APPLICATION OF POSTPONEMENT STRATEGY TO
INVENTORY MANAGEMENT:
A CASE OF A WOODEN FURNITURE MANUFACTURER

By

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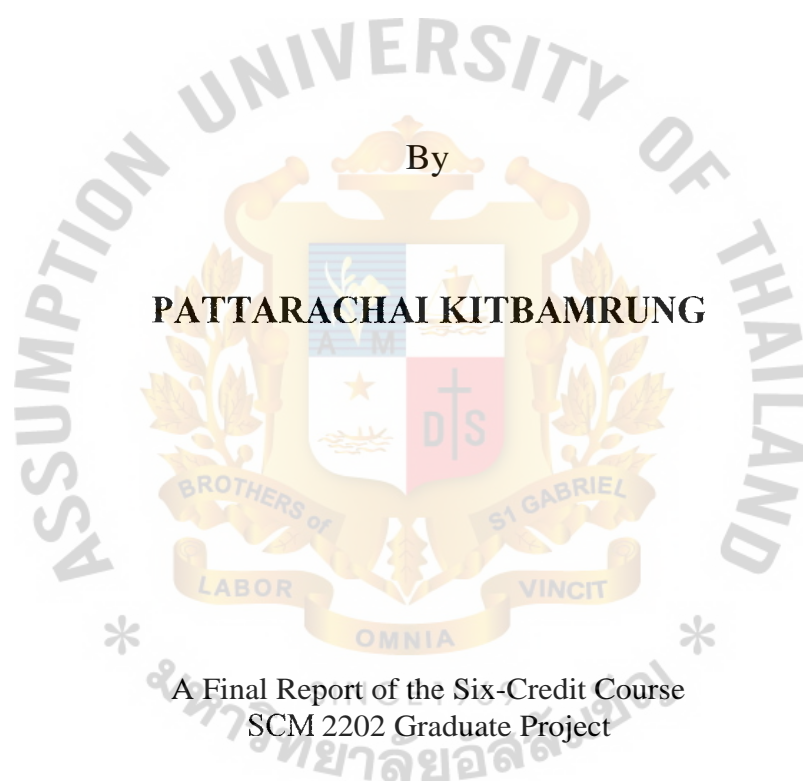SCM 2202 Graduate Project

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Master of Science in Supply Chain Management

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<u>Furniture Manufacturer</u>

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APPLICATION OF POSTPONEMENT STRATEGY TO INVENTORY MANAGEMENT: A CASE OF A WOODEN FURNITURE MANUFACTURER

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ABSTRACT

The purpose of this research is to improve inventory cost and turnover of a wooden furniture manufacturer by applying manufacturing postponement strategy. Manufacturing postponement is one of the postponement techniques, which allows the firms to postpone the final manufacturing process until customer demands are realized.

The data, such as current production process and lead times, historical sales data, customer behaviors, and delivery lead time, are collected and analyzed in order to develop a new production process. In order to point out the results of the new production process, Excel worksheets are created to control overall inventory transactions and movements.

After completing the worksheets, the results of existing and new production processes when applying postponement strategy are compared, in order to indicate the improvements. The results of postponement application were satisfactory. The average inventory costs of two studied product categories could be reduced by 30.27% and 21.28% respectively, and the average inventory turnovers could be improved by 43.41% and 27.03% respectively.

ACKNOWLEDGEMENTS

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CHAPTER I

GENERALITIES OF THE STUDY

In today's business, customer demand is more and more complex. Customers are changing their product preferences all the time, demanding that companies provide quick response to their requirements, with more concern about product quality rather than price. This fact leads business operators not only to enhance their product categories but also their operation management in order to serve the customers effectively. However the demand and supply should be balanced for if not, inventory handling problems will arise. Excessive inventory problem occurs when a company produces and stocks more products than are actually sold. Then surplus products need to be stored for a while. In contrast, if the inventory is insufficient, companies will not have enough products to serve all customers: customer dissatisfaction will occur as well as its consequences such as customer switching, lower loyalty, and intention not to buy. Both issues, inventory too high and too low, are critical logistics problems facing companies.

1.1 Background of the Study

The furniture industry is one of the growing industries in Thailand, in which its export value was US$ 1,172 million or 35,000 million Baht in 2010 (Ministry of Industry Thailand, 2011). Besides exporting, the furniture industry also plays an important role in the domestic economy, since the total number of furniture manufacturers is more than 3,000 companies and created 300,000 jobs. Therefore, the furniture industry is chosen to be 1 of 13 industries that are in government's support campaign to enhance exporting competitive advantage.

The furniture industry can be divided into two main parts: wooden furniture and metal furniture. The export values of wooden and metal furniture were approximately 17,500 and 2,200 million Baht respectively (Ministry of Commerce, 2010). Currently,

The furniture industry is facing high competition from both domestic and international companies. China and Vietnam are major competitors in the international market, and their export values are continuously increasing every year (Department of Export Promotion, 2010). On the other hand, IKEA, a Swedish world-class furniture retailer, has invested more than 40,000 million Baht to launch three branches in Thailand, and the first one will open on November, 2011. This trend would benefit to customers because they have more various choices to select, but it is worse for domestic manufacturers. As a result, any company who can respond effectively to customer needs would gain competitive advantage and survive in the market.

Pearl Company is a family business that produces wooden furniture with inlaid pearl decoration. Pearl Company is a retailer and manufacturer producing various types of wooden furniture such as, dining table, conference table, wooden cabinet, and living room set. There are eleven product categories in total. Some products samples are shown in Figure 1.1.

Figure 1.1: Examples of Pearl Company Products
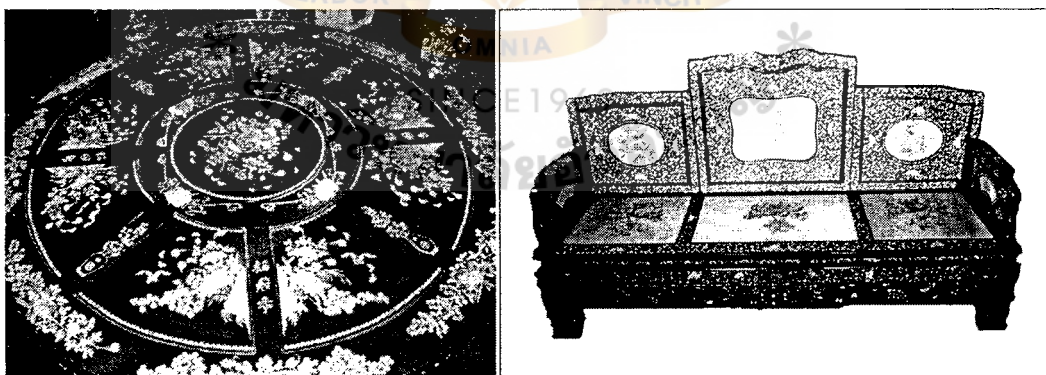
In addition, products in each category also have different designs and colors. For example, there are 15 designs of living room set, and each set has 3 to 4 different colors, such as, red, oak, brown and black. Therefore, the company has more than 500 SKUs of inventory to manage.

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1.2 Statement of Problem

As it operation in a highly competitive market, Pearl Company differentiates its products from the competitors by applying a unique Chinese traditional design in which pearls are inlaid on the surfaces of the products. Most of them are handmade. Due to demand complexity and varieties of customer preferences, the Company provides various product categories and designs in order to serve different demands of the customers. However, this strategy also causes the company to experience the following major problems: high inventory cost and low inventory turnover.

As most of products are handmade, the average production lead time ranges from 32 to 63 days depending on product category. Thus, Pearl Company currently keeps high inventory on hand to ensure that the products are sufficiently available to meet customer demand. The company normally stocks two to four units for the same SKU to prevent lost sales, and thus the Company has more than 500 SKUs, the average cost per SKU being approximately 45,200 Baht. Therefore, Pearl Company has to carry a very high inventory cost.

The average inventory turnovers of the Furniture industry and Company in 2010 are summarized in Table 1.1.

Table 1.1: Inventory Turnover of Furniture Industry and Company in 2010

Company	Cost of goods sold (Baht)	Average inventory (Baht)	Inventory turnover (Times)
Fancy Wood	783,956,712	110,559,825	7.09
Rockworth	584,904,770	123,752,925	4.73
Pearl Company	38,475,000	22,630,667	1.70

Source: The Stock Exchange of Thailand, and Company's financial data

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From Table 1.1, the inventory turnovers of Fancy Wood Company and Rockworth Company in 2010 were approximately 7.09 and 4.73 times respectively. However, the inventory turnover of Pearl Company was only 1.70 times. Thus, when compared to the other furniture manufacturers, the imbalance of inventory cost and cost of goods sold lead to low inventory turnover.

To solve the problems, postponement strategy is considered as an alternative solution. Postponement is an effective strategy to manage the risks associated with demand uncertainty and high inventory cost. The concept is to delay the final production process as close to customers as possible, and to customizes finished products based upon actual customer orders.

As Pearl Company is making a decision to apply postponement strategy for its manufacturing process to solve the problems, the focus question is: **"How could postponement strategy be implemented to reduce Pearl Company's inventory cost?"**.

1.3 Research Objectives

The three main objectives of the study are as follows.

1. To identify the key postponement activities that are appropriate for Pearl Company to improve its production process.
2. To plan for the implementation of the postponement activities to improve inventory turnover of the Pearl Company.
3. To illustrate the possible improvements of the production process and inventory turnover from the implementation of the postponement activities.

1.4 Scope of the Study

The scope of the study focuses on two main product categories of Pearl Company, which are living room sets and dining tables. The two product categories are selected

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because their values represent approximately 81% of total inventory cost, as illustrated in Figure 1.2:

Figure 1.2: Inventory Cost of Pearl Company for 2010
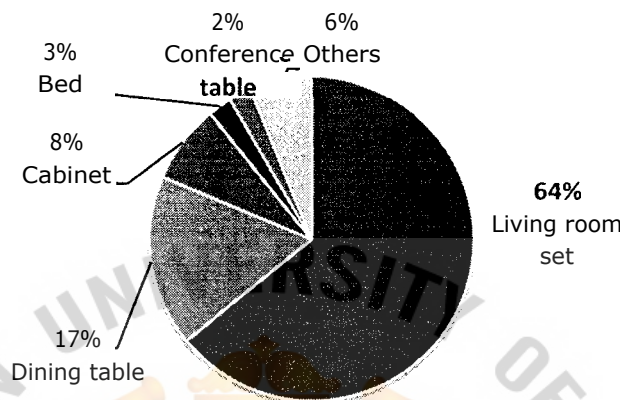
Source: Company financial data

From Figure 1.2, the living room sets were the major products of Pearl Company since they covered approximately 65 percent of total inventory cost. The dining tables were the second rank, approximately 17 percent. And the rest covered approximately 19 percent. Only the postponement concept is selected to solve the inventory problem of the Company in this project. One year data, for 2010 (January to December 2010) is used for the analyses and plans.

1.5 Limitations of the Study

There are some limitations of the research. First, this study only concentrates on Pearl Company, so the result may be limited only to this particular Company. Second, since this study mainly focuses on the application of the postponement strategy to improve inventory management effectiveness, other strategies and their possible outcomes are not included. Finally, this study does not emphasize other relevant costs, such as, transportation cost, storage cost, interest cost and warehousing cost. The study only concentrates on production manufacturing costs.

Furthermore, because of commercial confidentiality, the names of the studied products will be shown only as codenames.

1.6 Significance of the Study

The application of postponement strategy would help the company to obtain an opportunity to customize products based on customers' actual orders. As a result, the company can keep stock at minimum volumes, and this leads to the crucial outcome of the study which is reducing inventory cost.

In addition, the study also enhances the knowledge of postponement strategy in detail. The researcher learns how to apply the strategy, what are the limitations and the benefits. Furthermore, the most significant objective of the study is to gain deep understanding about supply chain management, and learn how to apply it in a real life situation.

1.7 Definition of Terms

Excess Inventory	The excess or surplus inventory occurs when the company has finished products greater than what customers would like to buy. Then the leftover amount would be kept in a warehouse or on-shelf (Capkun, Hameri & Weiss, 2009)
Inventory Cost	It is the cost of holding finished products in stock, including raw material cost, production cost, warehousing cost, obsolescence and shrinkage cost (Britney, 1980)
Inventory Management	It is the management of materials for customer satisfaction and profitability, while maintaining a minimum inventory investment, with maximum facility and manpower utilization (Lancioni & Howard, 1978).

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Inventory Turnover   The inventory turnover measures how many times the products are sold within a specific period of time. It could be measured both in term of money and units. The formula is as follows (Britney, 1980).

$$\text{Inventory Turnover} = \frac{\text{Cost of Goods Sold}}{\text{Average Inventory Level}}$$

Postponement Strategy   Postponement is a supply chain management concept about delaying the activities until the customer demand is specified, and then the final production process would be performed according to the customer's requirements (Yang, Burns & Backhouse, 2004).

Shortage Inventory   Shortage inventory is opposite to excess inventory; it is when the company does not have enough products to sell to customers (Capkun, Hameri & Weiss, 2009).

Supply Chain Management   Supply chain management is the integration and collaboration of the businesses involved in order to reach the ultimate utilization for the whole chain (Li, Kumar & Lim, 2002).

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CHAPTER II

REVIEW OF RELATED LITERATURE

The application of postponement strategy is a main concept to solve the inventory problem in this study. Thus, in order to gain deep understanding about the concept, this chapter reviews literature which is related to postponement strategy and inventory management.

2.1 Inventory Cost

In some industries, inventory is a huge investment amount that show in their balance sheets. For fast moving products, such as electronic component parts, because of short product life cycle the obsolete items could have a crucial impact on inventory cost. However, it is important to identify where the cost comes from. Walker and Wu, (2000) stated that there are two primary inventory cost elements, which are direct and indirect costs. Direct cost mainly comes from raw material cost. In contrast, utilities cost, labor cost, and warehouse space cost are indirect costs.

2.2 Inventory Management

Inventory consists of raw material, work-in-process, or finished goods (Capkun, Hameri, & Weiss, 2009), that should be kept in a warehouse or store at any given time. Shop owners have to know the amount of goods on shelves and storage areas in order to make replenishment and control stock loss. Manufacturers need to identify how many products are available to serve customer orders. Restaurant owners have to obtain the optimal quantity of ingredients based on their customer demands.

According to Capkun et al. (2009), the total inventory performance would be affected by raw materials, work-in-process, and finished goods. The characteristic of each items are presented below:

(1) Raw materials. They are the originate items that are required in order to produce the products.

(2) Work-in-process (WIP). It is an item that is already in the production process but not yet completed. This inventory type could be found at any production phase throughout the plant.

(3) Finished goods. They are the results of raw materials that have completed all production processes, and are waiting for sale (in a make-to-stock manufacturer), or ready for shipment (in a make-to-order manufacturer).

Inventory management is one of the most important functions in any industry, not only for retailers or manufacturers but governments also implement this concept (Ayad, 2008). Ineffective and inefficient management can result in some serious problems; such as excessive inventory, shortage inventory, unnecessary costs, lower customer service level, or obsolete cost (Lee & Kleiner, 2001). Thus, currently, many industries already apply an effective inventory management concept in their operations. Examples are the Warehouse Management System (WMS), that helps to operate and control the whole inventory in a warehouse (Spencer, 1993), and the application of Economic Order Quantity model (EOQ) to find the optimal amount that should be ordered at a time (Fazel, 1997). On the other hand, some manufacturers decided to manage inventory by increasing their manufacturing effectiveness. Mass customization is an approach that could help to achieve low production cost of various product categories, mostly applicable to mass production industries (Pine II, 1993). Another concept is postponement strategy. This is similar to mass customization, but it focuses on delaying the last manufacturing process as close to the market as possible (Yang et al., 2004), and it could be applied in both make-to-stock and make-to-order manufacturing processes. The benefits of each strategy are summarized in Table 2.1.

Table 2.1: Benefits of Each Strategy on Inventory

Author	Strategy implementation	Benefits
Pine II (1993)	Mass Customization	- Achieving customer satisfaction level with more product varieties. - Maximize benefit with products that are produced in mass, such as, electronic components. - Dell and IBM are good examples of achieving mass customization.
Spencer (1993)	Warehouse Management System (WMS)	- The scope of implementation is not specific only to the inventory part, but covers the whole warehousing activities.
Fazel (1997)	Economic Order Quantity (EOQ)	- Ordering raw materials at economic amounts. - Savings in ordering and transportation costs.
Rietze (2006)	Postponement strategy	- The overall inventory cost is lower since the finished goods will be produced according to customer orders. - Long production lead time could be shortened. - Embraer is a successful company that can shorten aircraft production lead time by one year.

2.3 Postponement Strategy

As previously mentioned, there are various supply chain management strategies and techniques that could reduce uncertainty and cost, while enhancing the customer satisfaction level. The postponement strategy is one of them, delaying the production process until receiving customer's orders could provide several benefits (Yang et al., 2004). The outcomes also affect reduction in transportation cost, inventory cost, obsolescence and shrinkage cost, and warehousing cost (Boone, Craighead, & Hanna, 2007).

Graman and Magazine (2006) mentioned that currently customers preferred products and services to be customized, and that their demands should be filled with quick responsiveness. Of course, they never want to pay any additional price for this customization. Then, what the company did in the past was to as much keep inventory as possible in order that all orders would be fulfilled. Unfortunately, this trend caused a worse problem of high inventory cost. Therefore, postponement is the answer to cope with demand uncertainty and reduce inventory cost (Huang & Li, 2009).

2.3.1 Categories of Postponement Strategy

Battezzati and Magnani (2000) identified at least two major postponement categories, which are logistic postponement and manufacturing postponement. For logistic postponement, the delaying activity takes place in the distribution network, thus the shipment would be performed according to customer order. On the other hand, manufacturing postponement would postpone the manufacturing activities within the factory, and then the final activities are carried out to a customer's specific order. The details of each category will be discussed below.

Logistic Postponement

Logistic postponement could be an important part in achieving postponement strategy (Battezzati & Magnani, 2000). In fact, the delivery lead time could be shortened by applying the logistic postponement concept in the distribution processes (Van Hoek, 2000). It could be applied in any business sector since it is not concerned with the

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product types, but the only limitation is transportation capability to achieve the delivery speed required by the market (Battezzati & Magnani, 2000). However, the maximum benefits of the strategy would be obtained when physical transportation contains customized products.

Manufacturing Postponement

This is a most common and popular postponement technique. The standard products are produced and then wait for the customer order. Once customer orders are received, the final phases would be performed. Thus, it should be remembered that the postponement would become extremely effective when it take place in the last production process (Battezzati & Magnani, 2000).

2.3.2 Benefits of Postponement Strategy

Customized products to get competitive advantage

Customers tend to request more differentiated products. Business operators should identify what customers really want in order to satisfy their needs. Each individual demand would be fulfilled by customizing products with high process flexibility (Senanayake & Little, 2010). Postponement allows companies to keep inventory at an acceptable level and be able to serve each specific customer's requirement. Thus, the companies that apply an appropriate postponement strategy could gain competitive advantage by providing more varied products and with responsiveness.

Improving customer service level

Shorter production lead time, quick response to fulfill customer order, and have available stock to satisfy order quantity: all of these could improve the customer service level of companies. In addition, the key factor to determine the postponement point is the maximum customer waiting time. The postponed activities and delivery lead time should not exceed than one week if that customer is willing to wait no longer than a week.

Inventory cost reduction

The numerous amounts of product categories also affect inventory cost. Since it is almost impossible to make an absolutely correct demand forecast, the company needs to continue carrying high inventory costs. Therefore, the appropriate inventory on hand for a single SKU during a period of time should be considered in order to reduce the whole inventory cost (Wallin, Rungtusanatham, & Rabinovich, 2006).

2.3.3 Postponement Strategy Implementation

Prior to implementation of the postponement concept, identifying the postponement point should be the first consideration. Pros and cons for all parties involved should be balanced. Thus, business operators should consider where the applicable delayed point is in the supply chain.

Figure 2.1 shows how the postponement could be applied in the supply chain processes. It shows how each postponement strategy could be applied in the supply chain activities. For Pure postponement, the whole activities will not be performed until customers' orders are received. It is appropriate to the firms that require special product design and functions. It is similar to the engineering to-order. Thus, this postponement type takes longest lead time. In contrast, for logistic postponement, the postponed activity is within the distribution networks. Products are already produced and shipped to the warehouses or distribution centers prior to customers' orders. Therefore, the company that applies this postponement type has the most responsiveness because the finished products are already stored close to the market. However, for manufacturing postponement, the delayed activities are taking place within production processes. Then the component parts are postponed to the final manufacturing process, and they are customized based on customer requirements. So, it has significance influence on inventory cost reduction since the company can store only semi-finished products (Yang et al., 2004).

Make to Forecast

Shipment to order

Engineering to order

Design → Purchasing → Fabrication → Assembly → Packaging → Distribution

Pure Postponement

Purchasing Postponement

Manufacturing Postponement

Assembly Postponement

Packaging/Labelling Postponement

Logistics Postponement

Pure Speculation

Standardisation
Lean
Globalisation
(Centralisation)

Customisation
Agile
Localisation
(Decentralisation)

Source: Yang et al. (2004)

There are three important steps for formulating and implementing a postponement strategy.

Step 1: Analysis of customer demands

Before applying the postponement strategy, companies have to clearly understand what the market requirements are, such as, color, size, material, and design. Thus, the first step is to understand the customer behavior, and also the source of demand variability (Yang et al., 2004).

Step 2: Consider and select the possible postponement points

After companies understand the customers' needs, they should consider where the possible postponement points are. For example, as shown in Figure 2.3 above, the possible postponement points are may be at final assembly stage, product packaging, product design, raw material purchasing, or distribution to customer. At these points, companies should analyze the costs and benefits of postponement implementation (Yang et al., 2004).

Step 3: Postponement strategy selection and implementation

Once the postponement points are selected, companies can start to re-design the products and processes for postponement (Johnson & Anderson, 2000). Some company could achieve postponement utilization by delaying operations or by re-sequencing processes, each of which is associated with a separate attribute (Lee & Tang, 1997). However, each business operator should understand that an individual postponement strategy effectiveness for a company may not affect the others. The internal operation and production processes of each business are important factors in selecting an appropriate postponement strategy. Therefore, Table 2.2 shows a summary of postponement strategies and the firms which would gain benefits from postponement implementation.

Table 2.2: List of Postponement Strategies and Potentially Interested Firms

Postponement Type	Potentially Interested Firms
Labeling	- Firms selling a product with several brand names - Firms with high unit value products - Firms with high product sales fluctuations
Packaging	- Firms selling a product under several package sizes - Firms with high unit value products - Firms with high product sales fluctuations
Assembly	- Firms selling products with several versions - Firms selling a product whose cube is greatly reduced if shipped unassembled - Firms with high unit value products - Firms with high product sales fluctuations
Manufacturing	- Firms selling products with a high proportion of ubiquitous materials - Firms with high unit value products - Firms with high product sales fluctuations
Time	- Firms with high unit value products - Firms with a large number of distribution warehouses - Firms with high product sales fluctuations

Source: Zinn and Bowersox (1988)

Labeling postponement is appropriate to those firms that sell a product under different brand names. The unlabeled products will be shipped to the warehouse, and then the

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labeling process could be performed after receiving customer orders. For packaging postponement, the firms that sell products with several package sizes are appropriate for using this strategy. The products will be shipped in bulk to the warehouse or distribution center. Then they would be packed in pallets or boxes according to customer orders. For assemble postponement, the products would be shipped unassembled to warehouse or customers. This strategy is appropriate to the products that can save shipment space if they are shipped unassembled. Manufacturing postponement is appropriate to the firms that sell products with a high proportion of common raw materials. Thus the firms can customize products based on customer requirements. Finally, in time postponement, the finished products are shipped to distribution warehouses prior to the customer orders. Then the products are stored close to the customers for rapid delivery.

2.4 Summary

From the literature review, it could be summarized that high inventory cost has significant effects on company overall performance, and one of the effective solution is the manufacturing postponement strategy application. The principle of manufacturing postponement is appropriate to Pearl Company because its benefit is to postpone the final production process to be as close to the customer as possible. So, the final phase will begin once a customer has placed an order, for then the product could be customized according to specific requirements. To gain highest postponement utilization, the following three steps should be applied: understanding the market requirements, considering and selecting the possible postponement points, and postponement strategy selection and implementation.

In conclusion, this study is applying the manufacturing postponement strategy to delay the final production phase in order to improve inventory turnover. As a result, Figure 2.2 shows the main steps for applying the postponement implementation for Pearl Company.

Figure 2.2: Steps of Formulating and Implementing a Postponement Strategy

1. Analysis of customer demand
2. Consider and select possible postponement points
3. Postponement strategy selection and implementation
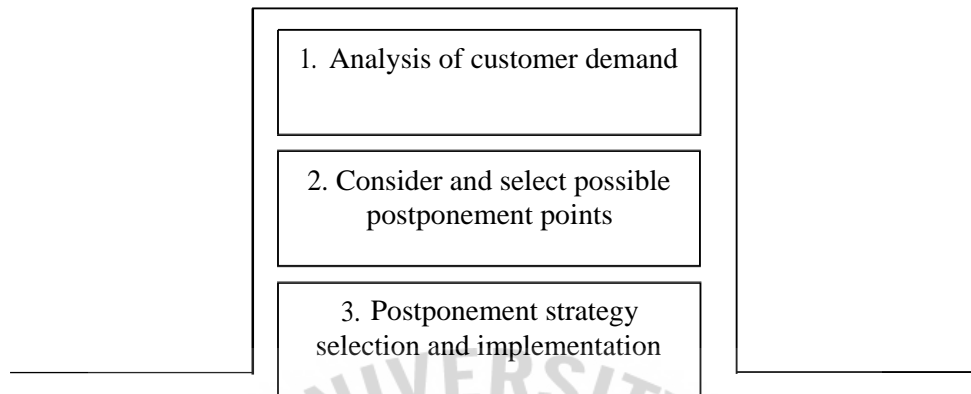
CHAPTER III

RESEARCH METHODOLOGY

This chapter explains the relevant methodology adapted to gather and analyze the data of the research. The researcher's six research steps are: data collection, analysis of production and business process mapping, analysis of customer demands, consider and select possible postponement points together with postponement strategy and selection plan, analyze and compare between new process and current process, and findings and conclusion.

3.1 Research Plan

This is a case study of Pearl Company. The Company is a family business that produces wooden furniture with inlaid pearl decoration. Two major product categories, which are living room set and dining table, are the focus of this study. 15 designs of living room set and 12 designs of dining table are commonly offered to the customers.

As only one business operation is concerned, the case study method is utilized. The methodologies applied in the research start from data collection, analysis of relevant factors, postponement implementation, and summarizing the research findings. In conclusion, the research project has six steps as shown in Figure 3.1 below.

Figure 3.1: Research Plan

Step 1	• Data Collection
Step 2	• Analysis of production process & Inventory cost
Step 3	• Analysis of customer demands
Step 4	• Identify the possible postponement points • Select the postponement strategy
Step 5	• Analyze and compare new and current process
Step 6	• Findings and conclusions

The first step, data collection, is the process of how the researcher collects and obtains relevant research data. Then, the production and business process are indentified and analyzed to gain deep understanding of the company's operation. After understanding the internal operation, the external factor, such as customer demands, should be considered. Analysis of customer demands is a process of obtaining customer behaviors and customer preferences in purchasing the company's products. Next, consideration and selection of the possible postponement points and postponement strategy are performed in step 4. After that, the current and new processes are compared and analyzed to identify the modified process. The results and findings of this research are discussed and presented in the last step. The explanations of each step are shown below.

3.2. Data Collection

The data collection process means the way to obtain relevant data. The purpose of this step is to gather the relevant data including financial data, historical sales data

business operation, production processes, and customer behaviors and characteristics. In this research, the following techniques are applied to collect research data:

(1) Document review.

Document review is the main data collection method in this research project. Since most relevant data are related to financial and production information, a review of the Company's documents is a crucial technique to collect data. The first key reviewed documents are the Company's operational documents in order to identify the business operation and production process and lead time. Second, Company's stock records show inventory on hand at a specific period. Next, sales documents are reviewed to analyze sales revenue and customer preferred delivery time. Finally, the material cost of 2010 is collected from purchase invoices.

(2) Observation.

Observations can give more accurate information on work flows, production processes and lead time by watching and recording the Company production processes. Thus, the researcher observes and collects data about how each production process is performed, how the products flow along the production processes, and how long the production lead time is.

(3) Interviews.

The interview is a data collection technique in which the researcher asks oral questions to respondents, either individually or as a group. The purpose of interviews is to obtain intensive information about the important topics from respondents. In this research, the business's owner and sales manager are the main interested respondents.

The researcher collects data of types of customer and customer preferred delivery times by interviewing the business's owner. The owner also provides more information about sales proportion between light and heavy buying customers. In addition, the researcher also interviews the sales manager to gain deep understanding about customers' preferences for Company products.

3.3 Analysis of Production Process and Inventory Cost

3.3.1 Production Process

Business operation is separated into two main parts - operation and production processes. Operation process is responsible for acquiring raw materials and delivering the products, while production process is the handling of all production parts. Once a customer purchases a product, the Company production process starts to replenish inventory immediately. The overview of business operation is illustrated in Figure 3.2.

Figure 3.2: Production Process Flow
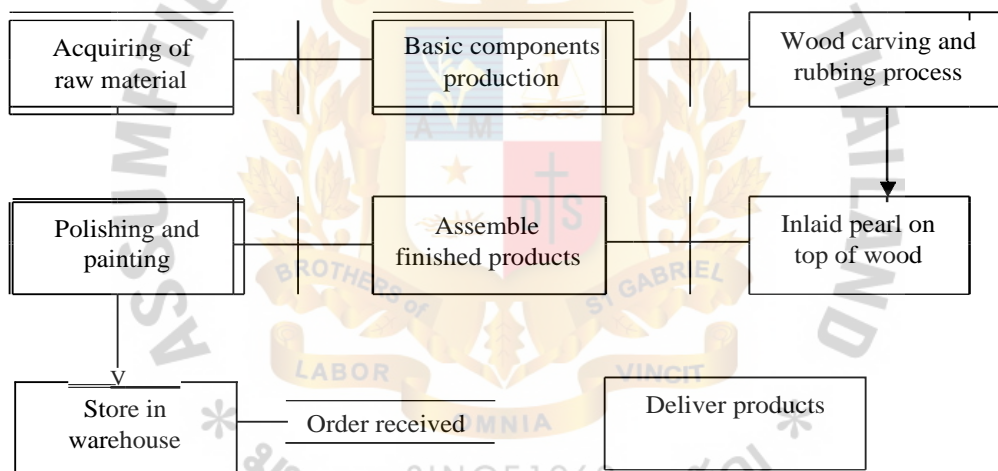
Source: Company's operational document

The production division is the main business operation and also source of cost. The production processes includes basic components production, wood carving and rubbing process, pearl inlaid in the wood surface, assemble finished products, and polishing and painting. These main activities convert raw materials into finished products.

3.3.2 Raw Materials

The essential raw materials are wood, marble, pearl oyster shell, and wood coloring. The cost of each item is presented in Table 3.1 below:

Table 3.1: List of Raw Materials

Raw material	Unit cost (THB)
Wood	1,200 THB per piece of 8 inches * 2 m. * 6 inches dimension. 2,200 THB per piece of 12 inches * 2 m. * 3 inches dimension.
Marble	250 THB per piece of 24 * 24 inches.
Pearl oyster shell	1,000 THB per kg.
Wood coloring	800 THB per gallon.

Source: The Company financial data

There are two sizes of wood; 8 inches * 2 m. * 6 inches, and 12 inches * 2 m. * 3 inches dimensions. The first one is raw material for producing table legs, chair legs and armchairs, while another size is for backseats, table surfaces and the rest of the components of living room set and dining table. Some product designs require putting marble on the top of wood, but pearl oyster shell should be inlaid on all products. Then, products go through the dying using wood coloring.

3.3.3 Production Lead Time

After collecting data, the current production process is analyzed in order to select possible postponement points. Figure 3.3 presents the current production process and production lead time for living room set and dining table.

Figure 3.3: Current Production Process and Lead Time

Basic components production (1-3 days)	Wood carving and rubbing process (14- 21 days)	Inlaid pearl on top of wood (7 − 21 days)
	Polishing and painting (5 − 10 days)	Assemble finished products (5 − 8 days)
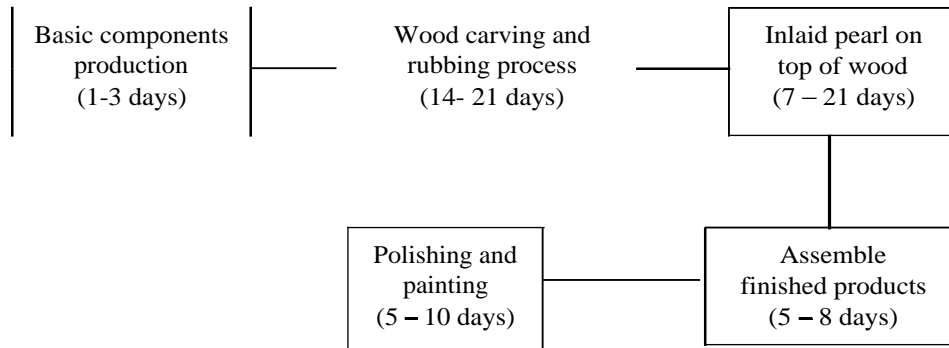
Source: Company production process

The first production process is the basic components production phase, in which all component parts, such as, table legs, chair legs, armchairs, and backseats, are produced. It takes about one to three days to complete. Then, all components pass through the next step which is wood carving and rubbing process. The components are carved out and rubbed up according to each specific design. This step is very important because the products would be differentiated from competitors according to unique designs. The process requires 14 to 21 days to complete. Next is to inlay pearl on the wood surfaces. Skilled employees put some pearl oyster shell on each component part, and draw some pictures on it. The lead time of this process is about seven to twenty-eight days. After that, component parts, such as chair legs and backseats are combined into a finished model, such as a chair. The processing time is about five to eight days. Finally, the products would pass through the final production process. They are polished up and dyed a color, such as, red, oak, black, or brown. It takes five to ten days to finish it. As a result, the total production lead time for producing a finished product is approximately 32 to 63 days.

3.3.4 Inventory Cost Analysis

Finished products are stored in the warehouse, waiting for customer orders. To emphasize how high inventory cost impacts the company, the inventory cost, cost of goods sold, and sales revenue for 2010, are shown in Table 3.2.

Table 3.2: Inventory Turnover and Profit Margin in 2010 of Pearl Company

Month	Inventory cost (in Baht)	Cost of goods sold (in Baht)	Sales Revenue (in Baht)	Profit Margin (%)
January	23,453,000	3,114,000	3,915,000	20%
February	22,855,000	2,735,000	3,248,500	16%
March	23,125,000	2,915,000	3,419,000	15%
April	22,542,000	3,819,000	4,642,000	18%
May	22,117,000	2,565,000	3,258,500	21%
June	22,572,000	2,718,000	3,418,000	20%
July	23,157,000	2,518,000	3,274,000	23%
August	22,451,000	3,305,000	4,264,500	22%
September	22,717,000	4,394,000	5,364,000	18%
October	22,381,000	3,329,000	4,014,500	17%
November	22,584,000	2,716,000	3,248,000	16%
December	21,614,000	4,347,000	5,521,500	21%
	Average = 22,630,667	Total = 38,475,000	Total = 47,587,500	Average = 19.15%
	Inventory turnover	1.70		

Source: Company's financial data

From Table 3.2, the average inventory cost for 2010 was 22,630,667 Baht. It was almost half the total sales revenue (47,587,500 Baht). Inventory turnover measures how often inventory is sold in a specific period of time, such as a year. Due to excess inventory cost, it affects the company inventory turnover. The annual average inventory turnover of 2010 was only 1.70 times.

However, high product varieties and high inventory cost of living room set and dining table are the main causes of these inventory problems. Thus, the inventory cost and turnover of living room set and dining table are presented in Table 3.3.

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Table 3.3: Inventory Cost and Turnover in 2010

Month	Living room set (in Baht)		Dining table (in Baht)	
	Inventory cost	Cost of goods sold	Inventory cost	Cost of goods sold
January	15,073,000	1,924,000	3,829,000	625,000
February	14,938,000	1,742,000	3,993,000	714,000
March	14,825,000	1,893,000	4,354,000	549,000
April	15,029,000	2,203,000	4,176,000	848,500
May	14,850,000	1,571,750	3,829,500	634,000
June	15,020,500	1,698,000	4,291,000	546,500
July	15,098,000	1,673,000	3,897,000	473,000
August	14,834,500	2,167,000	4,085,500	606,500
September	14,988,500	2,255,000	4,174,000	711,000
October	15,121,750	2,001,500	3,857,500	644,500
November	14,891,750	1,744,750	3,965,500	641,000
December	15,041,000	2,437,000	4,043,000	856,000
	Average = 14,975,917	**Total = 23,310,000**	**Average = 4,041,250**	**Total = 7,849,000**
Inventory turnover		**1.56**		**1.94**

Source: The Company financial data

In 2010, the average inventory costs of living room set and dining table were approximately 15 and 4 million Baht respectively. However, the total costs of goods sold were approximately 23 and 8 million Baht. Thus, turnovers of living room set and dining table were only 1.56 and 1.94 times respectively.

3.4 Analysis of Customer Demands

The interviews with the sales manager indicated that the customers of Pearl Company are different from other businesses. Their purchase decisions are based on what they actually see. It means they do not make any decisions without the presentation of the actual products or product. Moreover, sometimes customers' preferences are more specific on design, material, and color. The Company may lose revenue if cannot fulfill any requirement.

In addition, from interviews with the business owner, customers can be divided into two primary groups; light and heavy buying customers. Light buying customers buy one or two items at a time. In contrast, heavy buying customers purchase a set of products, such as, combination of a living room set, a dining table, wooden cabinets, and a set of altar table. The proportions of light and heavy buying customers are 70 and 30 percent respectively.

Furthermore, the business owner also clarifies that most of customers are Thai-Chinese, so whenever they purchase something, they select an auspicious day for delivering the products. In some case, customers have to clear the room space for new furniture and removing that existing. Thus the sold products have to be kept in store for a while.

As such customer prefer, delivery time is also important. Mostly, the delivery time is in the range of eight to fourteen days depending on product categories. However, because of unique product design of the company, sometimes the maximum waiting time can be more than a month. Figure 3.4 represents the average customer preferred delivery time after placing an order for living room sets and dining tables for 2010.

Figure 3.4: Average Preferred Delivery Time in 2010

Percentage of orders

49	
46	
27	26 — — Living room set
	Dining table
13	
9	6
4	

Preferred delivery time

1 - 3 days   4 - 7 days   8-14 days   15 - 28 days   29 days and above
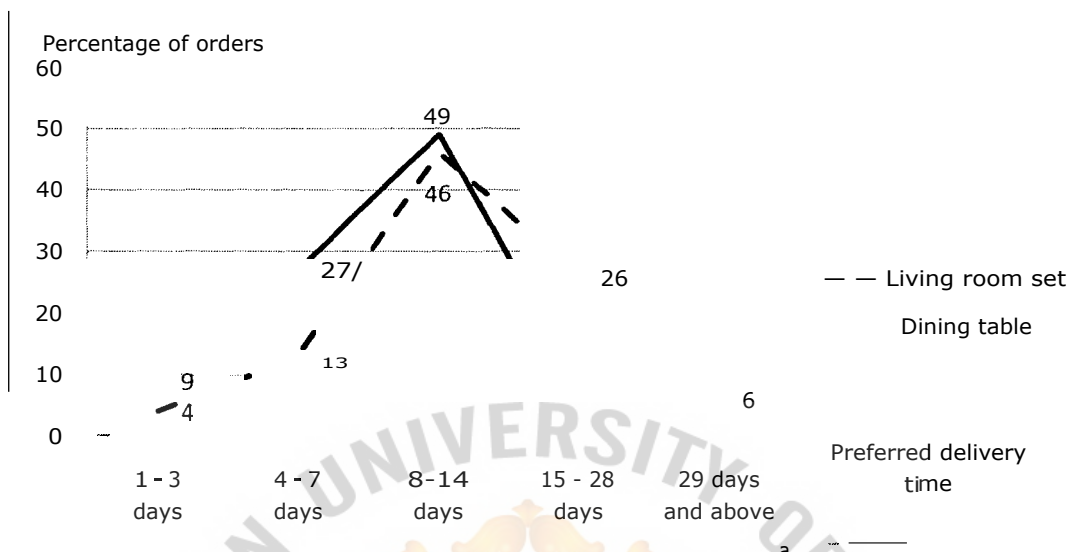
Source: Sales and delivery documents

The preferred delivery times of the two main products are not different. Only four percent of living room set orders request delivery within three days. Most orders prefer to wait for eight to fourteen days, and more than 72 percent request delivery within a range of eight to twenty-eight days. Similar to the dining table category, 49 percent of orders ask to ship the product within eight to fourteen days, and only 9 percent prefer responsiveness.

3.5 Possible Postponement Points & Postponement Strategy

The Company production process, customer demands, and other relevant data are analyzed to obtain the possible postponement points. In addition, the applicable postponement strategy should be considered and developed along with the Company production processes to make sure that the appropriate postponement strategy is implemented in the research.

3.6 Comparison of the New and Current Processes

In unique product design, the component parts are only produced for a specific finished product. So, it is difficult to produce component parts as basic units for all product designs. Moreover, due to customer preferred delivery lead times, half of all customers require delivery of the product within seven to fourteen days, while the total production lead time is 32 to 63 days. Thus, the only possible postponement point is the final phase, which is the polishing and painting phase. The production lead time of this phase is only five to ten days, and the process could enhance customer's satisfaction by delaying whilst waiting for a customer's order so that dyeing is the specific color according to the customer's requirement.

3.7 Findings and Conclusions of the Postponement

The findings and conclusions of the research are analyzed and presented for existing and new proposed production processes. The existing production process represents the current company's production processes, while the new proposed production process represents new production processes after implementation of postponement strategy. The findings between these two models are discussed and compared to point out how postponement strategy can improve inventory cost and turnover of living room set and dining table categories of Pearl Company.

3.8 Summary

This chapter explains the methodology and plan used for the research. The collected data and information are presented in order to gain deep understanding about the research. Furthermore, the brief details of postponement application are presented in this chapter to outline the implementation plan. Then, the researcher will interpret and compare the results of postponement implementation for the existing and new proposed production processes.

CHAPTER IV

PRESENTATION AND CRITICAL DISCUSSION OF RESULTS

The purpose of this chapter is to present and discuss the results of postponement implementation which is the main strategy applied in this research. This chapter begins with unit cost and production lead times of the existing process, total sales volume in 2010, development of the new proposed production process, results of the new proposed production process, analysis and comparison between existing and new proposed production processes, and a summary.

4.1 Unit Costs and Production Lead Times of the Existing Process

4.1.1 Unit Costs of Each Product

The existing production process of Pearl Company is to produce and store various finished products of living room sets and dining tables in order to serve different demands. The product cost mainly consists of wood, marble, pearl oyster shell, wood coloring and labor costs. The costs of raw materials are dependent on the usage amounts, but the labor cost is fixed according to the product design. Therefore the unit costs of each item in 2010 are presented in Table 4.1.

Table 4.1 shows unit costs of each product of living room sets and dining tables. The Company has a total of 15 designs of living room sets and 12 designs of dining tables. Each design has a different cost depending on material and labor costs. For living room sets, the unit costs varied from 43,750 to 445,000 Baht, while the unit costs of dining tables were in range of 24,000 to 92,000 Baht.

Table 4.1: Unit Cost of Living Room Sets and Dining Tables in 2010

Product	Unit Cost (in **Baht**)					
Living room sets	Wood	Marble	Pearl oyster shell	Wood coloring	Labor cost	Total
L001	31,600	4,500	8,700	5,200	35,000	85,000
L002	42,800	-	10,000	7,200	45,000	105,000
L003	18,000	-	6,000	4,000	30,000	58,000
L004	14,600	750	4,000	2,400	22,000	43,750
L005	28,200	-	7,800	6,000	33,000	75,000
L006	57,800	5,000	15,000	7,200	55,000	140,000
L007	38,400	-	9,000	5,600	42,000	95,000
L008	64,400	-	19,600	8,000	73,000	165,000
L009	22,600	-	6,400	4,000	32,000	65,000
L010	31,600	-	6,600	4,800	37,000	80,000
L011	70,000	8,500	25,300	11,200	105,000	220,000
L012	76,800		19,000	7,200	87,000	190,000
L013	64,600	-	8,200	7,200	55,000	135,000
L014	38,400	-	6,800	4,800	43,000	93,000
L015	148,000	14,000	40,600	22,400	220,000	445,000
Dining tables	Wood	Marble	Pearl oyster shell	Wood coloring	Labor cost	Total
D001	12,600		3,500	2,400	9,000	27,500
D002	16,200		6,100	3,200	20,500	46,000
D003	9,200		3,400	2,400	9,000	24,000
D004	12,800	2,500	8,000	3,200	21,500	48,000
D005	17,400	-	4,900	3,200	21,500	47,000
D006	16,200		7,100	3,200	21,500	48,000
D007	23,200		6,800	4,000	28,000	62,000
D008	21,000	3,000	9,000	4,000	30,000	67,000
D009	24,400	-	7,800	4,800	28,000	65,000
D010	15,200	-	5,600	3,200	18,500	42,500
D011	33,800		14,000	7,200	35,000	90,000
D012	26,800	4,500	16,900	8,800	35,000	92,000

Source: Company's financial data

4.1.2 Average Production Lead Time of Each Product Design

Production lead time varied across product designs. The average production lead time of living room sets and dining tables are presented in Table 4.2.

Table 4.2: Average Production Lead Time

Living room sets	Average production lead time (in days)			Dining tables	Average production lead time (in days)		
	Producing	Coating	Total		Producing	Coating	Total
L001	42	6	48	D001	27	5	32
L002	43	7	50	D002	38	7	45
L003	37	6	43	D003	33	6	39
L004	35	6	41	D004	38	7	45
L005	40	6	46	D005	36	7	43
L006	45	7	52	D006	37	7	44
L007	41	7	48	D007	43	8	51
L008	46	7	53	D008	44	8	52
L009	40	6	46	D009	44	8	52
L010	42	6	48	D010	38	7	45
L011	47	8	55	D011	43	8	51
L012	45	7	52	D012	45	8	53
L013	43	7	50				
L014	42	7	49				
L015	53	10	63				

Source: Company production process

In Table 4.2, the average production lead time is shown in two parts, which are producing and coating. Producing lead time includes the time used for producing a semi-finished product. This process starts from preparing the basic components of production process, wood carving and rubbing process, inlaid pearl on top of wood process, and assemble finished products process. Coating lead time shows the average production lead time of polishing and painting. Total average production lead times are shown in the column total, which are in the range of 32 to 63 days.

4.2 Total Sales Volumes

The sales volumes are presented to clarify the movement of company inventory in 2010. This data is helpful for determining the appropriate inventory level which points out the expected improvement after postponement implementation. The sales volumes of living room sets and dining tables in 2010 are presented. The numbers of units sold of living room sets are shown in Table 4.3.

Table 4.3: Sales Volume of Living Room Sets in 2010

Living room sets	Sales volume (in units)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
L001	2	1	1	2	2	-	1	1	2	2	2	2
L002	2	2	1	1	1	1	2	1	1	1	1	1
L003	-	-	2	2	1	2	2	1	2	2	1	2
L004	-	2	2	2	1	-	2	2	2	2	1	-
L005	1	1	1	1	1	1	1	2	1	1	1	2
L006	-	1	1	1	-	-	1	1	1	2	-	1
L007	1	-	1	1	1	1	1	1	1	-	1	2
L008	1	1	1	1	1	1	1	-	1	1	2	1
L009	1	-	1		1	1	1	2	1	2	2	1
L010	2	-	-	1	2	-	-	1	2	1	1	2
L011	1	1	1	1	1	1	1	1	1	1	1	1
L012	1		2	1	1	1	1	-	1	-	-	1
L013	1	1	2	1	1	1	1	1	1	1		1
L014	-	2	1	2	1	1	1	-	1	-	-	2
L015	1	1		1		1	-	2	1	1	1	

Source: Company's financial data

Each month, almost products of all designs were sold. Normally the monthly units sold of each product design were one or two units. This indicates that the living room product is slow moving which, in turn, would cause inventory movement to be low. The amounts of units sold of dining tables in 2010 are shown in Table 4.4.

Table 4.4: Sales Volume of Dining Tables in 2010

Dining tables	Sales volume (in units)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
D001	-	4	2	2	1	1	1	1	1	2	2	4
D002	1	1	-	1	1	1	1	1	1	1	-	1
D003	2	-	-	2	2	1	-	2	2	1	1	4
D004	-	-	-	2	1	1	1	-	1	2	1	1
D005	-	1	1	1	-	2	-	1	1	1	1	1
D006	-	-	1	1	1	-	-	-	1	1	1	1
D007	1	-	-	1	1	-	1	2	-	1	1	1
D008	2	1	1	1	-	1	-	1	1	1	-	1
D009	1	-	1	1	2	1	1	1	1	1	-	1
D010	-	4	2	1	1	2	1	-	1	1	2	2
D011	2	1	1	2	1	1	1	1	2	-	2	1
D012	1	2	1	1	1	-	1	1	1	1	1	1

Source: Company's financial data

Generally, the monthly sales volumes of each dining table design were in the range of one to four units. Its trend was similar to sales volumes of living room sets, and some product design could not be sold during some periods. Thus the dining tables category is also a slow moving product that causes low inventory movement.

4.3 Develop the New Proposed Production Process

After analyzing the existing production process and related data, the new proposed production process after implementation of postponement strategy is developed. The postponement point and postponement strategy are considered and selected in order to re-design a new production process. The postponement point is at the final production process, which is the polishing and painting process. Moreover, the appropriate postponement strategy is manufacturing postponement because the products have to be produced and stored as semi-product forms which can be colored according to customer demands.

4.3.1 Postponement Point
The difference between existing and new proposed production processes of the company is at the postponement of the polishing and painting process. Before

postponement, the product is produced for a specific color. Then it is progressed through all production processes, and polished and dyed a color before being kept in the storage area. As a result, the Company has to store seven to fourteen units for the same SKU in order to offer customers various product designs. After that, the delivery activity would be performed when there is a customer's order.

On the other hand, for after postponement, the semi-finished product would be kept in the storage area after passing through the assemble process. It is held until a customer's order is received. Then the polishing and painting process would be performed in order to dye a specific color. Thus, this re-process could help the company to produce and store semi-finished products, which leads to reduced inventory cost on hand.

4.3.2 Production Process Flow

The overview of new Company's production processes flow after implemented postponement strategy is presented in Figure 4.1.

Figure 4.1: New Proposed Production Process

35
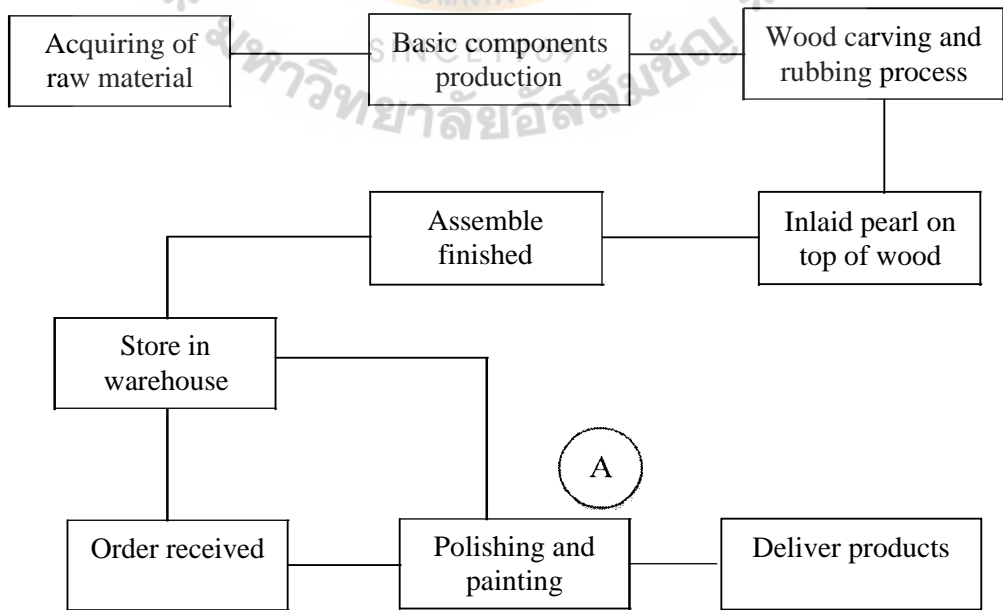
For the new proposed production process, the tasks of each step are not different from the existing production process except at the postponement point in which point A (the polishing and painting process) is postponed. After the assemble finished products process is completed, semi-finished products would be stored in a warehouse in order to wait for customer orders. Then, once the company received orders, the postponement activity would be performed to replace the sold units. For example, if a customer orders one red color unit of product L001, then the postponement activity will dye the red color on a stored semi-finished product of L001 product to deliver to a customer or store in the warehouse, and the production processes would be started to make the inventory replenishment in order to make sure that the ending inventory is at the same level as at the beginning and sufficient to serve customer demand.

4.4 Results of New Proposed Production Process

In order to ensure that the new proposed production process can improve company performance, the new proposed production process is analyzed and implemented in the worksheets in order to point out the improvements after postponement application. The analysis is based on actual sales volume in 2010.

4.4.1 Inventory

The inventory records were contained in Excel worksheet. These worksheets are applied to clarify the movement of each product design, and also to identify the ending inventory units that the company has to carry at the end of each period. To make the picture clearer, one product design, L001, is selected as a proxy for all product designs. Inventory and sales data are shown in Table 4.5.

Table 4.5: The Inventory and Work in Process of Product L001

	Current Process					**New Proposed Process**								
Month	Beginning inventory (in units)		Replenishment (in units)	Quantity sold (in units)	Total cost (in Baht)	Beginning inventory (in units)		Units sold	Replenishment (in units)	Finding inventory (in units)			Total cost (in Baht)	
	Finished	Semi-finished				Finished	Semi-finished			Finished	Semi-finished	Total		
Jan	2		1	2	1,020,000			2	2		2	2	8	584,600
Feb	1		1	1	1,020,000	4	4	1	1	4	3	1	8	61
Mar	1		1	1	1,020,000	4	4	1		4	3	1	8	6
Apr	2		1	1	935,000	4	4	2	2	4	2	2	8	584
May	2		2	2	935,000	4	4	2	2	4	2	2	8	584,600
Jun	0		2	3	105,000	4	4	0	0	4	4	0	8	659,200
Jul	1		1	13	105,000	4	4	1	1	4	3	1	8	1,900
Aug	1		1	13	105,000	4	4	1	1	4	3	1	8	900
Sep	2		1	2	1,020,000	4	4	2	2	4	2	2	8	84,
Oct	2		-4	1	935,000	4	4	2	2	4	2	2	8	84,
Nov	2		2	1	935,000	4	4	2	2	4	2	2	00	84,600
Dec	2		2	1	935,0	4	4	2	2	4	2	2	8	84,

Worksheets in Table 4.5 show the inventory and work in process of product L001. The sheet is separated into two parts, which are the actual result of the current process and the proposed result of the new proposed production process. For the current process, the actual beginning inventory of Product L001 in January, 2010 was 13 units. The sales volumes were two units, while the replenishment item was one unit. The ending inventory of January, 2010 was 12 units. The unit cost was 85,000 Baht, so that the total ending inventory on hand was 1,020,000 Baht.

For the new proposed process, the proposed quantities of beginning inventory in January 2010 are one unit for finished product and one unit for semi-finished product for the same product color. For example, there are four colors for product L001. Thus, the quantities of beginning inventory of finished products are four units, and for semi-finished products are four units. Moreover, as the Company sold two units during January 2010, the production process should be started to replenish the inventory to be the same level as at the beginning. Thus, the production quantities in January were two units. However, because of the long production lead time of product L001, which is 42 days, the production processes could not be finished within a month, so it should be recorded as work in process inventory (WIP). Furthermore, the inventory cost is calculated from unit cost and ending inventory on hand. As shown in Table 4.1, the total unit costs of a finished product L001 are 85,000 Baht. However, for a semi-finished product, it does not pass through the polishing and coloring process. Therefore the unit cost does not include wood coloring cost, which is 5,200 Baht. Thus, unit cost of a semi-finished product is 79,800 Baht (85,000-5,200), while the cost of the work in process item is estimated to be 50% of the finished product cost. Therefore, at the end of January 2010, the ending inventory consisted of four units of finished product, two units of semi-finished product and two units of work in process. The total cost was 584,600 Baht.

Based on worksheets, the summaries of monthly ending inventories on hand of both existing and new proposed processes are clarified in Table 4.6.

Table 4.6: Inventory Cost of Product L001

| Month | Ending inventory (in units) | | | | Ending inventory (in **Baht**) | | | |
| | Current | New proposed | Difference | | Current | New proposed | Difference | |
			units	%			**Baht**	%
January	12	8	4	33%	1,020,000	584,600	435,400	43%
February	12	8	4	33%	1,020,000	621,900	398,100	39%
March	12	8	4	33%	1,020,000	621,900	398,100	39%
April	11	8	3	27%	935,000	584,600	350,400	37%
May	11	8	3	27%	935,000	584,600	350,400	37%
June	13	8	5	38%	1,105,000	659,200	445,800	40%
July	13	8	5	38%	1,105,000	621,900	483,100	44%
August	13	8	5	38%	1,105,000	621,900	483,100	44%
September	12	8	4	33%	1,020,000	584,600	435,400	43%
October	11	8	3	27%	935,000	584,600	350,400	37%
November	11	8	3	27%	935,000	584,600	350,400	37%
December	11	8	3	27%	935,000	584,600	350,400	37%

Table 4.6 is the summarization from Table. 4.5 to compare the inventory cost of product L001 between the current and new proposed production processes. The monthly ending inventory is presented in terms of units and costs. For the current process, the monthly ending inventories are in the range of 11 to 13 units or 935,000 to 1,105,000 Baht: this is higher than new proposed process, which are 8 units or in the range of 350,400 to 483,100 Baht. It means that the new proposed process is able to reduce monthly inventory stock by 27% to 38% and also decrease monthly inventory cost by 37% to 44%.

In addition, all 15 designs of living room sets and 12 designs of dining tables have also have been examined on Excel worksheets in order to identify the improvements. The summarizations of outcomes are presented in the next part.

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4.5 Analyze and Compare between Existing and New Proposed Production Processes

After completing the worksheets, all results are summarized and compared to the existing data. The significant improvements of the research are focused on inventory cost reduction and inventory turnover improvement.

4.5.1 Inventory Cost Reduction

The existing production process of company is only focused on producing and storing sufficient amounts of finished products. However, the new proposed production process after postponement application can allow the company to reduce inventory cost by storing semi-finished products instead of finished items. As a result, the new production process is able to reduced inventory cost of living room set and dining tables comparing to existing process, as shown in Table 4.7 and 4.8.

Table 4.7: Comparison of Living Room Sets Category

Month	Living room sets					
	Ending inventory (in units)			Ending inventory (in **Baht**)		
	Current	New proposed	Difference	Current	New proposed	Difference
January	126	92	34	15,073,000	11,233,845	3,839,155
February	128	93	35	14,938,000	10,981,110	3,956,890
March	127	83	44	14,825,000	10,089,870	4,735,130
April	128	84	44	15,029,000	10,265,588	4,763,413
May	126	84	42	14,850,000	10,450,440	4,399,560
June	126	88	38	15,020,500	10,776,465	4,244,035
July	132	85	47	15,098,000	10,450,230	4,647,770
August	125	87	38	14,834,500	10,583,370	4,251,130
September	129	83	46	14,988,500	9,864,750	5,123,750
October	125	84	41	15,121,750	10,295,460	4,826,290
November	123	87	36	14,891,750	10,512,548	4,379,203
December	121	82	39	15,041,000	9,807,105	5,233,895
Average	126	86	40	14,975,917	10,442,565	4,533,352
			31.85%			30.27%

From Table 4.7, for the current process, the company has to carry inventories of all designs of living room sets in the range of 121 to 132 units, or approximately 14.8 to 15.1 million Baht, which is a lot more than the new proposed process. The new proposed process allowed the company to carry inventory of about 82 to 93 units or approximately 9.8 to 11.2 million Baht. As a result, on average, the new proposed process is able to reduce inventory stock of living room sets by 31.85% and decrease inventory cost on hand by 30.27%.

In addition, Table 4.8 presents the inventory cost reduction of the dining table category.

Table 4.8: Comparison of Dining Tables Category

| Month | Dining tables | | | | | |
| | Ending inventory (in units) | | | Ending inventory (in Baht) | | |
	Current	New proposed	Difference	Current	New proposed	Difference
January	73	66	7	3,829,000	3,453,660	375,340
February	79	59	20	3,993,000	3,094,875	898,125
March	83	61	22	4,354,000	3,195,465	1,158,535
April	81	57	24	4,176,000	3,024,630	1,151,370
May	87	60	27	3,829,500	3,143,385	686,115
June	81	59	22	4,291,000	3,109,680	1,181,320
July	74	64	10	3,897,000	3,386,880	510,120
August	78	62	16	4,085,500	3,239,355	846,145
September	78	59	19	4,174,000	3,102,330	1,071,670
October	73	60	13	3,857,500	3,225,495	632,005
November	78	61	17	3,965,500	3,228,330	737,170
December	81	54	27	4,043,000	2,972,970	1,070,030
Average	**79**	**60**	**19**	**4,041,250**	**3,181,421**	**859,829**
			23.86%			**21.28%**

From Table 4.8, for current process, the Company has to carry inventories of all designs of dining table in the range of 73 to 87 units, or approximately 3.8 to 4.4 million Baht. However, the new proposed process allows the company to carry lower inventory, which is in range of 54 to 66 units or approximately 3.0 to 3.5 million

Baht. As a result, on average, the new proposed process is able to reduce inventory stock of living room sets by 23.86% and decrease inventory cost on hand by 21.28%.

4.5.2 Improvement of Inventory Turnover

Inventory turnover is a major concern of Company, and one of the objectives of this research is to improve inventory turnover. Therefore, a comparison of inventory turnover between existing and new proposed production processes is presented in Table 4.9.

Table 4.9: Comparison of Inventory Turnovers

	Living room set (in Baht)		Dining table (in Baht)	
	Existing process	New process	Existing process	New process
Cost of goods sold	23,310,000	23,310,000	7,849,000	7,849,000
Average inventory cost	14,975,917	10,442,565	4,041,250	3,181,421
Inventory turnover	**1.56**	**2.23**	**1.94**	**2.47**
Different		**43.41%**		**27.03%**

The cost of goods sold in the existing and new processes are not different because this analysis is based on actual data in 2010. For living room set, the cost of goods sold was approximately 23 million Baht, while average inventory cost of existing and new processes were approximately 15 and 10 million Baht respectively. The inventory turnovers were 1.56 times for existing process and 2.23 times for new process. Thus, the inventory turnover of living room set could be improved by 43.41%.

For dining table, the cost of goods sold was approximately eight million Baht, while the average inventory cost of existing and new processes were approximately four and three million Baht respectively. The inventory turnovers were 1.94 times for the existing process and 2.47 times for the new process. Therefore, the inventory turnover of dining table could be improved by 27.03%.

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4.6 Summary

The company actual data in 2010 were collected and analyzed in order to improve the company production processes, inventory cost, and inventory turnover. After analyzing the data, the new proposed production process was developed in order to solve the problems of the company. The implementation plan was done on Excel worksheets, and the results were positive. The average units of inventory on hand of living room set and dining table could be reduced by 31.85% and 23.86% respectively. These improvements were in the same trend of average inventory cost. The average inventory cost for living room set and dining table decreased by 30.27% and 21.28% respectively. Therefore, the average inventory cost reduction has lead to improved inventory turnovers of living room set and dining table. The turnovers could be increased to 2.23 times or by 43.41% for living room set, and 2.47 times or by 27.03% for dining table.

However, since the results are based on actual data of 2010, which is currently the company business operation, forecasting of inventory in the future may be necessary if the company has plans to expand its business or launch new product designs. However, from interviewing the business owner, because of the current economic situation the company does not have plans to increase production capacity or launch new products. More importantly, the company also does not plan to open any new branches within the next five years. In contrast, the company only focuses on keeping sales revenue at the same level as 2010. Thus, the company expects to store inventory at the same quantity until there is any change in company policy.

CHAPTER V

SUMMARY FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

This chapter includes the conclusions and recommendations of this research. First, the summary of the findings shows results of this research. Second, the conclusion represents an overview of the research, Next are managerial implications and recommendations for the firm, and the final part is recommendations, which includes possible future research.

5.1 Summary of the Findings

Successful postponement strategy can enhance effectiveness of Company production processes, which leads to reduced inventory cost and improved inventory turnover. The finding indicates that the possible postponement point is at the final production process. Moreover, a new proposed production process is developed, and results analyzed by using Excel worksheets. The summary of key improvements in this research is as follows:

- The total units of inventory on hand have significantly decreased by 31.85% for living room set category and 23.86% for dining table category. By applying postponement, the company could reduce inventory on hand by producing and storing semi-finished products.
- The average inventory costs are reduced by 30.27% for living room set category and 21.28% for dining table category. Once the total units of inventory on hand are decreased, inventory costs reduction is also affected.
- The inventory turnovers could be improved by 43.41% for living room set and 27.03% for dining table. Since the average inventory costs are decreased, and the cost of goods sold is not changed, then, the inventory turnovers of the company have been improved

5.2 Conclusions

In 2010, the Pearl Company faced excessive inventory cost and low inventory turnover problems. Then, a postponement strategy was considered to be a solution in order to improve the production process, inventory cost, and inventory turnover.

In this research, the existing process was analyzed in order to improve the Company production process, inventory cost, and inventory turnover by applying postponement strategy. For existing production process analysis, the relevant data such as, production processes, production lead time, and customer preferred delivery time were collected and considered in order to select the postponement point and strategy. After the postponement point was selected, the new proposed production process was developed in order to improve company performance.

The results of the existing production process were compared to results of a new proposed production process for clarifying the improvements, especially in inventory. According to the objectives of the research, the results can solve the company problems. The inventory cost and inventory turnover are significantly improvements.

5.3 Managerial Implications and Recommendations for the Firm

This research is mainly for Pearl Company, as well as other companies that have similar production processes. The Company can improve its production process based on the new proposed process model, since the results of this research show that postponement strategy can effectively reduce inventory costs and improve inventory turnovers of living room sets and dining tables. Thus, the Company should extend the implementation to other product categories in order to improve overall inventory performances.

In addition, the appropriate quantity of finished and semi-finished product inventories should be considered if the company would like to expand its business in the future. Business growth leads to higher sales volumes and more customer orders. Thus, in

order to ensure that the products are sufficiently available for sales, the optimal quantity of inventory on hand should be clearly identified.

5.4 Recommendations for Future Research

The researcher suggests three areas that are highly recommended for future research. First, the results of this research are based on historical data and an assumption that the business operations are not changed. The factors affecting success or failure of postponement implementation should be researched, such as, sales growth, business plan, new product designs or colors, and other relevant costs. Further study may discover more appropriate plans that are suitable to changing environments.

Second, this research aimed to improve the production process by applying postponement strategy. Future research could study other strategies, such as lean manufacturing to better increase efficiency and effectiveness of the production process. Finally, this research was developed and analyzed based on Excel worksheet, in which it is required manually to key in data and information. Other software or programs may be adopted more appropriate to business.

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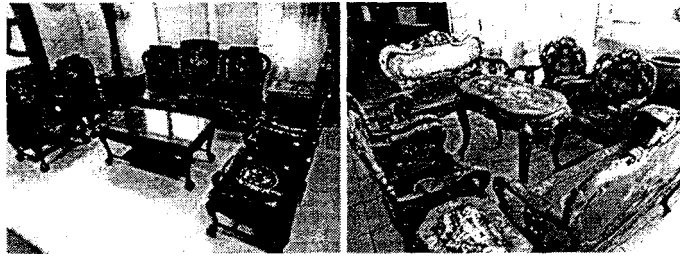
APPENDIX

APPENDIX

The Eleven Product Categories of Pearl Company

Product Categories

Living room set

Dining table

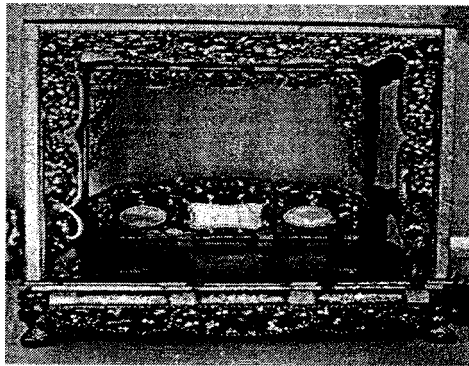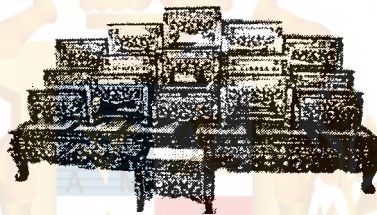*Wooden cabinet*

Wooden desk
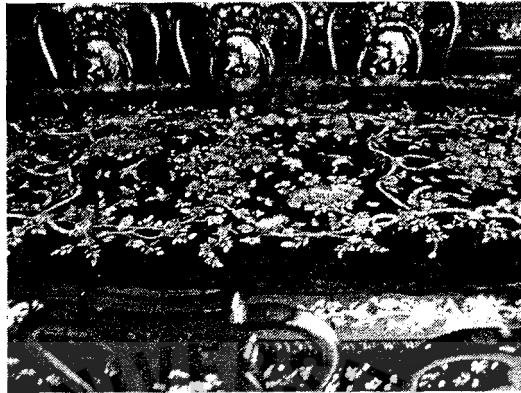

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Bed

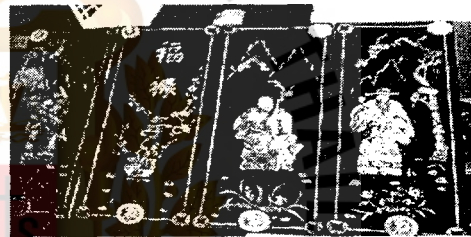*Set of altar table*

Wooden clock

Coffee table set

Conference table

Wooden picture

Wooden partition