventory day (day) <sup>b</sup>	Actual inventory day (day)	Inventory value (USD) <sup>d</sup>	49 out of 115 SKUs over target (SKU) <sup>e</sup>	Target inventory day (day) <sup>f</sup>	Actual inventory day (day) <sup>g</sup>	Inventory value (USD) <sup>h</sup>
A	17	306	2,141	2,068,315	7	126	2,073	1,398,263
B	15	265	490	1,782,798	10	178	443	1,440,479
C	13	390	1,162	1,212,250	10	300	1,088	1,061,461
D	12	192	300	1,793,924	6	96	247	1,099,279
E	40	708	1,167	5,232,367	10	168	976	2,211,937
F	18	288	722	547,073	6	72	770	177,529
<b>Sum</b>	<b>115</b>	<b>2,149</b>	<b>5,982</b>	<b>\$12,636,727</b>	<b>49</b>	<b>940</b>	<b>5,597</b>	<b>\$7,388,948</b>

Source: ABC Planning Manager

<sup>a</sup> = Total 115 SKUs selling to Japan separated by brand A - F during January to December 2011

<sup>b</sup> = Target inventory day for 115 SKUs

= Actual inventory day for 115 SKUs

<sup>d</sup> = Inventory value for 115 SKUs

= 49 out of 115 SKUs with inventory days over target

<sup>f</sup> = Target inventory day for 49 SKUs having inventory days over target

<sup>g</sup> = Actual inventory day for 49 SKUs having inventory days over target

<sup>h</sup> = Inventory value for 49 SKUs having inventory days over target

Therefore the research question is: "How can ABC Company achieve inventory cost saving by using logistics postponement strategy?"

### **1.3 Research Objectives**

This study aims to improve inventory level and cost saving for hair care products selling to Japan markets. There are four main objectives for this research:

- 1.3.1 To understand ABC Company actual inventory days and sales value at the end of 2011 for ABC product categories.
- 1.3.2 To study and compare target and actual inventory days for hair care SKUs selling to the Japan market during January to December 2011.
- 1.3.3 To provide a proposed model solution for the 49 SKUs which had inventory days over target, by using logistics postponement strategy.
- 1.3.4 To evaluate the benefit of implementing logistics postponement which helps reduce total inventory cost for ABC supply chain.

### **1.4 Scope of the Research**

ABC Company consists of four product categories: hair care, skin care, feminine care and color & professional care. Hair care category of ABC Company is studied in this research for being the biggest category with highest sales and inventory value. The researcher focused on the Japan market, the country with the most off-track inventory performance, but with its sales value being Number 1 among all hair care selling countries. Logistics postponement is selected for this study to improve supply chain strategy and inventory performance of ABC Company based on data collected during January to December 2011.

### **1.5 Significance of the Research**

ABC Company needs to stay competitive to be the leading manufacturer in the fast moving consumer goods industry. Therefore it is important for the company to keep the right amount of inventory and minimize total supply chain cost. Logistics postponement is studied to provide the solution to ABC Company. An appropriate

supply chain strategy can be achieved through implementing logistics postponement, with the inventory storage being moved from the end distribution center to the company central warehouse. This allows inventory reduction at the overseas distribution center and cost saving throughout the ABC supply chain. Furthermore, the proposed model provides a sustainable solution to strengthen ABC Company's competitive advantage and benefit the company in the long run. More importantly, this study provides an applicable methodology that can be adapted to other markets and other product categories in the ABC supply chain.

### **1.6 Limitations of the Research**

This research focuses on hair care category performance during January to December 2011. The information and list of SKUs will be changed or replaced over time due to the nature of FMCG business. The detailed information on cost structure setup is kept confidential for competitive advantage reasons. However, ABC Finance department has provided the company cost element and standard product cost at both storage locations; Thailand central distribution center and Japan distribution center, which are used for benefit comparison after adopting the proposed model. The logistics postponement model is chosen for this study, and the benefit from applying the proposed model is calculated through using Microsoft Excel spreadsheet.

### **1.7 Definition of Terms**

Fast moving consumer goods	Fast moving consumer goods or FMCG are products that have a quick turnover, and relatively low cost. Consumers generally put less thought into the purchase of FMCG than they do for other products.
Full truck load	Full truck load or FTL is the technical term for the section in logistics which concerns itself with the



transport of complete charge portions.

#### Postponement

An organizational concept whereby some of the activities in the supply chain are not performed until customer orders are received. Companies can then finalize the output in accordance with customer preferences and even customize their products (Van Hoek, 2001).

#### Stock keeping unit

Stock keeping unit (SKU) is an identification, usually alphanumeric, of a particular product that allows it to be tracked for inventory purposes.



## CHAPTER II

### REVIEW OF RELATED LITERATURE

This chapter contains a related literature review for this research. The study aims to understand the concept of supply chain management and strategies. First of all, the researcher focused on inventory performance measurement and its calculation, by studying the concept of inventory days. Then, the research continued by studying three different supply chain strategies: push, pull, and hybrid. Furthermore, the study continued with logistics postponement concepts which help minimize inventory level and cost. The detailed study and information sufficient to develop the proposed model is now presented.

#### 2.1 Inventory day, or days supply of inventory

Johnson (1999) provided the calculation method for inventory day. The inventory day supply is measured to understand the amount of the existing inventory and the right level for keeping it. The literature states the benefit of using "inventory day supply" as it can be applied for production measurement proposes. The manufacturing operation needs to understand the actual requirement to be able to plan and control. Therefore, knowledge on inventory day is needed to provide a visible optimal production quantity. Inventory day supply is considered as a time supply for inventory measurement. Having the right inventory day supply helps to minimize the risk of holding too much stock and inventory obsolescence. Figure 2.1 reveals the inventory day calculation formula.

**Figure 2.1: Inventory days supply calculation formula**

$$\text{Inventory Days Supply} = \frac{\text{Inventory currently on hand (in unit)}}{\text{Known requirement} + \text{Forecasting demand (in unit)} / \text{Day}}$$

Source: Johnson (1999)

Figure 2.1 explains inventory days supply as the number of days that the current stock will last without any additional receipt quantity from any source, when taking into account all demand elements, known requirements and forecasting demand divided by day unit. The more flexible the supply chain, the smaller the inventory day needed. Next the research moves on to a study of supply chain strategies.

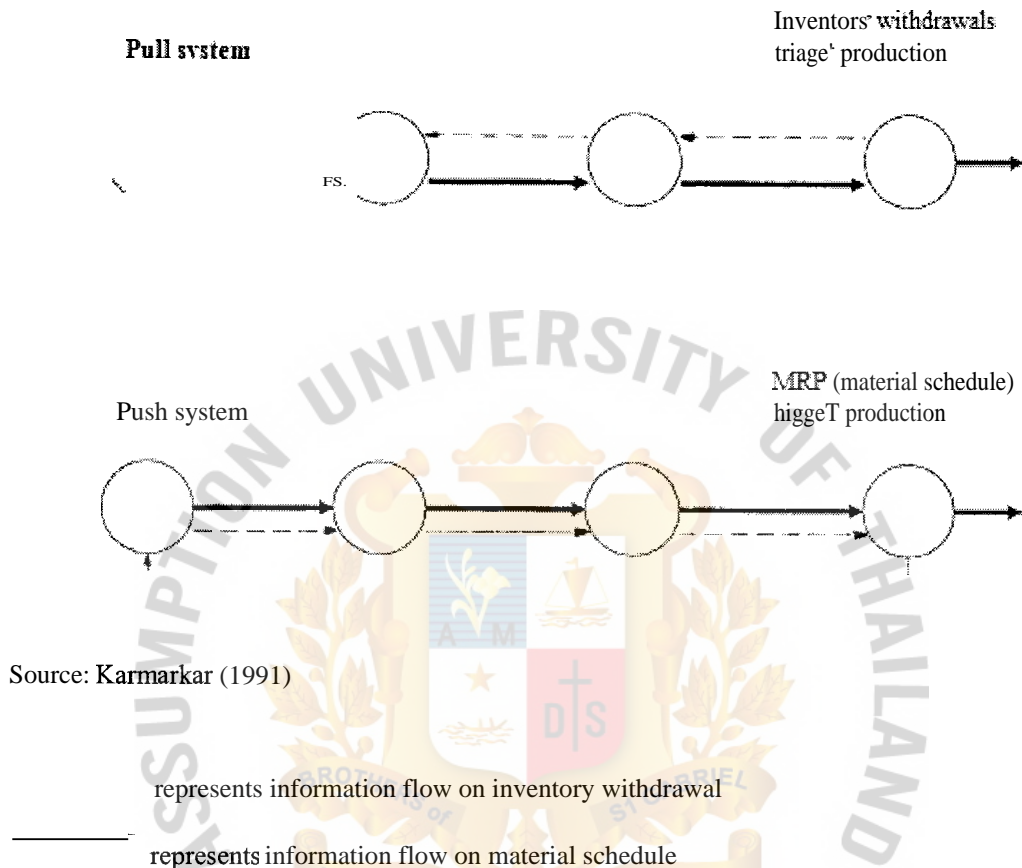
## 2.2 Push versus pull

706. -1

Chopra and Lariviere (2005) explained that push strategy, or pushing product driven by forecast, was not considered appropriate practice for inventory control. Pull concept has become the right strategy for many industries as supply chain activities are driven by actual demand. However, actual customer orders which normally require long lead times are necessary to start demand-driven activities. Thus the optimal practice adopted by many companies has shifted toward "push-pull strategy". Together with Chopra and Lariviere (2005), Karmarkar (1991) also stated that the evolution of push and pull systems in manufacturing were being used differently in various countries. In 1970's, the United State of America moved forward with push manufacturing systems. However, with the Kanban system from Toyota Company, Japan was recognized as having a successful pull system. Therefore the combination of push and pull systems is studied to identify supply chain strategy.

The characteristics of push and pull systems can be defined by the point at which activities are started, with or without an actual demand requirement. For a pull system, the production will be triggered by the decrease of stock or stock withdrawal due to customer ordering. An inventory level below a safety stock target will generate the need for replenishment and then stimulate need from production and material ordering. Meanwhile, the production for a push system happens prior to the acknowledgement of actual demand or availability of material. The features which distinguish push and pull systems can be identified by the information flows in Figure 2.2 below.

**Figure 2.2: Information flows in push and pull systems**



The information flow in a pull system in the first picture will typically move against the material scheduling and production direction explained by the bold arrows. The dotted arrows represent the flow of inventory withdrawal or actual customer orders which is the factor that triggers material ordering and production. The direction of the flows in the pull system is normally from the end of the chain to the beginning, or from the actual customer order to the production. On the other hand, for the push system in the second figure, the material flow will happen independently of the information flow. The material scheduling and production flow in bold arrows happens regardless of the information of actual customer orders in dotted arrows. In other word, the production is triggered by the material schedule with no consideration on information of inventory withdrawal. Next, Karmarkar (1991) continues the discussion of the evolution of push, pull and hybrid push-pull systems.

## **Push system**

Prior to push systems, pull systems were chosen to control production stages. The theme changed when a material requirement planning (MRP) system was executed, and the pull concept was found to fail for two main reasons. Firstly, there was lack of capability to establish information setup in the MRP system due to the insufficient level of reliability. Another reason was the logical problem regarding the MRP calculation. The computation logic for MRP system required production and other activities' lead times in order to match actual orders from customers. It was set based on the assumption of unconstrained capacity, while the actual order might exceed available capacity. The gap from unmatched capacity created queues in production lead times. Therefore the exact lead time could not be confirmed until an actual customer order was known. After all was done, it was needed to close the loop and revise the schedule regarding actual customer order condition. However, it needed high complexity and cost to acquire the setup for MRP logic, which led to exploring methods to overcome the closed loop performance by finding the open loop techniques (which will not be discussed in this study). Regarding the rationale mentioned, the push system was launched to correct the problem of MRP logic. The push system was considered as the direction for increasing computerization and centralization of information processing. The difficulty in achieving material planning scheduling and the lack of capability to systemize the order release process in a pull system enhanced the degree of centralization and the decline of scheduling actual customer orders.

## **Pull system**

Pull systems introduced make-to-order, order point (OP), order quantity (OQ) and base stock methods. They differ according to supply chain design, production and demand dynamics. OP and OQ needed known batch size, cost setup and fixed production lead time, which were not compatible with the MRP system as it failed to connect the production capacity and customer order release. Nevertheless, the make-



to-order approach was capable of demand information. The order quantity was calculated by average demand rate while the order point was computed from the variation of demand over the lead time period, so called safety stock. This method is different to the push strategy as it responds to demand not forecast. Another approach was the basic stock method which aimed to be used with inventory control. By keeping stock at a specific storage location, it was expected to minimize inventory holding cost and out of stock situations. Regarding the pull strategy concept, the customer order which withdrew stock was known. The replenishment was triggered by the need for stock fulfillment equaled to the quantity withdrawn from the actual order. Next is the base stock keeping which needs fixed and reliable production lead times that determine the right level of base stock. In this method, unlike OP, OQ, there was no fixed replenishment quantity or period but it acted according to the aligned base-stock level. The replenishment practice happened when the accumulated fulfillment matched the order lead time which depended on the supply side. The level of aligned base-stock could change anytime based on demand patterns which also created flexibility to produce minimum order quantity (MOQ) and replenishment quantity adjustment, which were beneficial to inventory control.

### **Hybrid push-pull systems**

This section explains the combination of push-pull strategies. Many systems required the combination of push and pull systems to smoothly operate supply chain activities. The replenishment release was normally driven by actual customer order withdrawal or a pull system. However the forecast number is still needed for production MOQ and material ordering scheduling. The inconsistency in production scheduling, demand uncertainty and the longer waiting time for actual customer ordering, make it difficult to conclude all supply chain activities in the pull strategy. By this, a push system will be needed for efficient production and material ordering. In contrast, the pure use of a push system will impact inventory levels and create unproductive cost. Therefore, the right concept is to keep the push strategy for some activities, for example MRP material ordering. Then use the pull system to hold up the production of finished goods as late as possible but ensure that the waiting time can still be offset

with the production and transportation lead time. The combination of push and pull strategies can be successful by separating the activities based on information and lead time. The processes need a long lead time and if it is difficult to access actual demand will be driven by the push strategy. The remaining activities that are predictable and can be achieved in a short reliable lead time will be assigned to the pull system. Common practice for using a mixed push-pull strategy is to reserve raw material, or work-in-process material, by pushing the purchasing activity which normally involves a longer lead time. Then pull the final production or assemble to final product when the customer order arrives. The combination of push-pull strategy helps create flexibility to the supply chain without the need to invest more cost in changing the whole MRP system. The right adjustment of this hybrid push-pull can be extended to fit specific supply chains which will promote efficient control of activities, cost saving, and inventory.

### **2.3 Postponement strategy**

Postponement is a concept introduced in the 1920s. Its foundation is that there are risks and costs attached to the customization or differentiation of finished products during the manufacturing and logistics processes. To reduce those risks, delay or postpone such operations to the latest point where actual customer requirements are confirmed (Pagh & Cooper, 1998). Pagh and Cooper (1998) proposed four generic supply chain strategies which are explained by the postponement/speculation matrix in Figure 2.3. The postponement/speculation matrix separates four supply chain strategies according to their manufacturing and logistics characteristics, based on decentralization versus centralization concepts, and make to stock versus make to order strategies. Each strategy has its own characteristics designed to match different type of manufacturing. The four postponement/speculation strategies are composed of the following: full speculation strategy, manufacturing postponement strategy, logistics postponement strategy, and full postponement strategy.

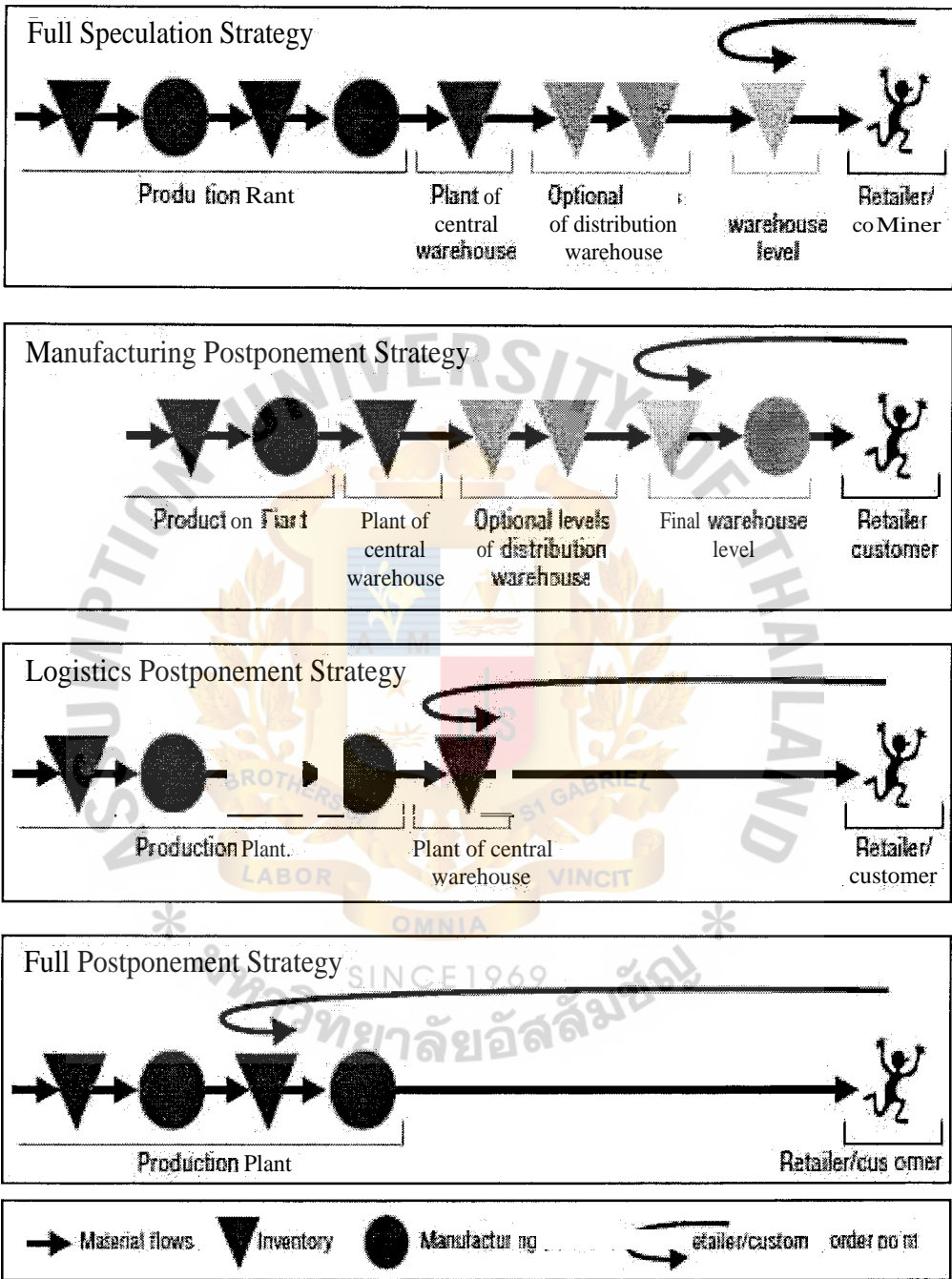
**Figure 2.3: The postponement/speculation matrix and general supply chain postponement/speculation-strategy**

		Logistics	
		Speculation. <i>Decentralized inventories</i>	Postponement <i>Centralized inventories and direct distribution</i>
Manufacturing	Speculation <i>Make to inventory</i>	<b>The full speculation strategy</b>	<b>The logistics postponement strategy</b>
	Postpone. menu <i>Make to order</i>	<b>The manufacturing postponement strategy</b>	<b>The full postponement strategy</b>

Source: Pagh and Cooper (1998)

Dong (2010) matches these four generic types of supply chain strategies with the four different customer ordering point positions shown in Figure 2.4. They are classified into: full speculation strategy, manufacturing postponement strategy, logistics postponement strategy and full postponement strategy. Figure 2.4 demonstrates that each supply chain strategy has four common components: material flow, inventory, manufacturing process, and customer ordering point. These four components are positioned differently based on different types of supply chain strategy. The details and characteristics of each strategy are provided separately.

**Figure 2.4: Different customer ordering points in term of different supply chain strategies**



Source: Dong (2010)

### 1. Full speculation strategy

This strategy is traditionally used by most companies where both manufacturing and logistics processes are driven by pure forecasts. The customer ordering point

is positioned at the end distribution center or the nearest warehouse to the customer. This method is suitable for standardized products with highly predictable requirements. Most of the mass products which use economy of scale production uses full speculation for the supply chain as the majority of inventory is being pushed and kept at the end distribution center to ensure availability. An outstanding advantage of this strategy is the benefit of high service rates and economies of scale. However, excess inventory and potential obsolescence are the downsides.

## **2. Manufacturing postponement strategy**

Manufacturing activity is positioned at the end distribution center or finished warehouse, to delay the customizing activities or differentiation, such as assembling, packaging or labeling to the very end point where the customer order has been confirmed. The successful implementation of this practice is minimum inventory value and simplification in upstream planning, but the firm will not gain economies of scale with the increased complexity downstream where the customer ordering happens.

## **3. Logistics postponement strategy**

This practice combines manufacturing speculation together with the delay of logistics. The ordering point or the point which actual customer requirement is known is placed at a central distribution center or between the manufacturing and logistics activities. In other words, the manufacturing is done based on forecast but the logistics will be driven by customer requirement. The advantages of using this strategy are inventory cost reduction, on-time delivery, constant transportation cost and manufacturing cost optimization through economies of scale. Nevertheless, the transportation cost per shipment might increase as the shipment size will be smaller and more frequent.

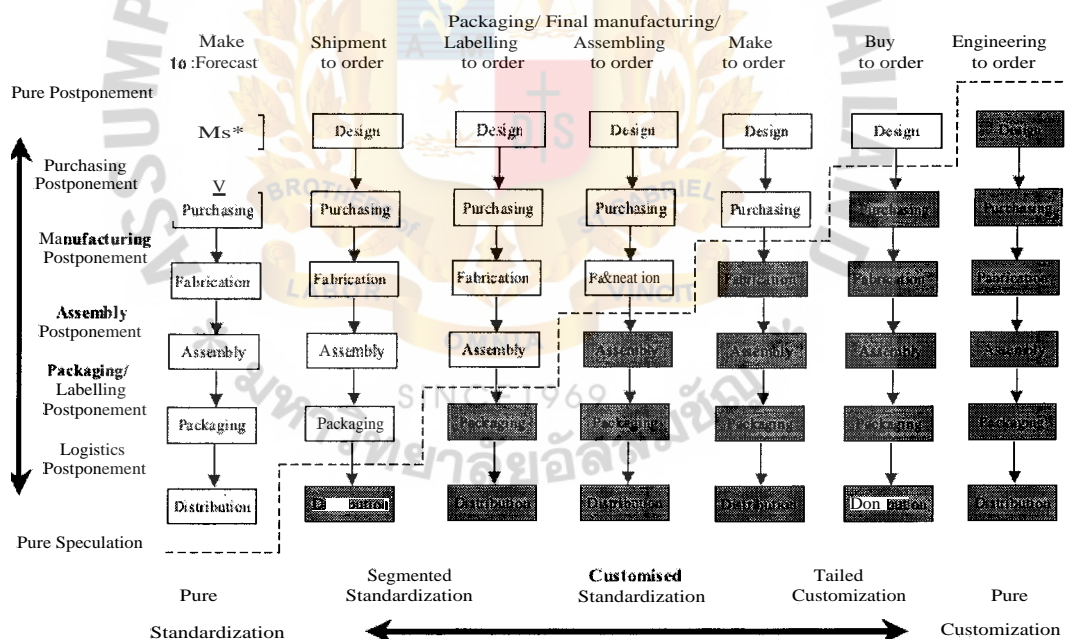


#### 4. Full postponement strategy

This is the extreme level of postponement. The point where customer ordering occurs is put at the manufacturing plant for full postponement strategy. This is totally customer order driven and right for uniquely customized products with unpredictable demand. The good points of adopting this strategy are lowest inventory cost and inventory level. But the economies of scale can be obtained only at the early stage of manufacturing.

Later, Pagh and Cooper (1998), and Yang and Burns (2003), defined postponement and speculation strategies in seven stages, as shown in Figure 2.5.

**Figure 2.5: Speculation-postponement strategy and a continuum of standardization-customization**



Source: Yang and Burns (2003)

The additional types of supply chain strategies mentioned by Yang and Burns (2003) in figure 2.5 are packing/labeling postponement, assembly postponement, and purchasing postponement, based on the different postponed activities in the chain. The forecast-driven and demand-driven activities of each postponement type are

separated by the dotted line. It also illustrates that the different degrees of postponement and speculation strategies are associated with various positions of the customer ordering points. Next, the researcher will discuss solely the study of logistics postponement, as the postponement/speculation matrix result proved to be the most compatible and applicable strategy for mass production with high economy of scale in production.

**2.4 Logistics postponement**

Yang, Burns, and Backhouse (2004) continued to explain that the concept of logistics postponement can help reduce the risk of placing the inventory at the wrong and quantity which will eventually improve the inventory performance throughout the supply chain. Then, in 2005, Yang, Yang, and Wijngaard (2005) studied the impact of postponement on transport. They defined logistics postponement as a combination of time and place postponement. The concept is to organize the inventory storage away from the customer until the requirement is known, to minimize inventory cost but still maintain service commitment. The finished product will be centralized or stored at the centralized location and replenished to the customer on time with the right quantity. Bartels (2010) emphasized the value of the logistics postponement concept, its characteristics, and the actions needed in order to successfully implement and optimize the benefits, as summarized in Table 2.1.

**Table 2.1: Logistics postponement characteristics, action needed, and benefits**

Characteristics	Actions needed	Benefits
Place and time management	Retain finished products at a central location	Reduce risk of placing inventory in wrong timing and quantity
	Delay the movement of inventory until the actual customer requirement is known	Inventory reduction at market distribution center, and cost saving throughout supply chain
	Ship the exact product quantity from the central location to meet specific customer requirement	Inventory reduction at market distribution center, and cost saving throughout supply chain

**Table 2.1: Logistics postponement characteristics, action needed and benefits**  
(continued)

Characteristics	Actions needed	Benefits
<b>Logistics management</b>	Work closely with logistics service providers to increase the ability to handle various shipment volume and timing	Increase on-time delivery, shorten lead times and improve reliability
	Work closely with logistics service providers to minimize transportation cost	Balance constant transportation cost

Source: Bartels (2010)

According to Table 2.1, logistics postponement needs two main management activities: time and place and logistics management. For time and place management, by place management, it requires the company to store the finished product at its central warehouse or distribution center. This practice will help reduce the risk of shipping wrong product quantities to the customer at the wrong time and stock obsolescence. For time management, it suggests that the firm holds the replenishment until actual customer ordering is received, then deploy the right quantity to the specific customer. This will optimize inventory storage cost throughout the supply chain and minimize stock level. Furthermore, logistics management is also important to successfully adopt logistics postponement. The company needs to have high collaboration with its logistics provider. Working closely and information sharing will help increase the capacity and capability to handle more frequent and smaller shipments which is the result of logistics postponement. On-time delivery with short vessel transit time can be achieved from good cooperation with reliable carriers. Logistics postponement will influence the balance of transportation cost spending, due to the regular shipments based on real customer consumption and not from the production MOQ or speculation.

## 2.5 Summary

The literature reviews was studied to understand the possibility to minimize inventory day and reduce cost in a supply chain by having the right inventory management. It also helped an exploration to identify the most appropriate solution for a specific supply chain by consolidating methodologies proposed by each research, as follows. The research started with a study of inventory day calculation as a measurement of inventory performance. It continued to study the concept of pull, push, and hybrid strategies to identify which type of business situation matches which supply chain scenario. After that, the researcher studied and discovered that a logistics postponement strategy can provide an opportunity for future improvement as it is considered most efficient and suitable for a fast moving consumer goods company.



## **CHAPTER III**

### **RESEARCH METHODOLOGY**

This chapter presents the research methodology for this study. The detailed explanation is separated into six stages. Data collection gives the sources of information and techniques for data gathering during January to December 2012, composed of in-depth interviews with ABC Company employees in Thailand and Japan, document review and data setup review. Data analysis is the integration of analytical information from data collection to understand the ABC situation in terms of inventory and sales value of the hair care product category and its selling countries. Gap finding concludes the result from data analysis and reflects current as-is practice at ABC Company. Then the researcher recommends a proposed model and solution to the inventory problem, based on the literature review. This section also contains a to-be scenario which is the expected result after implementation. The next stage examines the benefits expected from the proposed model, using Microsoft Excel spreadsheet to calculate and compare projected improvements. Finally, the researcher summarizes this chapter by concluding all key points and the expected improved results. Figure 3.1 below is the research framework which summarizes the research methodology for Chapter III.



Figure 3.1: Research framework

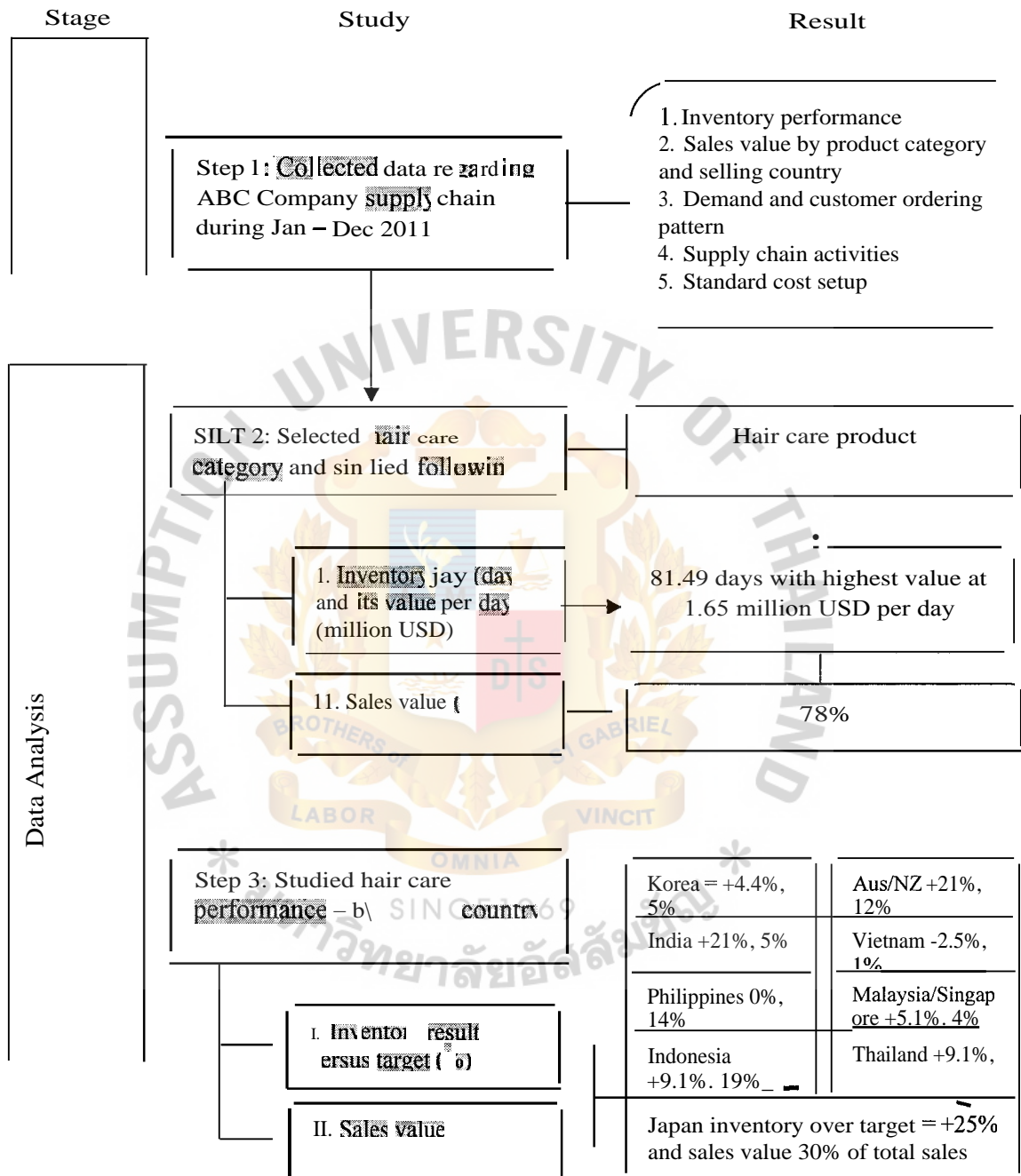
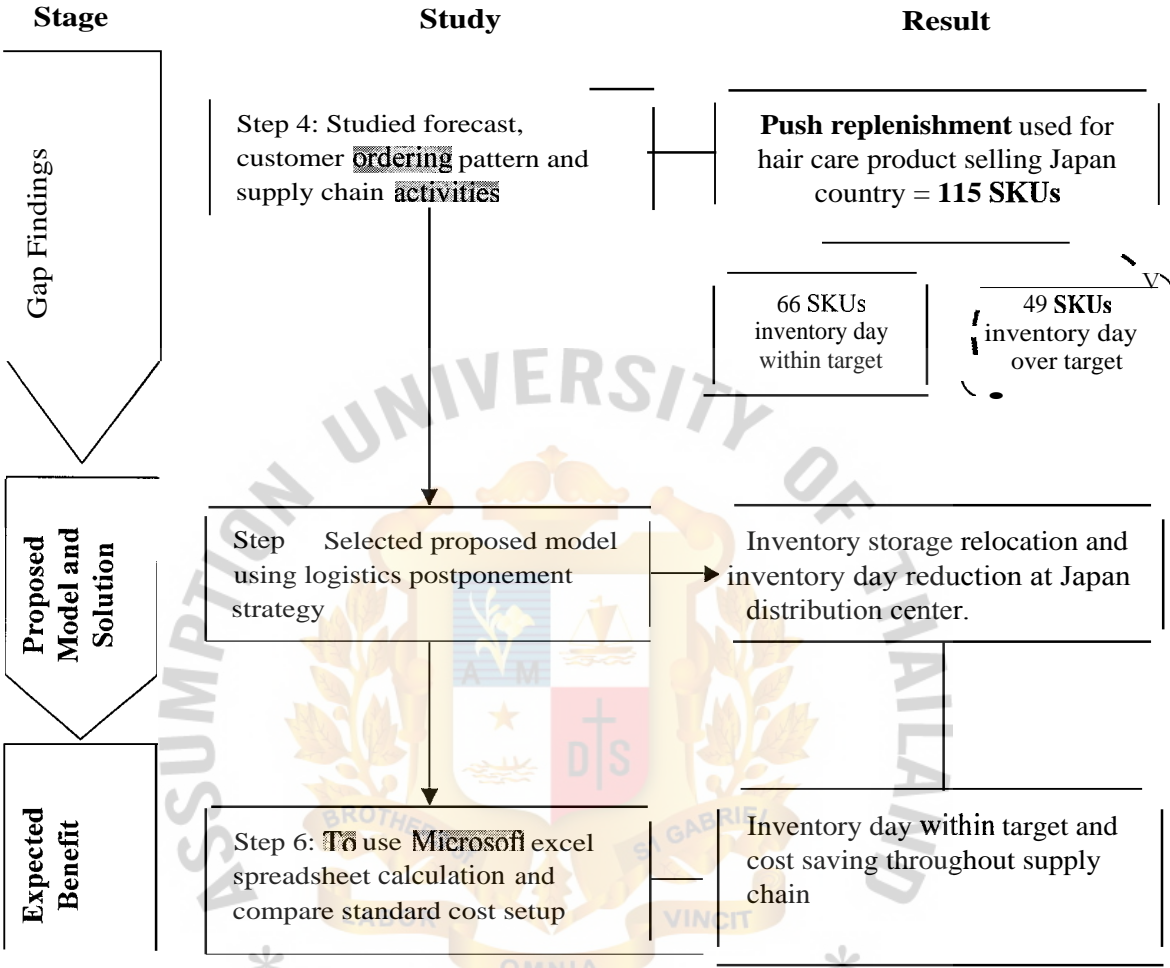


Figure 3.1: Research framework (continued)



Source: Author

### 3.1 Data Collection

This section explains methods of data collection for this study. There are three techniques applied to several sources of data. In-depth interviews were held with ABC planning managers, Thai planners and Japanese planners. The document review gathered critical information regarding supply chain activities during January to December 2011 on a monthly basis, as well as product standard cost setup collected from the ABC Company Finance department.

#### 3.1.1 In-depth interviews

##### Interview with ABC Planning Manager

Several interviews with ABC Planning Managers were arranged to access significant information. The discussions aimed to understand the inventory situation and how each business category performed and contributed in 2011. Furthermore, the interviews focused on each selling country inventory, sales performance, and ABC customers demand and ordering patterns. Those are the key criteria to set the direction of this study to move forward with the hair care category and focus specifically on Japan country customers.

##### Interview with ABC Planners

Next, the researcher set up an interview with ABC Thai planners to understand the ABC computerized system for forecast upload, as well as stock replenishment practice from ABC Thailand to Japan. Additionally, there were also a face-to-face interviews with Japanese planners in November 2011 to identify market characteristics, customer ordering behaviors, and shipment pattern. The detailed information from the interviews is shown in the data analysis section

List and number of interviewees;

1. ABC Planning Manager (1)
2. ABC Thai planners (3)
3. ABC Japanese planners (3)

### **3.1.2 Document review**

The researcher collected monthly supply chain activities; production, replenishment, customer orders, and inventory day levels during January to December 2011. These data were used to calculate day supply forward coverage or inventory day for 115 SKUs selling to Japan. More importantly, the document review was intended to understand the pattern of the replenishment process from ABC Thailand to Japan versus actual customer requirement and aligned inventory level. The information was in line with the in-depth interviews with the Thai and Japanese planners. Sales values by product category and by country were reviewed with inventory day result in 2011. The complete document review is critically important for this study as it justifies the direction of the project and scope of the study. Detailed information from the document review is shown in the data analysis section

### **3.1.3 Data setup review**

ABC Finance department provided information on product standard cost by SKU level and the company cost structure. Also provided was the standard cost of ABC products at different locations: Thailand central warehouse versus Japan distribution center were compared and used for result calculation of the proposed model. Also, the inventory day setup based on business alignment was provided by the ABC Planning Manager, to understand ABC Company's aligned inventory level and analyze the problem. This data setup review is considered significant information for this study. It helps justify the right practical solution and benefits of improvement. In the next section, data analysis provides detailed information on how the business set up its supply chain data.

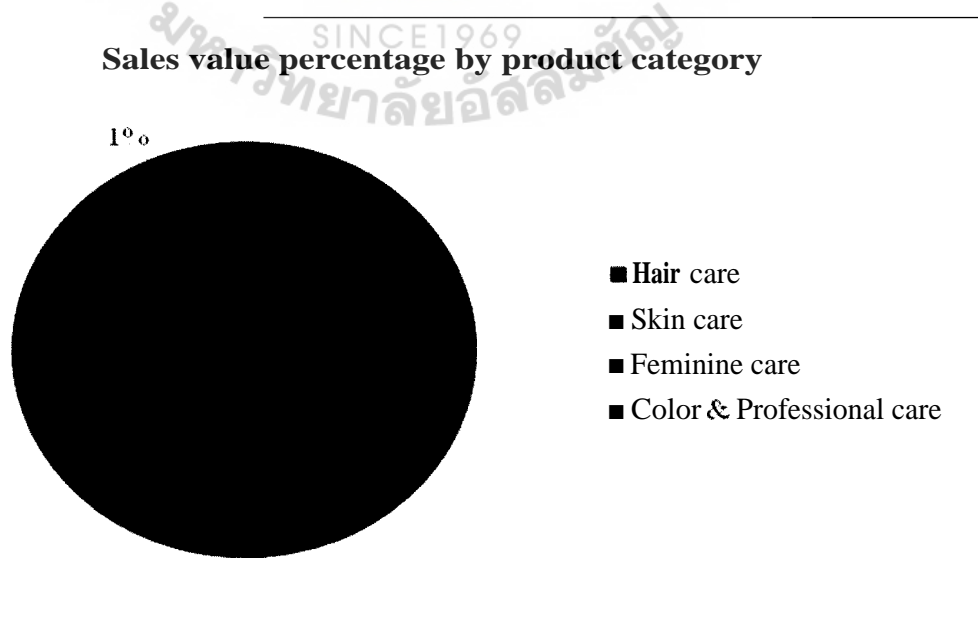
## **3.2 Data Analysis**

After the data collection stage, the researcher started by integrating related data from all sources, and analyzed the current situation at ABC Company.

### 3.2.1 Sales value and inventory result

According to the study of sales value and inventory result at the end of December 2011 for the hair care product category, the Japan market was chosen for this study for the following rationale. ABC Company is composed of four product categories: hair care, skin care, feminine care and color & professional care. In 2011, total hair care products had 82 inventory days with the highest inventory value among all product categories at 134.4 million USD (or 1.65 million USD per day). More importantly, the hair care sales value was 78 percents whereas skin care, feminine care and color & professional care were only 15 percents, 6 percents and 1 percent respectively, as shown in Figure 3.2. Therefore, skin care was excluded from this research as the study of hair care contributed more to the ABC supply chain. Additionally, feminine care and color & professional care categories were also excluded due to the feminine care category's planned close down in September 2012, while color & professional was only established in late 2010, and its system and measurement are not in place yet. As a result, the researcher selected to focus on the hair care product category. Next, the study moved forward to understand each selling country under the hair care category.

**Figure 3.2: Sales value percentage by product category as of December 2011**



Source: ABC Planning Manager



Hair care selling countries comprised nine market sectors: 1.Korea, 2.Japan, 3.Australia and New Zealand, 4.India, 5.Vietnam, 6.Philippines, 7.Malaysia and Singapore, 8.Indonesia and 9.Thailand. From Table 3.1, each country had its own aligned target inventory day from the agreement between ABC management team and the market countries. The target inventory day was set up to achieve expected an service level and the most appropriated inventory level of each market countries as well as to cope with other factors such as forecast accuracy, demand fluctuation, and transportation lead time.

**Table 3.1: Target and actual inventory days for 9 hair care selling countries**

No.	Hair care selling country sectors <sup>a</sup>	Target inventory day (day) <sup>b</sup>	Actual inventory day (day)	Day different of actual versus target (days)	Percentage different of actual versus target (%) <sup>c</sup>
1	Korea	68	71	+3	Over target 4.4%
2	Japan	48	60	+12	Over target 25.0%
3	Australia/New Zealand	81	98	+17	Over target 21.0%
4	India	46	37	-9	Under target 19.6%
5	Vietnam	40	39	-1	Under target 2.5%
6	Philippines	43	43	0	0
7	Malaysia/Singapore	39	37	-2	Under target 5.1%
8	Indonesia	33	36	+3	Over target 9.1%
9	Thailand	33	36	+3	Over target 9.1%

Source: ABC Planning Manager

<sup>a</sup> = The 9 selling country sectors under hair care product categories

<sup>b</sup> = Target inventory day by country

= Actual inventory day by country

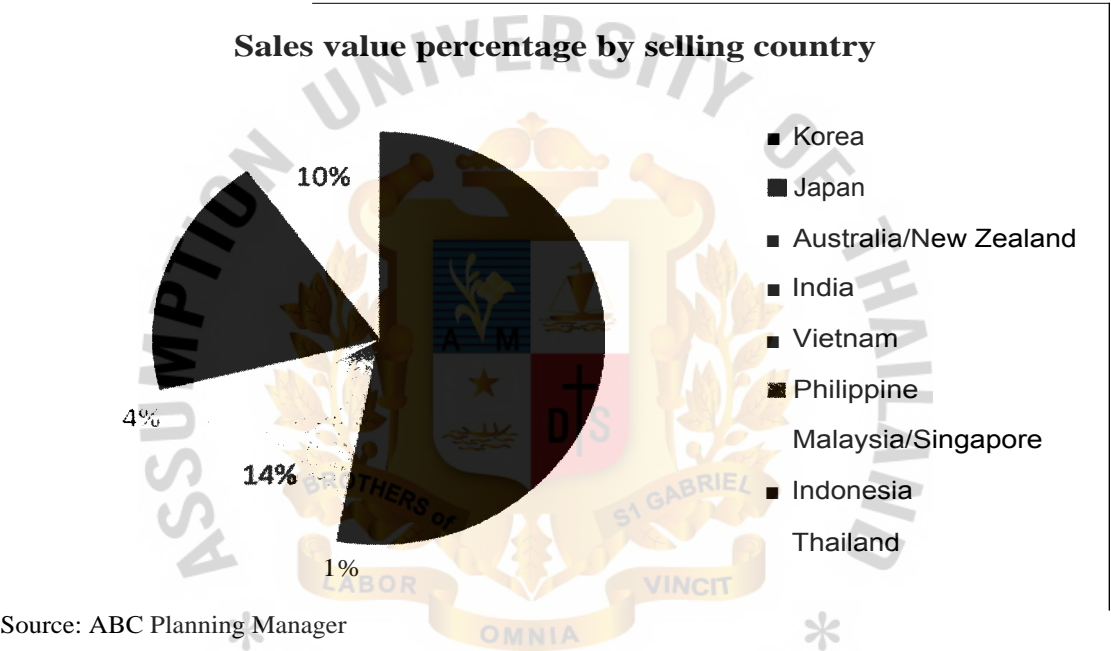
<sup>c</sup> = Day different of actual versus target (c) - (b)

= Percentage different of actual versus target (d) / (b) %

At year end, four countries; India, Vietnam, Philippines and Malaysia/Singapore had inventory day level within the target, while five sectors; Korea, Japan, Australia/New Zealand, Indonesia, and Thailand were over the aligned target. In particular, Japan was the highest off-track market at 60 days versus a target of 48 days (or 25% over

target). Figure 3.3 explains the sales value contribution for the nine selling market sectors. Japan generated the highest value at 30 percents of total hair care sales. Therefore, the Japan market was chosen for this study due to its highest inventory off-track and its largest sales value to ABC Company. The researcher continued to study SKUs selling to the Japan market under the hair care product category during January to December 2011.

**Figure 3.3: Sales value percentage by selling country as of December 2011**



The next section is the gap finding section where the researcher identified the root cause of inventory problems for 49 SKUs having inventory over target, based on information from data analysis and provides the as-is situation at ABC Company.

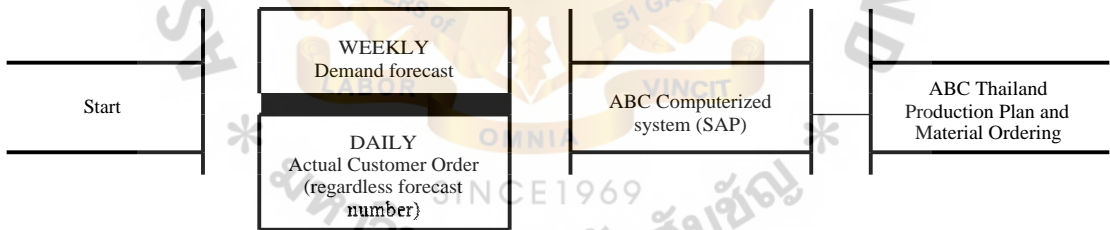
### 3.3 Gap Finding

The researcher discovered the three factors that contributed to ABC Company's inventory problem: forecast and customer ordering pattern, replenishment practice, and supply chain activities, during 2011.

3.3.1 Forecasting and customer ordering pattern

ABC received production requirements through weekly forecasts and daily customer orders. The forecast was reflected via computerized system on a weekly basis. It triggered production and replenishment activities. While actual customer orders from Japan customers can happen every day, it might or might not equal the forecast. Figure 3.4 demonstrates information flow for forecasts and actual customer orders. Regarding the interview with Thai planners, most of the time, ABC Company has to reacted to demand fluctuation as actual customer orders from Japan were not equal to the forecast number; thus ABC Thai planners accelerated the material ordering and advanced production plan to support customer requirements. Customer ordering pattern in the Japan market have been conservative, where an order can be placed at will to ensure the highest customer satisfaction. The order timing and quantity might or might not equal the forecast. Therefore this ordering pattern was considered one possible root cause for inventory problems related to the ABC Japan market.

Figure 3.4: Information flow for forecast and customer ordering pattern



Source: ABC Planners

Although the forecast number was uploaded and visible in the ABC computerized system, actual customer orders were given highest priority which triggered production plan scheduling and influenced planning activities at the ABC Company. The culture of order placement by Japan customers has to be kept traditional and conservative. Since the ordering pattern cannot be changed, the researcher continued to investigate replenishment practice which was also an important activity that could influence inventory.

### 3.3.2 Replenishment practice

The researcher studied supply chain activities in both countries. The activities involve: Thailand manufacturing plant and Japan distribution centers; production at manufacturing plant, shipment from Thailand to Japan, leftover stock at Thailand central warehouse, shipment to Japanese customers, the leftover stock at Japan distribution center and inventory days. According to the conservative ordering pattern, ABC Thai planners used push replenishment regardless of aligned inventory level based on the full speculation strategy.

ABC Thai planners replenished stock to the Japan distribution center to prevent supply shortage. They had a computerized system (SAP) to can help them detect SKUs needing replenishment. However, the planners did not follow SAP recommendations as they needed to ensure sufficient stock for daily customer ordering. Table 3.2 demonstrates supply chain activities at ABC Thailand starting from the production of 115 SKUs under brand A - F, then the replenishment plan from ABC Thailand to Japan distribution center, and inventory leftover.

**Table 3.2: Production and replenishment summary**

Production and replenishment during Jan - Dec'11	Brand A (case) <sup>a</sup>	Brand B (case) <sup>b</sup>	Brand C (case) <sup>c</sup>	Brand D (case) <sup>d</sup>	Brand E (case)	Brand F (case) <sup>f</sup>	Total (case) <sup>g</sup>	Percentage comparison (%)
Production	849,982	546,596	61,502	735,989	5,698,496	563,722	8,456,287	100.0%
Shipment from Thailand to Japan	821,933	530,606	48,422	727,699	5,573,959	551,554	8,254,173	97.6%
Leftover in Thailand central warehouse	28,049	15,990	13,080	8,290	124,537	12,168	202,114	2.4%

Source: ABC Thai Planners

<sup>a</sup> = production and replenishment for brand A

<sup>b</sup> = production and replenishment for brand B

<sup>c</sup> = production and replenishment for brand C

<sup>d</sup> = production and replenishment for brand D

<sup>e</sup> = production and replenishment for brand E

<sup>f</sup> = production and replenishment for brand F

<sup>g</sup> = total production and replenishment for brand A - F

<sup>h</sup> = percentage comparison for total production and replenishment (g) %

From the record, approximately 98 percent of stock produced at ABC Thailand was shipped out to Japan distribution right after production. The remaining 2 percent was left at central warehouse or Thailand central warehouse due to quality problems, product damage, or trade sample purposes. According to information from the interviews, that 98 percent was shipped to Japan distribution center using push replenishment scenario (pushing stock to end distribution center without confirmed information on actual customer orders). Based on the literature review regarding pull-push strategy, ABC's replenishment practice is considered as push replenishment based on full speculation, and is the root cause for inventory problem at ABC.

Next the researcher continued to investigate the supply chain activities at the Japan side. Table 3.3 summarizes the supply chain activities the Japan distribution center. Firstly, the Table demonstrates leftover inventory from 2010, then the shipment to Japan customer, the excess stock left after shipment, and inventory day of each brand at the end of 2011. Based on the study of replenishment practice where ABC planners pushed the entire stock to the Japan distribution center, consequently the actual inventory day for a total of 115 SKUs at the end of 2011 was equal to 5,982 days.

**Table 3.3: Shipment and inventory day summary**

Shipment and Inventory day during Jan - Dec'11	Brand A (case) <sup>a</sup>	Brand B (case) <sup>b</sup>	Brand C (case) <sup>c</sup>	Brand D (case) <sup>d</sup>	Brand E (case) <sup>e</sup>	Brand F (case) <sup>f</sup>	Total all brands <sup>g</sup>
Inventory leftover at Japan DC from 2010	14,720	7,164	120,961	41,274	398,803	92,488	675,412
Shipment to Japan customer	703,644	452,653	144,993	678,243	5,692,405	616,407	8,288,347
Leftover at Japan DC (plus beginning stock)	133,009	85,117	24,390	90,730	280,357	27,635	641,238
Inventory day supply	2,141	490	1,162	300	1,167	722	5,982

Source: ABC Japan Planners

<sup>a</sup> = shipment and inventory for brand A

<sup>b</sup> = shipment and inventory for brand B

<sup>c</sup> = shipment and inventory for brand C

<sup>d</sup> = shipment and inventory for brand D

<sup>e</sup> = shipment and inventory for brand E

<sup>f</sup> = shipment and inventory for brand F

<sup>g</sup> = total shipment and inventory for brand A - F (a) + (b) + (c) + (d) + (e) + (f)



Table 3.4 summarizes inventory day result of a total of 115 hair care SKUs under brand A – F, selling from ABC Thailand to the Japan distribution center in 2011. ABC's Planning Manager mentioned that each SKU was aligned to a specific target of inventory day. Ideally, all 115 SKUs at the Japan distribution center should have had inventory levels equal to 2,149 days. However, actual inventory day for a total of 115 SKUs was 5,982 days. In addition, 5,597 days were generated by 49 SKUs having stock over aligned target inventory days (see appendix A). At this point, the researcher discovered that based on the push replenishment, 49 out of 115 SKUs were the root cause for inventory day being over target.

**Table 3.4: Target and actual inventory days by brand**

Brand	Total 115 SKUs (SKU) <sup>a</sup>	Target inventory day (day) <sup>b</sup>	Actual inventory day (day)	49 out of 115 SKUs over target (SKU)	Target inventory day (day)	Actual inventory day (day) <sup>g</sup>
A	17	306	2,141	7	126	2,073
B	15	265	490	10	178	443
C	13	390	1,162	10	300	1,088
D	12	192	300	6	96	247
E	40	708	1,167	10	168	976
F	18	288	722	6	72	770
Sum	115	2,149	5,982	49	940	5,597

Source: ABC Planning Manager

<sup>a</sup> = Total 115 SKUs selling to Japan separated by brand A - F during January to December 2011

<sup>b</sup> = Target inventory day for 115 SKUs

= Actual inventory day for 115 SKUs

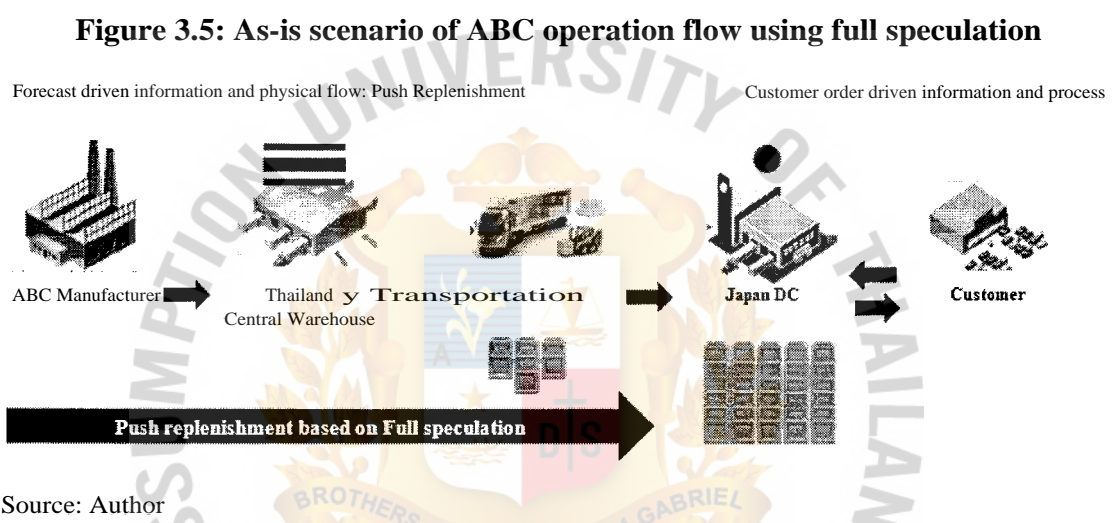
<sup>d</sup> = 49 out of 115 SKUs having inventory day over target

<sup>e</sup> = Target inventory day for 49 SKUs having inventory day over target

<sup>f</sup> = Actual inventory day for 49 SKUs having inventory day over target

After detailed study from data collection and analysis, the researcher identified ABC's current as-is scenario. From Figure 3.5, the production plan at ABC Thailand triggered material ordering, production, and a replenishment plan. The finished goods from production were transferred directly to ABC's central warehouse or the Thailand distribution center and then entirely shipped out to the market distribution center in Japan. Until this stage, all supply chain activities were implemented, forecast-driven, and the replenishment was done based on push strategy. The majority of the finished

products were being held in the Japan distribution center waiting for order placements from customers. From this point on, the supply chain activities generated were actual customer driven. Thus, the ABC inventory storage location was positioned at ABC's Japan distribution center where most stock was being kept waiting for actual demand, and thus called 'full speculation strategy'. As a result of the current scenario, ABC's Japan distribution center ended up with sunk cost from the 49 SKUs having inventory obsolescence equal to 5,597 inventory days.



Being the Japan market which contributed highest sales value to ABC Company, the ordering pattern was being kept conservative. Therefore, this study focuses on improving the replenishment practice. The next section proposes the methodology and model to improve ABC's supply chain strategy, to minimize inventory at the Japan distribution center and reduce cost throughout ABC supply chain. Logistics postponement strategy is proposed for ABC's inventory problem.

### 3.4 Proposed Model and Solution

The root cause of the ABC inventory problem was an inappropriate supply chain strategy and replenishment practice. Entire stock from production was pushed to the Japan distribution center to ensure supply availability against aligned inventory level. Therefore, inventory day for 49 SKUs selling to the Japan distribution center in 2011

was enormously over target. The researcher reviewed related literatures to achieve the optimal strategic solution to improve the inventory problem at ABC. Therefore, **logistics postponement strategy by Bartels, (2010)** is proposed for ABC.

Given the current situation at ABC Company, and literature reviews of the two fundamental approaches; make-to-stock (MTS) and make-to-order (MTO), MTO was not the right strategy for ABC Company as it was suitable for customized products which focus on speed, flexibility and responsiveness. However, ABC products are standardized FMCG that focus on pricing, high productivity and cost reduction. Therefore, make-to-stock (MTS) based on logistics postponement strategy was selected as the most appropriate supply chain strategy for the company's circumstance. Previously, the inventory storage for ABC Company was positioned at the Japan distribution center nearest to the customer. This scenario matches the full speculation strategy, or no postponement at all. However, this practice created inventory problem. Therefore, the study proposed a new supply chain strategy to improve the situation. Based on literature review, logistics postponement in which replenishment and logistics activities are driven by actual customer ordering, allows ABC Company to manage inventory day at Japan distribution center and improve replenishment practice. Regarding the concept of logistics postponement, the movement of inventory through logistics activities from Thailand is delayed until the information on actual customer requirement is visible. Table 3.5 displays detailed analysis of logistics postponement characteristics for the ABC supply chain, action needed and person in charge of each activity to successfully apply the logistics postponement concept, with applicability checks for all items.

**Table 3.5: Logistics postponement characteristics, actions needed and applicability check**

Characteristics and activities		Actions needed for ABC Company	Is Logistics postponement applicable for ABC Company?
Place and time management	Retain finished goods at a central location	Utilize its central warehouse, Thailand distribution center, to keep excess stock which is above the target inventory day.  By: ABC Planning manager and ABC Warehouse manager	Applicable
	Delay the movement of inventory until the actual customer requirement is known	Change replenishment practice from pushing stock to ABC Japan based on full speculation to fulfilling only when the inventory day drops below aligned target. However the material ordering and production are still push strategy to ensure availability and service rate.  By: ABC Thai planners	Applicable
	Ship the exact product quantity from the central location to meet specific customer requirement	Follow computerized system (SAP) recommendation for replenishment quantity. Stay in touch with market and customers to understand the shipment trend.  By: ABC Thai planners and ABC Japanese planners	Applicable
Logistics management	Work closely with logistics service providers to increase the ability to handle various shipment volume and timing	Work closely with carriers to evaluate the capability and capacity to handle flexible shipment and timing.  By: ABC Planning department and Cross border Logistics team	Applicable
	Work closely with logistics service providers to minimize transportation cost	Provide long term requirement for containers to carriers. Stabilized volume and full truck load (FTL) approach can be achieved through combined shipment with other ABC product categories; skin care and color & professional care. Frequent shipment can also promote balanced transportation cost.  By: ABC Planning department and Cross border Logistics team	Applicable

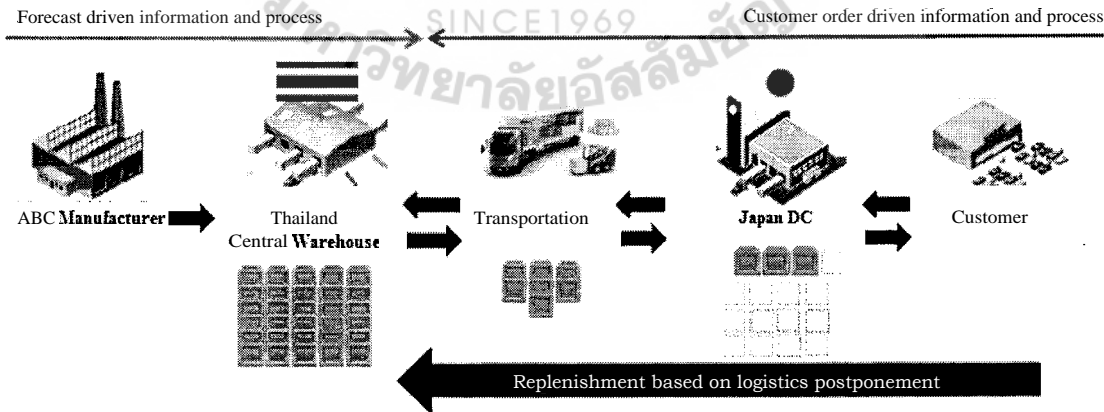
Source: Bartels (2010)

This strategy is suitable for ABC's supply chain and can be done by cooperation among ABC's cross functional team. The proposed model enables inventory reduction at ABC's Japan distribution center because only aligned stock is

replenished to fulfill target inventory day. Moreover, it can help minimize the costs throughout ABC's supply chain by changing the storage location from the Japan end distribution center to the Thailand central warehouse. Detailed information on cost saving will be discussed later, in the expected benefit section of the proposed model.

Based on logistics postponement characteristics, actions needed and applicability check, it can be concluded that logistics postponement is applicable to the ABC Company, and actions-needed items can be applied for successful implementation. Figure 3.6 explains the projected to-be scenario after using logistics postponement. The production plan and material ordering processes at ABC Thailand is kept as an as-is scenario on both timing and quantity, or still be driven by forecast. However, the finished goods which are transferred directly to ABC central warehouse or Thailand distribution center are retained there. Only the required quantity to fulfill aligned inventory day is shipped out to the ABC end distribution center or the Japan market. In other words, excess stock is held in Thailand waiting for stock withdrawal from order placements from Japan customers, which is considered to be a demand-driven approach. The inventory storage is positioned at ABC Thailand central warehouse to comply with logistics postponement.

**Figure 3.6: To-be scenario of ABC operation flow using logistics postponement**



Source: Author

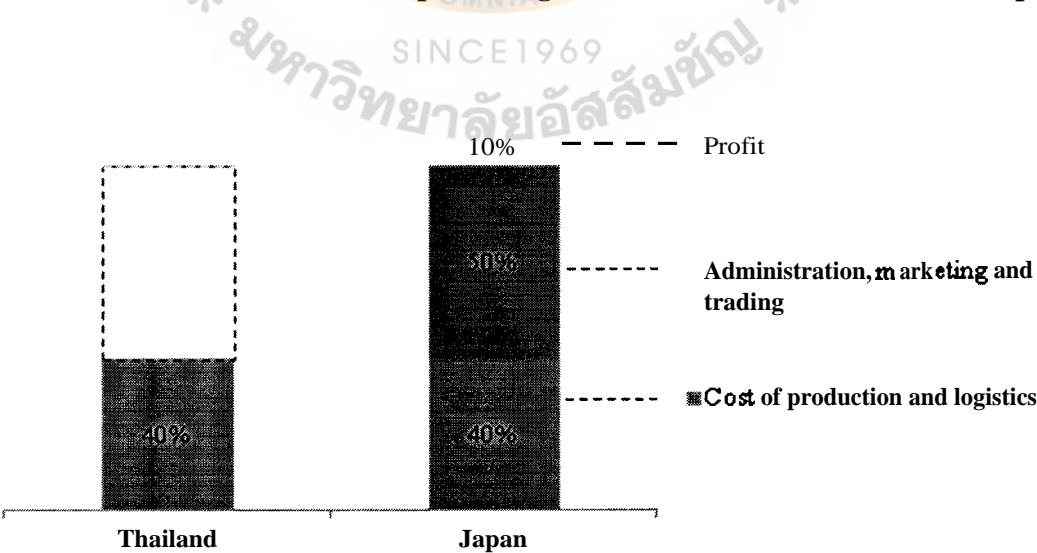


In the next section is the expected benefit of the proposed model which provides financial benefit achievement from the lower cost of inventory at central warehouse or Thailand distribution center.

3.5 Expected Benefit of Proposed Model

According to the proposed model, logistics postponement strategy, ABC Company renovates its supply chain strategy to improve inventory day at Japan distribution center and reduces cost throughout its supply chain. The result of to-be scenario after applying logistics postponement is calculated via Microsoft Excel spreadsheet. Previous to the result comparison calculating the as-is versus to-be scenarios, the researcher extended the benefit of this study by examining the standard cost setup for ABC products. ABC's Financial department provided standard product costs for 115 SKUs at both locations; Thailand central warehouse and Japan market distribution center (see appendix B). It is very noticeable that the standard cost at Thailand central warehouse is lower than Japan distribution center. This is based on ABC's three cost elements shown in Figure 3.7: cost of production and logistics; cost of administration, marketing and trading, and profit from sales.

Table 3.7: Cost elements and percentage allocation for standard cost setup



Source: ABC Finance Depacrtnent

As shown in Figure 3.7, ABC product cost at its local warehouse in Thailand accounts for only production and logistics expenditures, which are 40 percent of total cost. The cost of products at ABC's market or Japan distribution center when adding administrative, marketing and trading expenses, is 50 percent. Moreover, the target profit of 10 percent is included alongside the total standard cost at the Japan distribution center. Therefore, the logistics postponement strategy where inventory storage is relocated to the lower cost central warehouse helps to reduce both inventory day at the Japan distribution center and allows cost saving throughout the ABC supply chain. Detailed information on the quantified savings for the new supply chain structure will be discussed in Chapter N.

### 3.6 Summary

Push replenishment, based on full speculation, is the root cause for the inventory problem at ABC Company. Though, the company was equipped with a computerized system which determines the right inventory level needed to be fulfilled, but based on a conservative customer ordering pattern, replenishment was done differently. The entire available stock was pushed to the Japan distribution center and caused inventory over the aligned target. The inventory day for the 49 SKUs was 5,597 days versus a target of 940 days, with the inventory value at 7.39 million USD. The optimal solution for appropriate replenishment practice at ABC Company was therefore studied.

Logistics postponement was chosen as the optimum strategy for the situation. The inventory storage location is repositioned to the central warehouse which helps reduce inventory days at the Japan distribution center. The main concept of logistics postponement is to change the storage location to the central warehouse where the cost of inventory is lower. Therefore, cost savings throughout ABC supply chain can be achieved. More importantly, the logistics flexibility and service reliability are accomplished through shipment and loading consolidation with other ABC product categories.

## **CHAPTER IV**

### **PRESENTATION AND CRITICAL DISCUSSION OF RESULTS**

This chapter is composed of three sections. First, it starts with logistics postponement implementation by managing time, place and logistics. Then the researcher evaluates the result from applying logistics postponement strategy, by comparing inventory days at the Japan distribution center, and values between as-is and to-be scenarios. Finally, the study reveals cost saving from applying the proposed model and proves that there are no drawbacks from inventory storage relocation. Lastly is a summary of the chapter, with a critical analysis and benefits resulting from implementing logistics postponement.

#### **4.1 Applying logistics postponement strategy**

The logistics postponement concept recommends delaying finished goods replenishment until an actual customer order is acknowledged. Logistics postponement also suggests inventory storage repositioning to a location with lower storage cost. Furthermore, to successfully implementing this strategy, the company requires an effective logistics service. Therefore, ABC Company needs to modify two major managements aspects: time and place management and logistics management.

##### **4.1.1 Time and place management**

Previously, ABC Company used full speculation strategy in its supply chain which resulted in an inventory problem. Figure 4.1 displays the result of inventory days and values for the 49 SKUs over aligned target, which caused a need for supply chain reconfiguration.

**Table 4.1: Inventory days and value for 49 SKUs over aligned target**

Brand	49 SKUs over target (SKU) <sup>a</sup>	Target inventory day (day) <sup>b</sup>	Actual inventory day (day) <sup>c</sup>	Inventory value (USD) <sup>d</sup>
A	7	126	2,073	1,398,263
B	10	178	443	1,440,479
C	10	300	1,088	1,061,461
D	6	96	247	1,099,279
E	10	168	976	2,211,937
F	6	72	770	177,529
Sum	49	940	5,597	\$7,388,948

Source: ABC Planning Manager

<sup>a</sup> = 49 out of 115 SKUs selling to Japan under brand A - F during January to December 2011

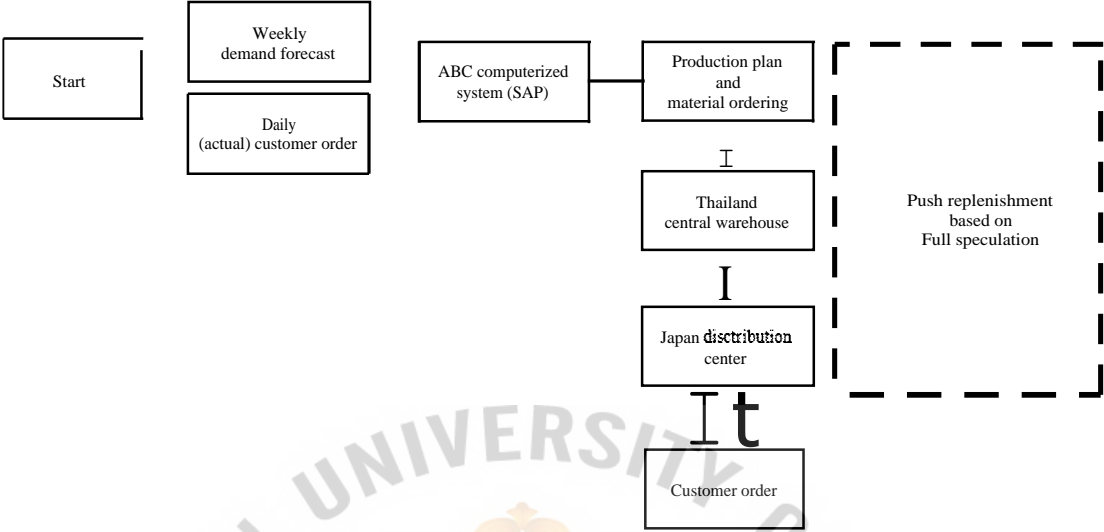
<sup>b</sup> = Target inventory day for 49 SKUs having inventory day over target

<sup>c</sup> = Actual inventory day for 49 SKUs having inventory day over target

<sup>d</sup> = Inventory value for 49 SKUs having inventory day over target

ABC Company employs three main activities required for place and time management under the logistics postponement concept. Firstly, it utilizes the central warehouse in Thailand to retain the excess finished goods over aligned inventory levels. Then ABC planners delay the inventory replenishment until the customer requirement is known. More importantly, only the essential amount of stock is shipped to the Japan distribution center to align with inventory day setup. To comply with time and place management, the ABC Company needs to change its supply chain operation. Figure 4.1 shows the current operation and information flow for ABC Company supply chain, and the restructuring point for inventory storage location and replenishment activities.

Figure 4.1: Restructuring ABC operation flow

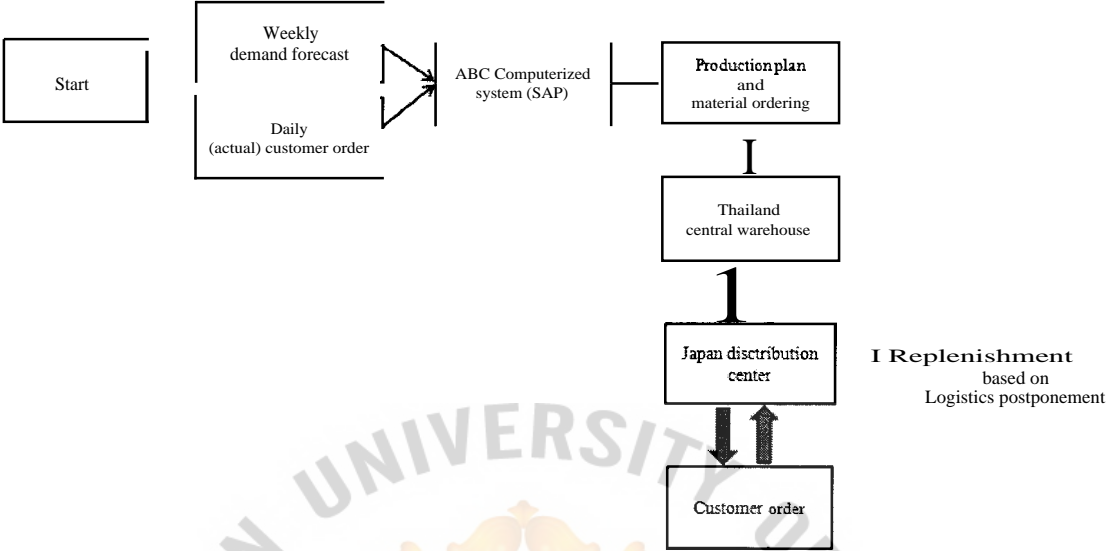


Source: Author

Figure 4.1 explains that push replenishment, based on full speculation, or shipping the stock from the Thailand manufacturing plant to the Japan distribution center prior to actual customer order confirmation, is eliminated. Moreover, the one-way communication starting from material ordering, production and replenishment from the Thailand central warehouse is replaced by logistics postponement strategy in which replenishment is triggered by inventory withdrawal from an actual customer order, and the inventory storage location is placed where the lower storage cost is. The new operation flow for ABC Company after applying time and place management is presented in Figure 4.2.



**Figure 4.2: New ABC operation flow using logistics postponement**



Source: Author

After restructuring, the replenishment at ABC Company is based on the aligned inventory level. The information flow is two-way communication where replenishment activity is triggered by actual customer ordering. A customer places an order to the Japan distribution center which causes stock withdrawal. Subsequently, the stock level at the customer distribution center falls below the aligned inventory day and stimulates the need for replenishment to the Thailand central warehouse via the computerized system. As a result, the planners create replenishment a plan in line with the agreed inventory level to achieve a healthy level of safety stock. The new structure and operation determine the new inventory storage location which is moved from the Japan distribution center to the Thailand central warehouse. By this, extra inventory beyond aligned inventory day is held locally until additional customer demand arises. The result from restructuring is shown in Table 4.2, where inventory days at the Japan distribution center is reduced from 5,597 days to the aligned target of 940 days.

**Table 4.2: Inventory days and value through logistics postponement strategy**

Brand	49 SKUs over target (SKU)	Japan distribution center		Thailand central warehouse	
		Inventory day (day) <sup>a</sup>	Inventory value (USD) <sup>b</sup>	Inventory day (day) <sup>c</sup>	Inventory value (USD) <sup>d</sup>
A	7	126	264,148	1,947	561,354
B	10	178	663,534	265	491,035
C	10	300	384,425	788	187,716
D	6	96	504,099	151	247,371
E	10	168	706,944	808	776,435
F	6	72	40,195	698	133,864
Sum	49	940	\$2,563,346	4,657	\$2,397,775

Source: Author

<sup>a</sup> = Inventory days at Japan after applying logistics postponement

<sup>b</sup> = Inventory value at Japan after applying logistics postponement

<sup>c</sup> = Inventory days at Thailand after applying logistics postponement

<sup>d</sup> = Inventory value at Thailand after applying logistics postponement

Table 4.2 also demonstrates the value of inventory in Japan, after applying time and place management, which is reduced to 2.56 million USD. However, the material ordering and production quantity remains constant; thus excess stock above the aligned 940 inventory days is retained at the Thailand central warehouse. The lower cost of inventory after applying logistics postponement is the result of inventory storage relocation, which is the key concept of a logistics postponement strategy. A total 4,657 days of inventory remained at the Thailand local warehouse, yields a value of 2.40 million USD. The reason why those 4,657 days of inventory worth are lower is explained by ABC's cost element mentioned in Chapter III, the expected benefit of the proposed model, and standard cost setup by SKU in appendix B. In the next section is an assessment of logistics management which is required for successfully implementing the logistics postponement strategy.

#### 4.1.2 Logistics management

Once the ABC Company improved time and place management activities by restructuring its supply chain operation, the next step is to focus on logistics activities. In order to manage logistics activity effectively to conform to logistics postponement strategy requirements, the ABC Company needs to work closely with its logistics service providers. Highly flexible freight carriers are required to handle various and more frequent shipments due to the stock fulfillment being triggered by actual inventory withdrawal and not by forecasting. This requirement can be achieved easily as ABC Company currently has contracts with various leading carriers; as shown in Table 4.3. These logistics service providers offer flexible vessel schedules and cutoff times. The carriers travel to two destinations in Japan, Kobe and Tokyo ports; nevertheless, similar total transportation times ranged from 11 to 16 days. As a result, each can provide an equally effective service for ABC shipments.

**Table 4.3: List of contracted logistics service providers and transport timeline**

Port of loading <sup>a</sup>	Port of discharge <sup>b</sup>	Carrier <sup>c</sup>	Percentage allocation (%) <sup>d</sup>	ETD	Total transport time (day) <sup>e</sup>	ETA <sup>g</sup>
Laemchabang, Thailand	Kobe, Japan	MOL	70%	Thursday (Week 1)	13	Thursday (Week 2)
		MOL	70%	Thursday (Week 0)	11	Thursday (Week 1)
		OOCL	30%	Sunday (Week 0)	13	Wednesday (Week 2)
		MCC	Back up	Tuesday (Week 1)	15	Saturday (Week 2)
		NYK	50%	Monday (Week 1)	13	Thursday (Week 2)
Laemchabang, Thailand	Tokyo, Japan	MOL	50%	Thursday (Week 1)	16	Sunday (Week 2)
		MOL	50%	Thursday (Week 0)	13	Sunday (Week 1)
		OOCL	50%	Sunday (Week 0)	15	Friday (Week 2)
		NYK	Back up	Tuesday (Week 1)	12	Wednesday (Week 2)

Source: ABC Planning Manager

<sup>a</sup> = Thailand port, loading location in Laemchabang

<sup>b</sup> = Japan ports, Kobe and Tokyo

<sup>c</sup> = List of contracted carriers

<sup>d</sup> = Percentage share allocated to each carrier

<sup>e</sup> = Estimated time of departure of each carrier

<sup>f</sup> = Total transport time of each carrier (day)

<sup>g</sup> = Estimated time of arrival at destination port of each carrier

Another activity under logistics management is to ensure that the changes in inventory storage relocation and logistics activities will not cause additional cost to the ABC supply chain. Therefore, the researcher assessed the logistics cost which is composed of three components; administration cost, transport cost, and inventory holding cost (Office of the National Economic and Social Development Board, 2009). Firstly, the administration cost of ABC is 30 percent lower in Thailand, a developing country compared to a highly developed country like Japan. Next, the transportation cost assessment which evaluated container requirements for both as-is and to-be scenarios. or before and after applying logistics postponement, as shown in Tables 4.4 and 4.5.

**Table 4.4: Replenishment and container requirement summary using push replenishment**

<b>Replenishment and container requirement (Push replenishment)</b>	<b>Brand A</b>	<b>Brand B</b>	<b>Brand C</b>	<b>Brand D</b>	<b>Brand E</b>	<b>Brand F</b>	<b>Total</b>
Production for 49 SKUs over target (case) <sup>a</sup>	283,290	329,237	42,305	552,778	687,063	21,656	<b>1,916,329</b>
Shipment from Thailand to Japan based on push replenishment (case) <sup>b</sup>	283,267	328,762	42,148	552,392	686,325	21,616	<b>1,914,510</b>
Convert shipment to Japan in case to pallet (pallet) <sup>c</sup>	4,426	4,648	567	7,702	9,665	338	<b>26,590</b>
Convert pallet to container (container) <sup>d</sup>	111	116	14	193	242	8	<b>665</b>
Number of container per month (container) <sup>e</sup>	9	10	1	16	20	1	<b>55</b>

Source: Author

<sup>a</sup> = Production for 49 SKUs over target

<sup>b</sup> = Shipment to Japan based on push replenishment

= Convert (b) to number of pallet gathered from ABC planners

<sup>d</sup> = Convert (c) to number of container gather from ABC planners

= Number of container per month calculated by (d) / 12 months

**Table 4.5: Replenishment and container requirement summary after applying logistics postponement**

<b>Replenishment and container requirement (Replenishment based on logistics postponement)</b>	<b>Brand A</b>	<b>Brand B</b>	<b>Brand C</b>	<b>Brand D</b>	<b>Brand E</b>	<b>Brand F</b>	<b>Total</b>
Production for 49 SKUs over target (case) <sup>a</sup>	283,290	329,237	42,305	552,778	687,063	21,656	<b>1,916,329</b>
Shipment to Japan based on actual customer order (case) <sup>b</sup>	214,655	280,237	30,841	509,461	543,674	18,309	<b>1,597,176</b>
Convert shipment to Japan in case to pallet (pallet)	3034	3955	431	7102	7654	286	<b>22,462</b>
Convert pallet to container (container) <sup>d</sup>	76	99	11	178	191	7	<b>562</b>
Number of container per month (container) <sup>e</sup>	6	8	1	15	16	1	<b>47</b>

Source: Author

<sup>a</sup> = Production for 49 SKUs over target which remain the same as as-is scenario

<sup>b</sup> = Shipment to Japan based on actual customer order and aligned inventory day

= Convert (b) to number of pallet gathered from ABC planners

<sup>d</sup> = Convert (c) to number of container gather from ABC planners

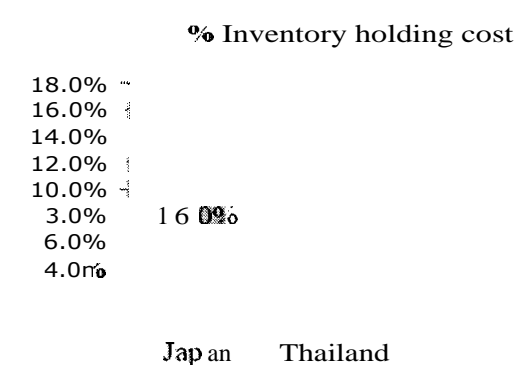
= Number of container per month calculated by (d) / 12 months



Table 4.4 shows the annual production for 49 SKUs under brand A – F, with replenishment based full speculation. Total container requirement per month was 55 containers. Then Table 4.5 provides information for container requirement based on the logistics postponement concept. The production for those 49 SKUs is still the same at 1,916,326 cases but the quantity shipped to Japan is 1,916,326 cases, only to fulfill the aligned inventory level. The monthly number of containers is reduced to 47 containers which can still achieve full truck load (FTL) and stabilize transportation cost. The other 8 containers that will be kept in Thailand to prevent inventory obsolescence or remnant stock which causes over-days supply, and to control inventory days at the Japan distribution center. Furthermore, to ensure FTL in case of demand fluctuation in hair care products, ABC can mix loads with other product categories which are also shipped to Japan every week.

Lastly, a study of inventory holding cost is needed to ensure no possible drawbacks from applying logistics postponement. Figure 4.3 provides information on inventory holding cost percentage comparisons between Japan and Thailand. The chart reveals that the Thailand inventory holding cost is lower at 5 percent of its total inventory value, whereas the inventory holding cost in Japan is 16 percent due to costly storage space and higher cost of labor.

**Figure 4.3: Inventory holding cost percentage comparison**



Source: ABC Planning Manager

In conclusion, the changes in inventory storage relocation and logistics activities after logistics postponement implementation do not cause additional cost to the ABC supply chain. This is proved by the lower administration cost in Thailand, the full truck load practice that can be achieved after applying logistics postponement, as well as the lesser inventory holding cost in Thailand. The next section will summarize the inventory days and cost savings between the as-is and to-be scenarios.



## 4.2 Result comparison of inventory days and value

At this point, the research shows that the relocation of inventory storage based on logistics postponement strategy helps reduce inventory day at the Japan distribution center and the cost of ABC's supply chain without adding more logistics cost from the inventory storage relocation. The evaluation result for inventory days and value is analyzed through Microsoft Excel spreadsheet calculations. The comparison of as-is versus to-be scenarios is presented in Table 4.6.

**Table 4.6: Result comparison of inventory days and value**

		Inventory day (days)			Inventory value (USD)		
Brand	49 SKUs over target (SKU)	As-is	To-be		As-is	To-be	
		Japan	Japan	Thailand	Japan	Japan	Thailand
A	7	2,073	126	1,947	1,398,263	264,148	561,354
B	10	443	178	265	1,440,479	663,534	491,035
C	10	1,088	300	788	1,061,461	384,425	187,716
D	6	247	96	151	1,099,279	504,099	247,371
E	10	976	168	808	2,211,937	706,944	776,435
F	6	770	72	698	177,529	40,195	133,864
			940 <sup>b</sup>	4,657		\$2,563,346 <sup>f</sup>	\$2,397,775 <sup>g</sup>
Sum	49	5,597 <sup>a</sup>	5,597 <sup>d</sup>		\$7,388,948 <sup>e</sup>	\$4,961,121 <sup>h</sup>	
					Saving (USD)	\$2,427,827'	

Source: Author

<sup>a</sup> = Total inventory days for as-is scenario

<sup>b</sup> = Inventory days for to-be scenario at Japan

<sup>c</sup> = Inventory days for to-be scenario at Thailand

<sup>d</sup> = Total inventory days for to-be scenario

<sup>e</sup> = Total inventory value for as-is scenario

<sup>f</sup> = Inventory value for to-be scenario at Japan

<sup>g</sup> = Inventory value for to-be scenario at Thailand

<sup>h</sup> = Total inventory value for to-be scenario

<sup>i</sup> = Saving calculated by (e) – (h)

The result achieved from logistics postponement implementation by the ABC Company is explained in Table 4.6. The inventory days split into two locations: 940

days at Japan and 4,657 days at Thailand. However, the production and total inventory days are still the same after as before using a logistics postponement strategy. The change only happens with inventory days at the Japan distribution center, with a reduction to 940 days. This is due to inventory storage relocation to the Thailand central warehouse. More importantly, the total inventory value is decreased from 7.39 to 4.96 million USD or reduced by 2.43 million USD. This is derived from the inventory storage at Thailand central warehouse which is 2.40 million USD, and the lower inventory value in Japan distribution center at 2.56 USD.

#### 4.3 Summary

The ABC Company supply chain is improved by restructuring its two management aspects, time and place management and logistics management. The change in inventory storage location from Japan to the Thailand local warehouse is considered place management. It helps reduce inventory days and cost at a market distribution center due to cheaper inventory handling and storage cost. The time management is to delay replenishment until an actual customer order requirement is known. Then the replenishment plan is done to fulfill only the aligned quantity to meet the aligned inventory level. Another management aspect is logistics, which requires close collaboration with logistics service providers to successfully handle various shipments with control of transportation cost.

The result from applying logistics postponement to the ABC Company supply chain is most remarkable. The inventory days at the Japan distribution center reduce from 5,597 to 940 days, within the target caused by relocating inventory storage to the Thailand central warehouse and eliminating inventory obsolescence at the market distribution center. Despite that, total production and inventory quantity remains the same, and the inventory value decreased significantly. ABC Company can save 2.43 million USD annually and enhance its competitive advantages in the fast moving consumer goods.

## CHAPTER V

### SUMMARY FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

This chapter summarizes the findings of this research with the conclusion of the problem solution and its result after implementation of the logistics postponement strategy. Furthermore, the theoretical implications are reviewed, based on the literature used for this study. Finally, the managerial implications, the limitations and recommendations for this research, are also explored.

#### 5.1 Summary of the Findings

Inventory days of 49 hair care product SKUs selling to the Japan market were over their aligned targets. Total inventory at the end of 2011 was 5,597 days while the target was set at 940 days with a value of 7.39 million USD. The data analysis explained that push replenishment was the root cause for the high inventory at the Japan distribution center. The supply chain activities from material ordering and production in Thailand to replenishment to the Japan market, were driven by forecast. The supply chain activity from the Japan distribution center to customers was done on a demand-driven base. The total inventory was kept in the Japan distribution center until actual customer orders occurred. Excess inventory over customer requirements, or obsolescent, remained in the Japan distribution center. This supply chain strategy is called full speculation, which was not efficient for the ABC Company as it created an inventory problem.

Logistics postponement was proposed as the most appropriate solution to ABC's supply chain. The concept is to improve two major operations: place and time management and logistics management. To manage place, inventory storage is relocated to the Thailand central warehouse which helps reduce inventory in Japan where inventory cost is higher. The restructuring of supply chain strategy alters the level of forecast and demand driven activities and extends two-way communication.



Time management is to control replenishment timing and quantity to align with inventory day setup. Furthermore, high collaboration with logistics service providers is required to ensure that transportation is cost sufficient. The logistics costs, consisting of administration, transportation and inventory holding costs at Thailand and Japan were also assessed to ensure no negative effect from applying the concept. The result in inventory days reduction and cost saving confirms that applying a logistics postponement strategy within the ABC Company can help reduce inventory at the Japan market distribution center and reduce cost throughout the supply chain.

## **5.2 Conclusions**

Logistics postponement strategy implementation benefits the ABC Company by introducing the most suitable supply chain strategy that helps minimize inventory at the market distribution center and reduce cost. To successfully adopt the concept, ABC Company needs strategic decision and management for its inventory storage location, replenishment practice, and logistics service providers. The collaboration and communication between cross functions are extremely important, to maintain customer satisfaction when replacing full speculation with logistics postponement.

The comparison of the result after applying logistics postponement justifies that the proposed solution is the answer to the research question "How can ABC Company achieve inventory cost saving by using a logistics postponement strategy?". This is proved by the savings the ABC Company can gain by restructuring its supply chain strategy based on logistics the postponement concept. Inventory day at the Japan distribution center can also be reduced to 940 days as the aligned target, with 2.43 million USD cost saving.

## **5.3 Theoretical Implications**

The objective of this study is to identify and apply the supply chain strategy that is most appropriate for a fast moving consumer goods manufacturer. The push and pull strategy by Karmarkar (1991) has been studied to understand which practice is

appropriate to which supply chain characteristics. Dong (2010) explains how different customer ordering positions impact the decision for supply chain strategy modification. Finally, Bartel (2010) recommends logistics postponement as the most appropriate strategy for a firm's situation.

Logistics postponement recommends the management of time and place, by proposing inventory storage relocation to the lower inventory storage location. Moreover, it requires effective replenishment practice by understanding customer requirements and fulfilling orders only to match the demand at the right time. The possible drawback of logistics postponement is the ineffective use of transportation which can impact logistics costs. However, the literature mentions that high collaboration with logistics service providers can prevent that negative effect from attaching to a logistics postponement strategy.

The new supply chain using logistics postponement, will benefit a supply chain by minimizing inventory days at the market distribution center, by introducing the concept of relocation inventory storage to the most optimum location, and by promoting cost saving. Therefore, logistics postponement is an applicable and practical strategy which should be applied to the supply chain management.

#### **5.4 Managerial Implications**

The benefit of applying the logistics postponement concept by restructuring the supply chain strategy and replenishment process, is the improvement in inventory days and value. It also provides a solution to the inventory problem, which enhances competitive advantage. The concept is applicable and practical for firms and business owners. It suggests inventory storage relocation to a central warehouse where inventory and logistics cost is lower. Inventory level can be controlled by redesigning the replenishment process; stock over aligned target, and without customer requirement confirmation, remains in the central location. The transportation cost can be stabilized by full truck load shipments or mixed loading with other product categories which guarantees to meet service levels and customer requirements.

More importantly, the implementation of the logistics postponement strategy can be used as a model by other industries. The collaboration between supply chain members is the key factor for the business management team to promote in order to successfully apply to the rest of the company's product categories. Finally, the supply chain restructuring to logistics postponement helps to encourage teamwork and cooperation across functions, which sustains the organization and contributes to continuous improvement.

### **5.5 Limitations and Recommendations for Future Research**

The scope of this research is the nature of fast moving consumer goods which is characterized by constant change. The most appropriate strategy for today can potentially become outdated with changes in environment, customer preferences, competitors, and other factors.

There are opportunities for future research based on this study of logistics postponement for ABC hair care products selling to the Japan market. Firstly, the logistics postponement concept can be applied or extended to other selling countries besides Japan, as it proves that it can minimize inventory at the customer distribution center and minimize supply chain cost. Moreover, the strategy can be used with other product categories in the ABC Company, for skin care, or color & professional care. Furthermore, the delay in supply chain activities can be broadened further than logistics alone. Other upstream activities, such as production, purchasing and new product development, can also adopt a postponement strategy that best suits the specific supply chain.

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## APPENDICES

The logo of Assumption University of Thailand is a circular emblem. It features a central shield with a blue top-left quadrant containing a white lily and the letters 'A M', a white top-right quadrant with a red cross and the letters 'D S', and a red bottom half with a white star. The shield is flanked by golden laurel branches. Above the shield is a golden crown. Below the shield is a golden banner with the Latin motto 'OMNIA VINCIT'. The entire emblem is encircled by the text 'ASSUMPTION UNIVERSITY OF THAILAND' in a grey arc. At the bottom of the circle, the Thai text 'มหาวิทยาลัยอัสสัมชัญ' is written in a grey arc, flanked by two grey asterisks. The text 'BROTHERS of' is on the left and 'S1 GABRIEL' is on the right of the shield. The text 'LABOR' is on the left and 'VINCIT' is on the right of the banner. The text 'SINCE 1969' is at the bottom center of the circle.

## APPENDIX A

Target and actual inventory days for 115 hair care SKUs selling to Japan, separated into 6 brands.

As of December 2011

Brand A

Item	SKU#	Material Description	Aligned Inventory Day (days)	Actual Inventory Day (days)
1	82151120	A SH 200MLX24 TOUCHABLE SMOOTH NEW ROSE	18	281
2	82151121	A CN 200GX24TOUCHABLE SMOOTH NEW ROSE	18	413
3	82144518	A SH 340MLX12 TOUCHABLE SMOOTH	18	16
4	82144487	ACN 340GX12 TOUCHABLE SMOOTH	18	16
5	82147109	A TRT 200GX24 TOUCHABLE SMOOTH	18	18
6	82144194	A SH 200MLX24 TOUCHABLE MOISTURE	18	558
7	82144455	A CN 200GX24 TOUCHABLE MOISTURE	18	676
8	82144482	A SH 340MLX12 TOUCHABLE MOISTURE	18	34
9	82144484	A CN 340GX12 TOUCHABLE MOISTURE	18	74
10	82144005	A TRT 200GX24 TOUCHABLE MOISTURE STK	18	38
11	82151122	A TRT 200GX24TOUCH SMOOTH STK NEW ROSE	18	0
12	82144524	A SH 375MLX12 TOUCHABLE SMOOTH	18	16
13	82144488	A CN 375GX12 TOUCHABLE SMOOTH	18	2
14	82144483	A SH 375MLX12 TOUCHABLE MOISTURE SH	18	-6
15	82144485	A CN 375GX12 TOUCHABLE MOISTURE	18	4
16	82144197	A SH 9MLX480 TOUCH SMOOTH (96*70) JP	18	0
17	82144527	A CN 9GX480 TOUCH SMOOTH (96*70) JP	18	0

Brand B

Item	SKU#	Material Description	Aligned Inventory Day (days)	Actual Inventory Day (days)
18	82152112	B SHM 200MLX6X4 MOISTURE JP STKR	18	30
19	82152114	B COND 200GX6X4 MOISTURE JP STKR	18	51
20	82152221	B TRMT 180GX24 MOISTURE JP STKR	18	25
21	82152113	B SHM 200MLX6X4 REFRESH JP STKR	18	49
22	82152115	B COND 200GX6X4 REFRESH JP EOL	18	93
23	82142370	B TRMT 180GX3X8 REFRESH JP STKR	12	21
24	82152126	B SHM REFILL 360MLX12 MOISTURE JP	15	10
25	82152127	BSHM REFILL 360MLX12 REFRESH JP	15	18
26	82152128	B COND REFILL 360GX12 MOISTURE JP	15	32
27	82152129	B COND REFILL 360GX12 REFRESH JP	15	68
28	82152121	B SHM 530MLX9 MOISTURE JP STKR	18	18

Brand B (continued)

Item	SKU#	Material Description	Aligned Inventory Day (days)	Actual Inventory Day (days)
29	82152124	B COND 530GX9 MOISTURE JP STKR	18	17
30	82152122	B SHM 530MLX9 REFRESH JP STKR	18	-12
31	82152125	B COND 530GX9 REFRESH JP STKR	18	14
32	82152222	B TRMT 180GX24 REFRESH JP STKR	31	56

Brand C

Item	SKU#	Material Description	Aligned <u>Inventory</u> Day (days)	Actual Inventory Day (days).
33	82135602	C SHM 280MLX3X4 HTR JP STKR	30	30
34	82135616	C SHM 550MLX12 HTR JP STKR	30	33
35	82135606	C COND 250GX3X4 HTR JP STKR	30	19
36	82135620	C COND 550GX12 HTR JP STKR	30	41
37	82135605	C SHM 280MLX3X4 FRZ DEF JP STKR	30	84
38	82135619	C SHM 550MLX12 FRZ DEF JP STKR	30	78
39	82135610	C COND 250GX3X4 FRZ DEF JP STKR	30	44
40	82135622	C COND 550GX12 FRZ DEF JP STKR	30	73
41	82135604	C SHM 280MLX3X4 F&T JP STKR	30	24
42	82135617	C SHM 550MLX12 F&T JP STKR	30	151
43	82135609	C COND 250GX3X4 F&T JP STKR	30	39
44	82135621	C COND 550GX12 F&T JP STKR	30	150
45	82135669	C HTMT 150GX12 F&T JP STKR	30	394 --

Brand D

Item	SKU#	Material Description	Aligned Inventory Day (days)	Actual Inventory Day (days)
46	82131837	D SHM 200MLX6X4 NATURE CARE CORA JP	12	32
47	82131839	D COND 200GX6X4 NATURE CARE CORA JP	12	31
48	82131835	D SHM 350MLX12 NATURE CARE CORA JP	18	26
49	82131836	D COND 350GX12 NATURE CARE CORA JP	18	37
50	82148098	D COND 385GX12 NATURE CARE CORA JP	18	48

Brand D (continued)

Item	SKU#	Material Description	Aligned Inventory Day (days)	Actual Inventory Day (days)
51	82148099	D SHM 385MLX12 NATURE CARE CORA JP	18	73
52	82132441	D SHM 480MLX9 NATURE CARE CORA JP	18	15
53	82132438	D COND 480GX9 NATURE CARE CORA JP	18	17
54	82131842	D TRMT 180GX3X8 NATURE CARE CORA JP	12	2
55	82133509	D TRMT 100GX48 NATURE CARE CORA JP	12	8
56	82133371	D SHM 15MLX480 NATURECARECORA(96*70)JP	18	4
57	82133373	D COND 15GX480 NATURECARECORA(96*70)JP	18	6

Brand E

Hein'	SKU#	Material Description	Aligned Inventory Day (days)	Actual Inventory Day (days)
58	82121246	E SHM 200MLX6X4 EDC IRIS JP	18	71
59	82145852	E COND 200GX6X4 EDC ABSOLUT JP	12	103
60	82146812	E TRMT 180GX3X8 EDC ABSOLUT JP	18	10
61	82121247	E SHM 200MLX6X4 SSC IRIS JP	18	109
62	82145847	E COND 200GX6X4 SSC ABSOLUT JP	12	245
63	82146811	E TRMT 180GX3X8 SSC ABSOLUT JP	18	45
64	82145848	E SHM 200MLX6X4 EDC ABSOLUT JP	12	5
65	82121256	E SHM 500MLX9 EDC IRIS JP	18	14
66	82145851	E SHM 500MLX9 EDC ABSOLUT JP	18	18
67	82145855	E COND 500GX9 EDC ABSOLUT JP	18	12
68	82121308	E TRMT 100GX48 EDC IRIS JP	18	1
69	82139955	E TRT 10MLX480 EDC (96*70) JP	18	13
70	82157321	E TRT 10MLX480 EDC (96*70) JP EXP TOP	24	1
71	82121260	E SHM 500MLX9 SSC IRIS JP	18	14
72	82145862	E SHM 500MLX9 SSC ABSOLUT JP	18	13
73	82145861	E COND 500GX9 SSC ABSOLUT JP	18	17
74	82121309	E TRMT 100GX48 SSC IRIS JP	18	3
75	82129669	E SHM 385MLX12 SSC IRIS JP JIKKAN	18	43
76	82146171	E SHM 385MLX12 SSC CUST N	18	196
77	82145859	E COND 350GX12 SSC ABSOLUT JP	18	16



Brand E (continued)

Item	SKU#	Material Description	Aligned Inventory Day (days)	Actual Inventory Day (days)
78	82148617	E COND 385GX12 SSC CUST N ABSOLUTJP	18	107
79	82145860	E COND 385GX12 SSC CUST N	18	31
80	82127168	E SHM 350MLX12 EDC IRIS JP	18	4
81	82145849	E SHM 350MLX12 EDC ABSOLUT JP	18	1
82	82127169	E COND 350GX12 EDC IRIS JP	18	0
83	82145853	E COND 350GX12 EDC ABSOLUT JP	18	11
84	82127170	E SHM 350MLX12 SSC IRIS JP	18	17
85	82145858	E SHM 350MLX12 SSC ABSOLUT JP	18	3
86	82127171	E COND 350GX12 SSC IRIS JP	18	0
87	82145850	E SHM 385MLX12 EDC ABSOLUTE JP	18	-1
88	82146169	E SHM 385MLX12 EDC CUST N	18	17
89	82148614	E SHM 385MLX12 EDC CUST N ABSOLUT JP	18	2
90	82129668	E COND 385GX12 EDC IRIS JP JIKKAN	18	0
91	82145854	E COND 385GX12 EDC ABSOLUTE JP	18	1
92	82146170	E COND 385GX12 EDC CUST N	18	-1
93	82148615	E COND 385GX12 EDC CUST N ABSOLUT JP	18	25
94	82145856	E SHM 385MLX12 SSC ABSOLUTE JP	18	0
95	82148616	E SHM 385MLX12 SSC CUST N ABSOLUT JP	18	0
96	82129670	E COND 385GX12 SSC IRIS JP JIKKAN	18	0
97	82146172	E COND 385GX12 SSC CUST N	18	0

Brand F

Item	SKU#	Material Description	Aligned Inventory Day (days)	Actual Inventory Day (days)
98	82129289	F SHM 190MLX6X4 PREMIUM BASE CARE	12	181
99	82129299	F COND 190GX6X4 PREMIUM BASE CARE	12	67
100	82129311	F TRMT 180GX8X3 PREMIUM BASE CARE	12	51
101	82129294	F SHM 190MLX6X4 PREMIUM COLOR CARE	12	121
102	82129306	F COND 190GX6X4 PREMIUM COLOR CARE	12	325
103	82129313	F TRMT 180GX8X3 PREMIUM COLOR CARE	12	24
104	82129290	F SHM 350MLX12 PREMIUM BASE CARE	18	18

Brand F (continued)

Item	SKU#	Material Description	Aligned Inventory Day (days)	Actual Inventory Day (days)
105	82129302	F COND 350GX12 PREMIUM BASE CARE	18	16
106	82129307	F COND 350GX12 PREMIUM COLOR CARE	18	16
107	82129287	F SHM 500MLX12 PREMIUM BASE CARE	18	16
108	82129297	F COND 500GX12 PREMIUM BASE CARE	18	15
109	82129293	F SHM 500MLX12 PREMIUM COLOR CARE	18	16
110	82129305	F COND 500GX12 PREMIUM COLOR CARE	18	17
111	82129295	F SHM 350MLX12 PREMIUM COLOR CARE	18	5
112	82129291	F SHM 385MLX12 PREMIUM BASE CARE	18	0
113	82129304	F COND 385GX12 PREMIUM BASE CARE	18	-60
114	82129296	F SHM 385MLX12 PREMIUM COLOR CARE	18	-42
115	82129309	F COND 385GX12 PREMIUM COLOR CARE	18	-63



The background of the page features a large, light gray watermark of the Assumption University of Thailand logo. The logo is circular, with the text "ASSUMPTION UNIVERSITY OF THAILAND" around the top and "มหาวิทยาลัยอัสสัมชัญ" around the bottom. In the center is a shield with a crown on top. The shield is divided into four quadrants: top-left (blue with a white lily and the letters "A M"), top-right (white with a blue sailboat), bottom-left (white with a blue star and a cross), and bottom-right (red with a white cross and the letters "D S"). Below the shield is a banner with the text "BROTHERS of ST GABRIEL". At the very bottom of the shield is the text "OMNIA SINCE 1969".

## APPENDIX B

Standard product cost setup for 115 hair care SKUs selling to Japan, separated into 6 brands at 2 locations: Thailand central warehouse and Japan distribution center.

As of December 2011

Brand A

Item	SKU	Description	Standard Product Cost at Thailand (USD per case)	Standard Product Cost at Japan (USD per case)
1	82151120	A SH 200MLX24 TOUCHABLE SMOOTH NEW ROSE	10.65	18.61
2	82151121	A CN 200GX24TOUCHABLE SMOOTH NEW ROSE	8.5	18.44
3	82144518	A SH 340MLX12 TOUCHABLE SMOOTH	6.62	13.1
4	82144487	ACN 340GX12 TOUCHABLE SMOOTH	5.92	13.28
5	82147109	A TRT 200GX24 TOUCHABLE SMOOTH	13.2	40.3
6	82144194	A SH 200MLX24 TOUCHABLE MOISTURE	10.48	18.66
7	82144455	A CN 200GX24 TOUCHABLE MOISTURE	8.39	18.66
8	82144482	A SH 340MLX12 TOUCHABLE MOISTURE	6.96	13.33
9	82144484	A CN 340GX12 TOUCHABLE MOISTURE	5.79	13.33
10	82144005	A TRT 200GX24 TOUCHABLE MOISTURE STK	16.2	40.33
11	82151122	A TRT 200GX24TOUCH SMOOTH STK NEW ROSE	16.34	40.33
12	82144524	A SH 375MLX12 TOUCHABLE SMOOTH	7.06	12.56
13	82144483	A CN 375GX12 TOUCHABLE SMOOTH	6.79	12.56
14	82144488	A SH 375MLX12 TOUCHABLE MOISTURE SH	6.27	12.56
15	82144485	A CN 375GX12 TOUCHABLE MOISTURE	6.11	12.56
16	82144197	A SH 9MLX480 TOUCH SMOOTH (96*70) JP	8.69	9.39
17	82144527	A CN 9GX480 TOUCH SMOOTH (96*70) JP	7.2	8.62

Brand B

Item	SKU#	Description	Standard Product Cost at Thailand (USD per case)	Standard Product Cost at Japan (USD per case)
18	82152112	B SHM 200MLX6X4 MOISTURE JP STKR	20.18	24.39
19	82152114	BCOND 200GX6X4 MOISTURE JP STKR	17.35	24.34
20	82152221	B TRMT 180GX24 MOISTURE JP STKR	16.58	53.58
21	82152113	B SHM 200MLX6X4 REFRESH JP STKR	21.83	24.34
22	82152115	B COND 200GX6X4 REFRESH JP EOL	18.86	24.34
23	82142370	B TRMT 180GX3X8 REFRESH JP STKR	17.58	53.68
24	82152126	B SHM REFILL 360MLX12 MOISTURE JP	8.69	18.89
25	82152127	BSHM REFILL 360MLX12 REFRESH JP	8.58	18.89

Brand B (continued)

Item	SKU#	Description	Standard Product Cost at Thailand (USD per case)	Standard Product Cost at Japan (USD per case)
26	82152128	B COND REFILL 360GX12 MOISTURE JP	6.8	18.89
27	82152129	B COND REFILL 360GX12 REFRESH JP	6.56	18.9
28	82152121	B SHM 530MLX9 MOISTURE JP STKR	13.41	20.98
29	82152124	B COND 530GX9 MOISTURE JP STKR	11.66	20.98
30	82152122	B SHM 530MLX9 REFRESH JP STKR	13.62	20.98
31	82152125	B COND 530GX9 REFRESH JP STKR	11.7	20.98
32	82152222	B TRMT 180GX24 REFRESH JP STKR	17.09	53.59

Brand C

Item	SKU#	Description	Standard Product Cost at Thailand (USD per case)	Standard Product Cost at Japan (USD per case)
33	82135602	C SHM 280MLX3X4 HTR JP STKR	11.12	38.18
34	82135616	C SHM 550MLX12 HTR JP STKR	13.4	80.69
35	82135606	C COND 250GX3X4 HTR JP STKR	8.34	38.21
36	82135620	C COND 550GX12 HTR JP STKR	12.44	80.69
37	82135605	C SHM 280MLX3X4 FRZ DEF JP STKR	11.34	38.19
38	82135619	C SHM 550MLX12 FRZ DEF JP STKR	12.34	80.69
39	82135610	C COND 250GX3X4 FRZ DEF JP STKR	8.37	38.2
40	82135622	C COND 550GX12 FRZ DEF JP STKR	12.73	80.69
41	82135604	C SHM 280MLX3X4 F&T JP STKR	10.99	38.16
42	82135617	C SHM 550MLX12 F&T JP STKR	11.71	80.69
43	82135609	C COND 250GX3X4 F&T JP STKR	7.03	38.15
44	82135621	C COND 550GX12 F&T JP STKR	10.23	80.69
45	82135669	C HTMT 150GX12 F&T JP STKR	6.55	38.14



## Brand D

Item	SKU#	Description	Standard Product Cost at Thailand (USD Per case)	Standard Product Cost at Japan (US!) per case)
46	82131837	D SHM 200MLX6X4 NATURE CARE CORA JP	10.01	17.98
47	82131839	D COND 200GX6X4 NATURE CARE CORA JP	7.72	17.75
48	82131835	D SHM 350MLX12 NATURE CARE CORA JP	7.36	15.31
49	82131836	D COND 350GX12 NATURE CARE CORA JP	5.22	14.6
50	82148098	D COND 385GX12 NATURE CARE CORA JP	7.23	15.87
51	82148099	D SHM 385MLX12 NATURE CARE CORA JP	5.37	15.91
52	82132441	D SHM 480MLX9 NATURE CARE CORA JP	10.9	34.85
53	82132438	D COND 480GX9 NATURE CARE CORA JP	8.74	34.85
54	82131842	D TRMT 180GX3X8 NATURE CARE CORA JP	11.23	87.68
55	82133509	D TRMT 100GX48 NATURE CARE CORA JP	12.11	47.15
56	82133371	D SHM 15MLX480 NATURECARECOR(96*70)JP	11.88	13.25
57	82133373	D COND 15GX480 NATURECARECOR(96*70)JP	8.12	10.23

## Brand E

Item	SKU#	Description	Standard Product Cost at Thailand (USD per case)	Standard Product Cost at Japan (USD per case)
58	82121246	E SHM 200MLX6X4 EDC IRIS JP	8.79	32.85
59	82145852	E COND 200GX6X4 EDC ABSOLUT JP	8.47	18.01
60	82146812	E TRMT 180GX3X8 EDC ABSOLUT JP	11.17	37.35
61	82121247	E SHM 200MLX6X4 SSC IRIS JP	8.43	32.38
62	82145847	E COND 200GX6X4 SSC ABSOLUT JP	8.18	17.75
63	82146811	E TRMT 180GX3X8 SSC ABSOLUT JP	11.06	43.36
64	82145848	E SHM 200MLX6X4 EDC ABSOLUT JP	8.9	17.98
65	82121256	E SHM 500MLX9 EDC IRIS JP	11.08	28.75
66	82145851	E SHM 500MLX9 EDC ABSOLUT JP	10.01	20.68
67	82145855	E COND 500GX9 EDC ABSOLUT JP	9.52	17.76
68	82121308	E TRMT 100GX48 EDC IRIS JP	13.42	48.82
69	82139955	E TRT 10MLX480 EDC (96*70) JP	7.77	9.6
70	82157321	E TRT 10MLX480 EDC (96*70) JP EXP TOP	8.33	10.33

Brand E (continued)

Item	SKU#	Description	Standard Product Cost at Thailand (USD per case)	Standard Product Cost at Japan (USD per case)
71	82121260	E SHM 500MLX9 SSC IRIS JP	11	28.78
72	82145862	E SHM 500MLX9 SSC ABSOLUT JP	9.94	20.68
73	82145861	E COND 500GX9 SSC ABSOLUT JP	9.43	17.85
74	82121309	E TRMT 100GX48 SSC IRIS JP	13.38	48.82
75	82129669	E SHM 385MLX12 SSC IRIS JP JIKKAN	7.64	16.13
76	82146171	E SHM 385MLX12 SSC CUST N	7.67	16.06
77	82145859	E COND 350GX12 SSC ABSOLUT JP	5.82	15.72
78	82148617	E COND 385GX12 SSC CUST N ABSOLUT JP	6.11	16.18
79	82145860	E COND 385GX12 SSC CUST N	6.11	15.99
80	82127168	E SHM 350MLX12 EDC IRIS JP	7.24	24.53
81	82145849	E SHM 350MLX12 EDC ABSOLUT JP	6.29	15.31
82	82127169	E COND 350GX12 EDC IRIS JP	5.75	24.5
83	82145853	E COND 350GX12 EDC ABSOLUT JP	5.83	14.6
84	82127170	E SHM 350MLX12 SSC IRIS JP	7.24	24.48
85	82145858	E SHM 350MLX12 SSC ABSOLUT JP	6.31	15.77
86	82127171	E COND 350GX12 SSC IRIS JP	5.74	24.45
87	82145850	E SHM 385MLX12 EDC ABSOLUTE JP	5.76	15.42
88	82146169	E SHM 385MLX12 EDC CUST N	7.66	15.61
89	82148614	E SHM 385MLX12 EDC CUST N ABSOLUT JP	5.86	15.61
90	82129668	E COND 385GX12 EDC IRIS JP JIKKAN	5.95	15.73
91	82145854	E COND 385GX12 EDC ABSOLUTE JP	6.07	15.73
92	82146170	E COND 385GX12 EDC CUST N	5.98	15.65
93	82148615	E COND 385GX12 EDC CUST N ABSOLUT JP	6.07	15.65
94	82145856	E SHM 385MLX12 SSC ABSOLUTE JP	5.77	15.88
95	82148616	E SHM 385MLX12 SSC CUST N ABSOLUT JP	5.87	16.06
96	82129670	E COND 385GX12 SSC IRIS JP JIKKAN	5.94	16.24
97	82146172	E COND 385GX12 SSC CUST N	6.01	16.18

Brand F

Item	SKU#	Description	Standard Product Cost at Thailand (USD per case)	Standard Product Cost at Japan (USD per case)
98	82129289	F SHM 190MLX6X4 PREMIUM BASE CARE	17.61	22.61
99	82129299	F COND 190GX6X4 PREMIUM BASE CARE	17.56	22.84
100	82129311	F TRMT 180GX8X3 PREMIUM BASE CARE	13.62	50.19
101	82129294	F SHM 190MLX6X4 PREMIUM COLOR CARE	19.55	22.85
102	82129306	F COND 190GX6X4 PREMIUM COLOR CARE	16.6	22.56
103	82129313	F TRMT 180GX8X3 PREMIUM COLOR CARE	13.63	50.21
104	82129290	F SHM 350MLX12 PREMIUM BASE CARE	7.24	13.62
105	82129302	F COND 350GX12 PREMIUM BASE CARE	5.49	13.68
106	82129307	F COND 350GX12 PREMIUM COLOR CARE	5.5	13.41
107	82129287	F SHM 500MLX12 PREMIUM BASE CARE	15.16	40.64
108	82129297	F COND 500GX12 PREMIUM BASE CARE	13.82	40.85
109	82129293	F SHM 500MLX12 PREMIUM COLOR CARE	15.65	40.64
110	82129305	F COND 500GX12 PREMIUM COLOR CARE	13.83	41.29
111	82129295	F SHM 350MLX12 PREMIUM COLOR CARE	7.26	13.6
112	82129291	F SHM 385MLX12 PREMIUM BASE CARE	7.56	17.88
113	82129304	F COND 385GX12 PREMIUM BASE CARE	5.64	17.91
114	82129296	F SHM 385MLX12 PREMIUM COLOR CARE	7.57	17.85
115	82129309	F COND 385GX12 PREMIUM COLOR CARE	5.64	17.89