ORDER FULFILLMENT PROCESS IMPROVEMENT IN AN ELECTRONICS MANUFACTURING COMPANY

By

YANG ZHANG

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

OCTOBER, 2016

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A Final Report of the Six-Credit Course
SCM 7203 Graduate Project

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Declaration of Authorship Form

I, Mr. Yang Zhang, declare that this project and the work presented in it are my own and has been generated by me as the result of my own original research.

Project Title: ORDER FULFILLMENT PROCESS IMPROVEMENT IN AN ELECTRONICS MANUFACTURING COMPANY

I confirm that:

1. This work was done wholly or mainly while hi candidature for the M.Sc. degree at this University;
2. Where any part of this project has previously been submitted for a degree or any other qualification at this University or any other institution, this has been clearly stated;
3. Where I have consulted the published work of others, this is always clearly attributed;
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5. I have acknowledged all main sources of help;
6. Where the project is based on work done by myself jointly with others, I have made clear exactly what was done by others and what I have contributed myself;
7. None of this work has been published before submission.

Signed 71/M YA.Ah(

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ADVISOR'S STATEMENT

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

Signed ______________________

(Dr. Wuthichai Wongthatsanekorn)

Date (30' _ 2o1U

ACKNOWLEDGEMENT

It has been a long journey to come to this stage. Without all of you, I could not complete this project.

First of all, I would like to express my sincere gratitude to my advisor, Dr. Wuthichai, who encouraged me to focus on this case study. He patiently helped and gave me constructive suggestions. I still remember, he taught me that the numbers could speak and every number has a meaning. It is my great honor to be under his great guidance.

I would like to express my heartfelt gratitude to Dr. Piyawan, Dr. Scott and Dr. Srobol for giving me precious advice and confidence on this work. Moreover, I truly appreciate all the committee members and respondents for their comment and support. Furthermore, my sincere gratitude goes to all my professors who shared their priceless knowledge with me, which helped me become more professional in my career.

Finally, my deep appreciation is extended to my colleagues and friends who helped me in this work. I would to thank my family for standing by me and loving me always.

I will keep the love and support from all of you to guide me in my future endeavor.

Yang Zhang

Assumption University

September, 2016

ABSTRACT

This case study was based on a Thailand electronics manufacturing company, ABC Company, which has just changed its business mode to improve its long term relationship with its customer. The problem was under a time based competition, fulfill customer's order with speed and efficiency which requires a new order fulfillment process to support and long lead time process could not meet the customer's requirement. The management level and the customer were looking for the way to improve the current business.

Business Process Improvement (BPI) was applied in this study, which started with the study of the current company business delivery performance, customer requirements and current business issues, identified the root cause of the lead time problem, then improved the process.

The study found that the lead time problem in ABC Company's order fulfillment processes was during the schedule change and additional material pulling. The information sharing system has helped the company and its customer to have quick responses on order change and material control. Furthermore, the case study indicated that BPI has helped the company achieve a better business performance.

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I, A. Mary Bien Catalan, have proofread this Graduate Project entitled

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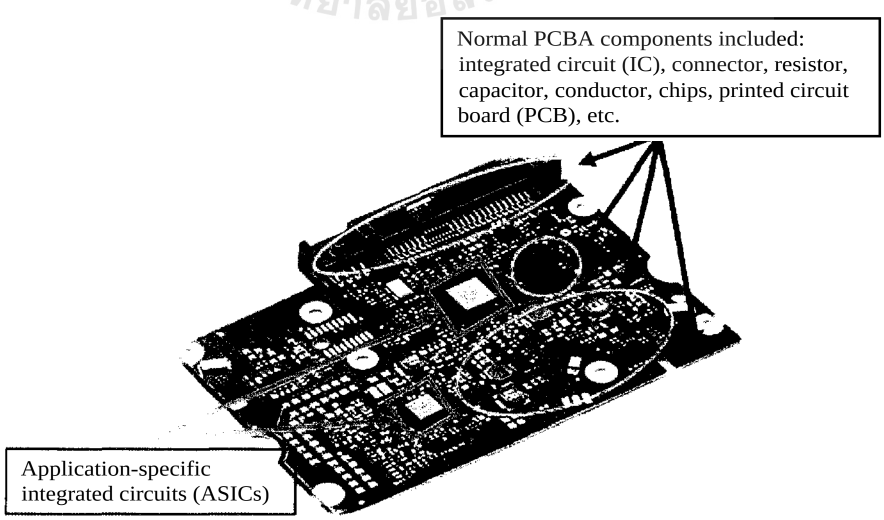
CHAPTER I

GENERALITIES OF THE STUDY

1.1 Background of the Research

ABC is a Printed Circuit Board Assembly (PCBA) Manufacturing Company located in Thailand. As one of the major suppliers, ABC Company was facing a fierce competition among other competitors. Following with the customer, the business has been continuously growing, a new business model was launched by the customer for the purpose of reducing its material handling cost between the normal PCBA components and the special controlled components, Application-specific integrated circuits (ASICs) shows in figure 1.1. The challenge to ABC regarding the change of the business model is that the ABC needs to create an effective order fulfillment operation process of PCBA from order receiving, material purchasing to delivery to meet the highly flexible order and to manage its supply chain and meet customer requirements. Among the company's supply chain, there are three main parties linking with ABC to execute the order fulfillment process which are the customer, the raw material hub and the ABC finished goods hub.

Figure 1.1: Printed Circuit Board Assembly Drawing



Source: Author

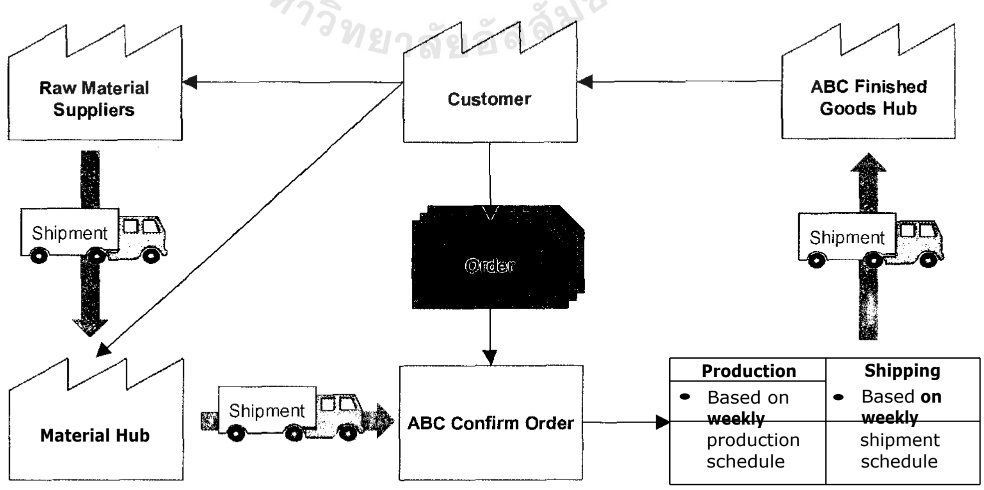
Customer: the guider of the new business model. Responsible for providing the order forecast and releasing Mater Production Schedule (MPS). The customer's material team also controls the critical component which is the Application Specific Integrated Circuits (ASICs) and the key raw material suppliers.

Raw Material Hub: help both customer and ABC to store the raw material and deliver the raw material to ABC after receiving the material pulling request from ABC.

ABC Finished Goods Hub: Customer's assembly factory will use the PCBA from the ABC's finished goods hub based on daily assembly schedule according to the demand from customer's customer. Customer's planning team will also provide production status to its headquarters to update the latest demand forecast.

ABC Company: As a linkage between customer and raw material hub, illustrated in Figure1.2. For ABC, the old order fulfillment process has included five major steps: order receiving, order confirmation, raw material receiving, PCBA production, and final products shipping until payment.

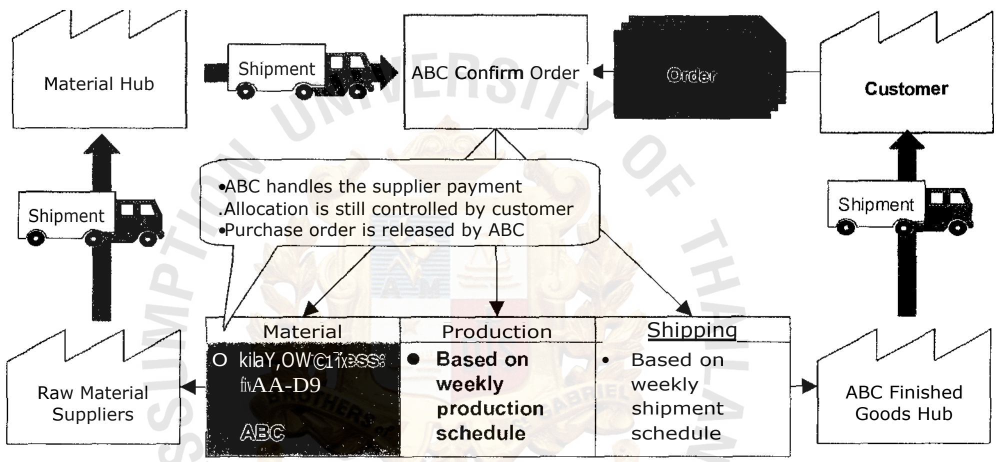
Figure 1.2: Order Fulfillment under Old Business Model



Source: Author

When the ABC Company was under the old business model (Figure 1.2), all material were controlled and consigned by the customer side. Single side information and sample coordinate operation were very easy to control in the whole supply process. After the new business model was implemented (Figure 1.3), except for the critical components, ASICs which are still controlled by customer, all of the normal components are handled by ABC Company.

Figure 1.3: Order Fulfillment under New Business Model



Source: Author

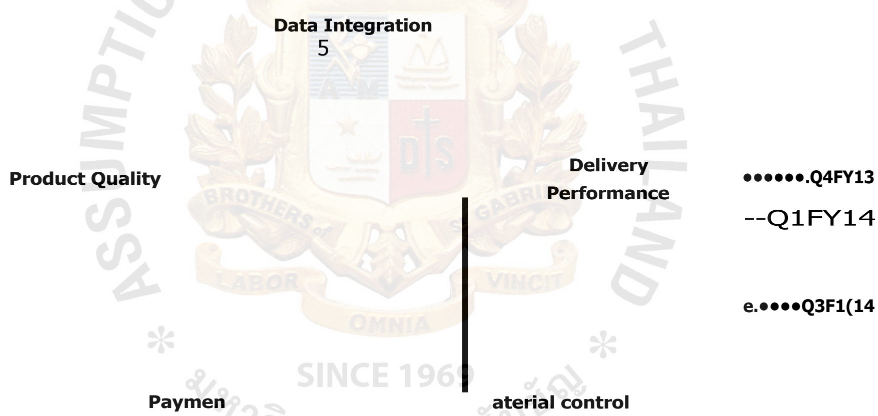
Internally, more decision making opportunities require the company to make the order fulfillment in an efficient way. As for customer's benefit, on-time delivery is not the only key point to be evaluated in business performance but also the order commitment speed. As a supplier, if the commitment is lost, it means gaining opportunity for other competitors. Externally, ABC needs to work with the customer and the material hub at the same time to make sure that all of the supply information is reached by each party for further operation able to be activated. Any delay will cause related operation miss the best timing of order fulfillment.

For ABC Company, the order fulfillment process has been changed after the new business. The challenges are regarding the on-time delivery and material control, both points are considered as the key business performance by ABC's customer. As a matter of fact, there was a negative business performance appeared in the company.

1.2 Statement of Problem

There is a Quarterly Business Review for the customer to evaluate the current supplier's performance. Figure 1.4 shows ABC's delivery and material control sections start to drop down since Q3FY14, the problem is found in the ABC's order fulfillment process when the schedule change and additional material pulling while the customer changes order. ABC cannot respond to the order change at a very short time, instead, the ABC's order fulfillment sub processes of schedule change and additional material pulling waste a lot of time on information exchange and confirmation which directly affected the on-time delivery and material control.

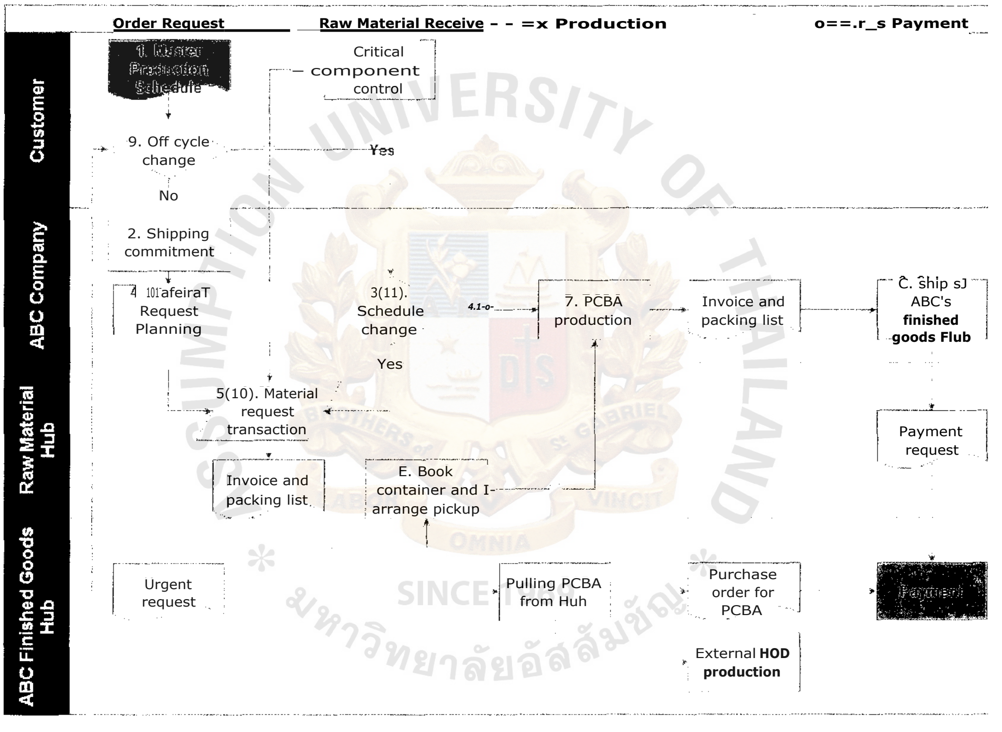
Figure 1.4: ABC Quarterly Business Review 2014



Source: Company data 2014

From the customer's comments, ABC's inefficient operation has affected the company's total business performance which resulted in falling behind other competitors. The lack of information sharing lead to a slow information transformation which extended the customer responsiveness. The key point is, only the capable PCBA suppliers can do the order fulfillment with more efficiency and less time consuming way can get more orders from the customer. Under this circumstance, it is very important to improve the company's current order fulfillment process to be able to respond to the customer's requirement and fulfill the order quickly with a short total lead time. Figure 1.5 shows the current order fulfillment process of ABC Company. The main activities of schedule change and re-confirm order and additional material pulling process in the ABC order fulfillment process (Table 1.5 activities 4-6) which took a total of 9.9 hours to complete order confirm and response to the customer. Thus, this project tried to solve the problem, **"How to reduce the order fulfillment process lead time by applying business process improvement under a time based competition?"**

Figure 1.5: Current ABC Order Fulfillment Process



Source: Author

Table 1.1: Current Order Fulfillment Lead Time

	ABC Activities	Lead time (hour)
1	Order receive and confirm	0.5
2	Production schedule process	1.1
3	Material request process	1.0
4	Schedule change and re-confirm the order	4.0
5	Additional material pulling process	4.9
6	Material request transaction	1.0
	Total	**12.5**

Source: Company data 2014

1.3 Research Objectives

1.3.1 To study the current ABC order fulfillment process and related business performance, which include the process lead time and finished goods on-time delivery status.

1.3.2 To reduce the total order fulfillment process lead time by applying business process improvement (BPI).

1.4 Scope of the Research

The research background of this study was focused on the customer's new business which started after Q3FY14, because both ABC Company and customer management level were expecting a long term solution for the ABC business performance to be improved under the new business. The analysis of the documentation and historical data was taken from the beginning of the new business for a total of six quarters from Q3FY14 to Q4FY15. The anticipant trading partners were the customer material team and the customer planning team. The third party raw material hub team. ABC Company side was included the planning and inventory team. The order fulfillment process has started from the demand receiving to finished goods delivery.

1.5 Limitations of the Research

This research was focused on the improvement of the current order fulfillment process lead time of the ABC Company. The order fulfillment process focused on the order receiving, raw material requesting, and raw material receiving. However, the production lead time was not considered. The order fulfillment process did not include the raw material supplier price quotation and purchase order release and other material price related issues. The supply performance has included on-time delivery and material control. Lead time parameters are the total ABC's order fulfillment lead time and efficiency. The internal process of other trading partners were not considered. The whole process improvement was focused on the information flow and physical flow.

1.6 Significance of the Research

This research intends to make a successful order fulfillment process under a new business circumstance. More importantly for the ABC company team to take a new insight of supply chain management in order to gain a ability to deal with the uncertainty of order demand in a very short lead time with a seamless fulfillment. Moreover, for the ABC company to utilize the information system in order to work closely with the customer and to deliver the value-added finished goods on time. Furthermore, to help the company get a better supply performance in the supply chain by initiating a win—win scenario.

1.7 Definition of Terms

Business process improvement	A methodology that is designed to bring about step-function improvements in administrative and support processes using approaches such as process benchmarking, process redesign and process re-engineering (Harrington, Esseling and Van 1997).
Information sharing	Access to information residing in another company in the supply chain (Mattsson, 2013).
Lead time	Time as a resource itself, consumed by the process. Lead time computed as the lapse from the moment all the inputs of the first activity of the process are available to the delivery of the output. (Bartezzaghi, 1994).
Order fulfillment process	Order fulfillment is a key process in managing the supply chain. It is the customer's orders that put the supply chain in motion (Croxton, 2003).

Time-based competition	Time-based competition (TBC) is a managerial approach which focuses on shrinking the time required for businesses to complete key activities (Bozarth, 1996).

CHAPTER II

REVIEW OF RELATED LITERATURE

This chapter explores the related literatures and theories of: (1) Order fulfillment process, to study related mechanisms; (2) Time-based competition as a strategy in manufacturing industry could lead to a better order fulfillment responsiveness; (3) information sharing is the most critical improvement action for reducing process lead time; (4) Business process improvement (BPI) is a tool guide to solve the lead time problem. This chapter further includes conceptual framework for applying business process improvement regarding lead time reduction in order fulfillment process.

2.1 Order Fulfillment and Sub-Processes

Order fulfillment is about the process from order receiving to finished goods delivery. Mattsson (2008) defined order fulfillment processes as the company's individual processes together with transportation processes rather sub-processes within such integrated cross company processes. Croxton (2003) defined order fulfillment as a key process in managing the supply chain. The first priority is to fulfill customer's order efficiently and effectively. To provide customer services, the order fulfillment process is not only about coordinating from the steps order receiving to finished goods delivery, but also designing a network and a process that permits a firm to meet customer's requests while minimizing the total cost. For a successful order fulfillment process, it is important that process team be cross-functional, integrating key customers and suppliers can help streamline and improve the process. No matter it is through idea sharing or information sharing.

Forslund (2008) summarized that there are four main participants and sub-processes in manufacturing background: customer and ordering, supplier and material delivery, logistics service provider and transportation, and manufacturer and finished goods receipt.

2.1.2 Order fulfillment and Responsiveness

Responsiveness is an important factor to evaluate an order fulfillment process in manufacturing. It is seen as the ability of a department within a firm to respond to changes in customer needs. Barclay, Poolton and Dann (1996) described responsiveness as a competitive advantage. They defined responsiveness as the ability to react purposefully and within an appropriate timescale to significant events, opportunities or threats (especially from the external environment) to bring about or maintain competitive advantage. Especially when facing with the customer demands in terms of flexibility and delivery reliability, manufacturing unit needs to put a high priority on being a customer oriented which focuses on the production and delivery of the products that meet exact requirements of the customers as quickly as possible.

Stalk and Hout (1990) focused on time-based competition and refered to responsiveness as one of the outcomes of implementing a time-based approach. They recommended that the system procedures be simplified and the computer-based technology be improved. On one hand, the ordering process should contribute to the responsiveness by acting quickly and flexibly to customer's demand. On the other hand, it should contribute to the cost saving.

2.2 Order Fulfillment and Time-based Competition

Regarding the order fulfillment in manufacturing environment, Stalk and Hout (1990) said that time is the secret weapon of business because of its advantages in the response time to lever up all differences that are basic to overall competitive advantage. Bozarth (1996) stated that an idealized organization structure for time-based competitors is seen as a fully integrated, value-added delivery system designed to meet customer's needs in a minimum amount of time. This is a managerial approach which focuses on shrinking the time required for businesses to complete the key activities within each of the operational links (order entry, procurement and scheduling, and production) to determine total cycle time, or response time to the customer.

2.2.1 Time-based Competition as a Strategy

One of the strategies that focuses on improving the responsiveness of manufacturing to specific customer requirements, combining all these practices leads to a shrinking in the cycle times and the ability to respond quickly to changes in demand level or customer requirements call time-based competition (Bozarth & Chapman, 1996) As a main strategy of lead time reduction, time-based competition is refers to the delivery of products or services faster than the other competitors. It is redefining the business activities of the strategic importance of the continuous development of the organization based on the competitiveness of time (Hummingbird, 1995).

2.2.2 Lead Time Efficiency

Lead time efficiency could be expressed by the percentage of value added activities within the lead time for the whole process. It reflects the inefficiencies of the lead time caused by delays of interfaces between sub-processes and additional time consuming of process management (Hopp & Spearman, 2001).

2.3.3 Lead Time Calculation

The manufacturing lead time encompasses order preparation time, queue time, set-up time, run time, move time and inspection time; distribution time includes the time required for order transmission, order processing, order preparation and transit. To identify lead-time bottlenecks throughout transaction, monitor the system for continued opportunities for improvement (Daugherty & Pitman, 1995).

For calculating one process lead time, there is a lead time management model described by Bartezzaghi, Spina and Verganti (1994), which is under a highly information or material interchangeability and a low process steadiness condition with six components:

1 Run Time (R), a total time lapses during one operation;

2 Set up Time (SU), the periods during which the object waits before being processed;

3 Queue Time (Q), the times of running and set up of proceeding objects;

4 Wait to Move Time (WTM), accounts for the time an object waits for the completion of either next resource or start the processing;

5 Synchronization Time (SY), the waits between parallel phases of the process;

6 Problem solving Time (PS), the time waits for non-routine decisions;

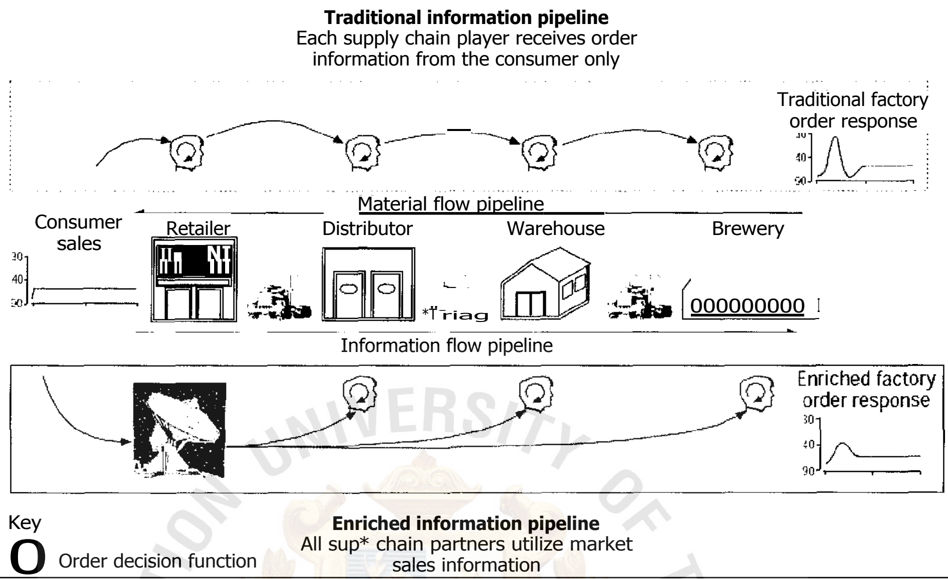
The equation of total lead time is:

$$LT = R + SU + Q + WTM + SY + PS$$

2.3 **Information Sharing**

Information sharing is an important factor in supply chain management. Christopher and Lee (2004) pointed out that the key to improve supply chain visibility is shared information among the supply chain members. When they studied the risk of supply chain, they mentioned that Synchronous supply requires transparency of demand and the pipeline inventory is as close to real time as possible (Christopher & Lee, 2004). Jones and Towill (1997) described the information as a valuable advantage for company (Figure 2.1). To maximize competitive advantage, all members within the supply chain should "seamlessly" work together to serve the end consumer. Traditionally, companies tend to subscribe to the view that "information is power" and to interpret the phrase, it means that power is diminished if that information is shared.

Figure 2.1: Traditional and Enriched Information Pipeline



Source: Jones and Towill (1997)

2.3.1 The Information Shared in Order Fulfillment Process

In the order fulfilment process, the supplier is dependent on both the customer's information and information internal to the supplier. Both order and forecast information do affect the order fulfilment process performance (Forslund, 2007). In the activities of the order fulfilment process, different information is needed and different information features are appreciated. The activity order entry deals with receiving, entering and editing orders. As short lead times are demanded, the order arriving in time is critical for on-time delivery. Changes in product content, order quantity or delivery time are often challenging during the suppressed lead time.

2.3.2 Information Technology Apply in Order Fulfillment Process

In manufacturing industry, there are many researchers who proposed information technological methods to improve the order fulfilment processes with minimal waste to practices a fast response to customer. Christoper and Robert (2004) chose one fashion clothing manufacturer as a case study and worked closely with the key supplier and the customer key position person. They found that the information technological methods can achieve high levels of customer responsiveness. By network based system, the manufacturer is able to meet the delivery time and quality targets, and the system is flexible enough to cope with the sudden changes in demand. Pierre Hadaya and Luc Cassivi(2007) conducted an survey with 53 suppliers in a single supply network in the telecommunications. Sharing information positively and significantly impacts the strength of supply chain members, the advantages include reduction in the time spent on process, reduction in errors transactions, and process simplified information access to manage the relationships with customers.

2.4 Business Process Improvement

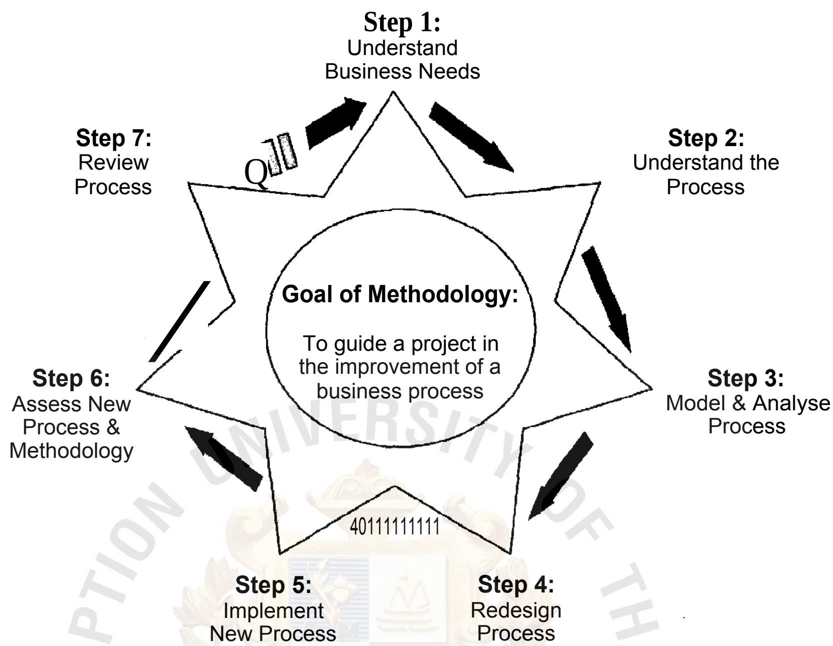
Baines (2005) demonstrated a systematic evaluation method in practicing business process improvement (Figure 2.2). A business process improvement is driven by environment pressures as customer expectations, new technologies, and growing global competition. Business processes within organisations are dynamic and constantly changing to respond quickly to business environment changes.

The generic seven-step approach (Lee & Chuah, 2001) is summarized as below:

Step 1: To understand the business background, the improvement should come from the customer requirement and the business environment.

Step 2: Generate organization and map out the AS-IS process flow chart with a common understanding. Identify the involved members and sub-processes.

Figure 2.2: Business Process Improvement



Source: Adesola and Baines (2005)

Step 3: In order to make the improvement program to be measurable and objective, measure the existing process performance. Identify the problem areas and non-value added activities that need to be changed or eliminated or the most time consuming sub-processes or establish a baseline for improvements;

Step 4: This phase seeks to improve the problematic tasks performance to the level of desired states so that the output of the processes can accomplish the level required or expected by the customers. Redesign the TO-BE process.

Step 5: After determining the improvement path, a comprehensive action plan should be developed that shows clearly the key implementation steps, dates, costs, and accountable staff prior to changing the processes. Clearly define roles of directly and indirectly involved personnel when implementing the action plan.

Step 6: Evaluate the improvement results and ensure whether or not the operation performance of the critical processes has achieved the customers' requirements and/or the set target.

Step 7: Review the whole process, and keep track of the performance to set up new process target and performance, develop strategic view of business.

The BPI is not only a one time process improvement tool, instead, the improvement needs to be continuous and manageable. The process coordinator needs to track the process key performance all the time to make sure that the improve target is achieved and keeps on progressing (Chang, 1995).

2.5 Conceptual Framework

This research was focused on the lead time reduction of ABC order fulfillment process. By following **BPI** procedure (Baines, 2005) the conceptual framework of this project is show in table 2.1

Table 2.1: Business Process Improvement Framework

Steps	**Purpose**	**Activities**
Understand the business needs	Identify the customer needs Evaluate the current business performance	**Data** collection Business change review
Understand the process	Study AS-IS order fulfillment process Measure current process lead time	Process mapping Process Lead time calculation
Analyze the process	Identify the main problem in sub-process.	Process performance measurement **Root** cause analysis
Redesign the process	Propose TO-BE process model	Improvement proposal
Implement the new process	Plan the implementation of technological development plan Roll-out changes	Improvement action
Assess the new process and the improvement results	Evaluate new process lead time and related business performance	Process lead time calculation Comparison of improvement results

Source: Adapted from Baines (2005)

2.6 Summary

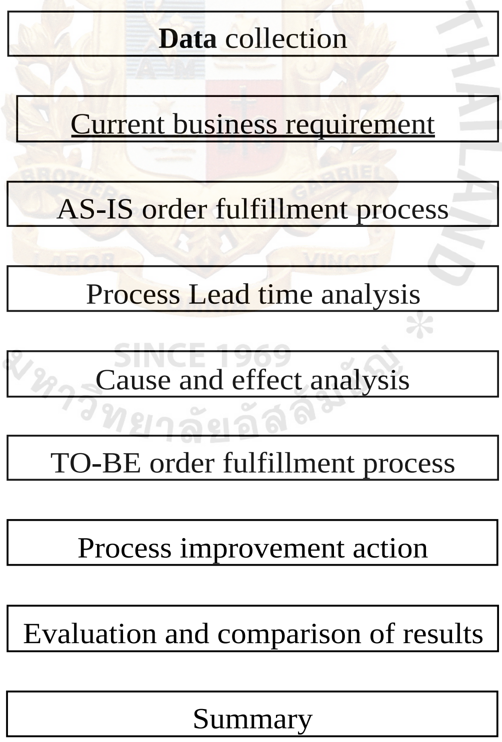
This chapter gives visible concepts related to the research. Under time-based competition in the supply chain environment, sharing of information with different parties is essential to achieve the on-time delivery and superior material control and support various supply targets. Managing the process lead time from wasting and the non-value added activities could help the company get a better supply performance to customer especially to gain abilities in fast feedback and a flexible order fulfillment. With BPI implementation, it is available to access ABC Company business to find and eliminate the inadequate point of current order fulfillment process and make the further improvement.

CHAPTER III

RESEARCH METHODOLOGY

This chapter explains the collection of data for current order process and the application of the first three steps of business process improvement: (1) explore current business, (2) understand current ABC order fulfillment process to (3) define current order fulfillment process lead time problem and analyze current order fulfillment process lead time performance.

Figure 3.1: Research Methodology Structure



3.1 Data collection

In-depth interview: The interview is of two parts. Firstly, meeting with the company's cross-function team leaders who are the persons in charge of the order fulfillment process. The meeting was conducted during the business changing and aimed to find out the major concerns of performance in each department. Secondly, conversations with ABC's trading partner via call conference which included the customer planning and material team in Singapore. The conference was conducted with the aim of having a better understanding about each organization's operation process and responsibility under the new business which was regarded as the main change point on order fulfillment process.

Table 3.1: In-depth Interview Attendants

Internal Participants	External Participants
Company Planning team	Customer Material team
Company Inventory team	Customer IT team
Company IT team	
Company Shipping team	

Extraction data: The scope of data collection was Q3FY14 to Q4FY15 total six quarters, including the key performance aspects as those data are evaluated by the customer at the end of each quarter regarding order fulfillment process and the original data which was extracted from ABC's operation system and daily report.

Table 3.2: Data Collection Table

Company data	Time period
Monthly Finished Goods Inventory Report	2014-2015
Monthly Sales report	2014-2015
Monthly Raw Material Inventory Report	2014-2015
Monthly Daily Shipment Report	2014-2015
Quarterly Business Review Score Package	2014-2015

Order fulfillment process lead time data records: The data records were analyzed and evaluated as they reflect the process efficiency and responsiveness under the new business. Each main activity lead time was recorded by the auditor. The cut off time at each trigger point was taken from email record, the ABC's order fulfillment process time consumption was counted manually.

3.2 Current ABC-Customer Business Requirement

To have a better understanding of the current business between ABC and its customer, the researcher looked into the exact relative ABC order fulfillment processes and policies which have been changed and very important for further study. Below is the table which shows the relative ABC order fulfillment change points as a result of the in-depth meeting with customer:

Table 3.3: Difference between Old Business and New Business

	Old Business	New Business
Business Model	Consignment for all materials.	Consignment / Non-Consignment.
Purchase Order(PO)	All parts PO generated by customer side.	PO is released by ABC, customer only controls the Non-consign parts.
Order Forecast	Monthly update, order was changed once a week.	Changes are done more than twice a week.
Material Inventory	ABC had zero inventory holding cost of components	ABC owns inventory of all materials. For consign parts stock is checked every quarter.
Component Traceability Request	All components written off transactions were tracked in ABC.	Only consign parts need to be tracked at the point of PCBA receipt transactions.
Payment Objective	Customer paid to all raw material suppliers.	ABC pays to suppliers for non-consign parts; Customer pays to suppliers for consign parts.
Material Liabilities	Customer paid to ABC for idle parts exposure.	ABC handles Non-consign parts idle exposure. Customer handles consign parts exposure.

Source: Author

The above check points, there are two sections impact the order fulfillment the most. Order forecast and Material inventory were considered as significant reference for ABC to improve the AS-IS business which was conducted by ABC internal department after meeting with the customer.

Affected Internal Department: Internal discussion was done with each affected department, and the previous functions have been affected by the current business as shown in Table 3.4:

Table 3.4: Affected Internal Department and Customer Requirements

Department	Explanation Operation	Customer Requirements
Planning	Order fulfillment is facing a high order forecasting change frequently.	Need to be fast-feedback on order confirmation, accurate.
Inventory	Raw material inventory is controlled for both consign and non-consign parts.	Total material and finished goods inventory must be less than five days of sustainability.
Manufacturing	Production capacity management includes manpower and production line.	Minimize times of the occurrence of line down and times of line conversion and overtime cost
Shipping	Stable shipment schedule and full commit quantity.	On-time delivery and reliability No shipping delay in any case.

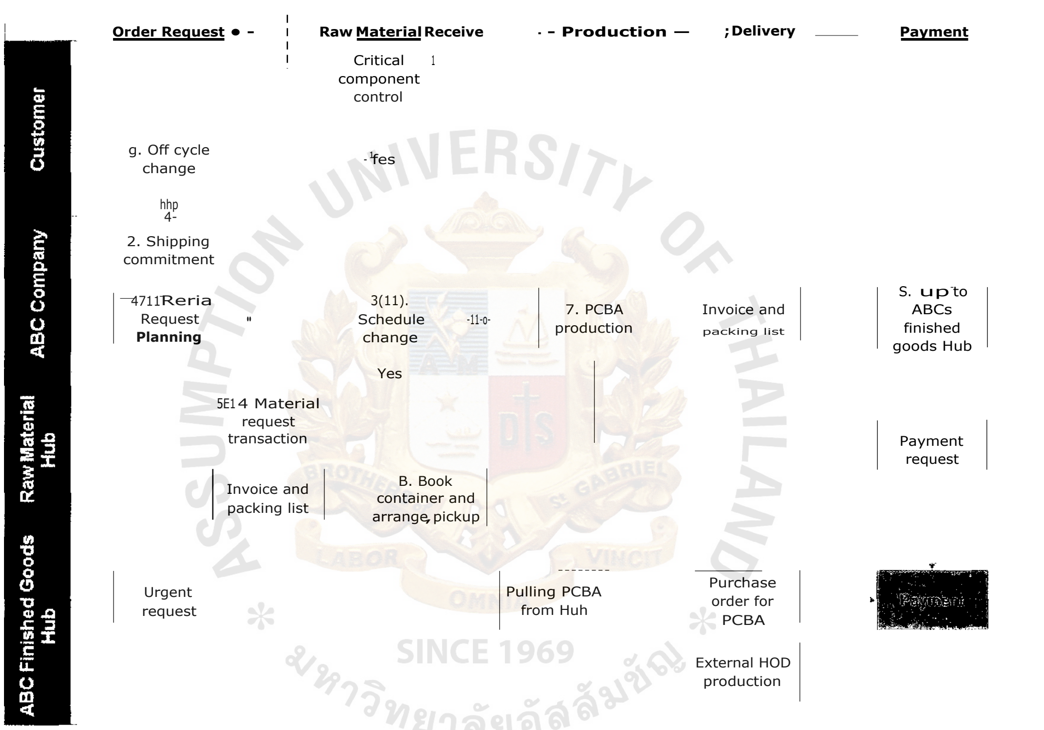
Source: Author

The ABC Planning team was facing with a potential risk in coordinating order fulfillment, with the customer focusing more on marketing which caused a high order change frequency, at the same time requiring the finished shipment without any delay, material and finished goods inventory cannot be prepared over five days of sustainability under the purpose of ASICs control, production should avoid line down and minimize the line conversion. From the above analysis, two notifications were identified regarding order fulfillment as follows: Firstly, a high speed and efficiency order fulfillment process is needed to ensure delivery reliability. Secondly, response to customer when the demand change is on alert not only concerning about the speed but also minimizing the internal operation cost of material and finished goods inventory control.

3.3 AS-IS Order Fulfillment Process

As figure 3.2 shows, the current order fulfillment process which involve internal and external team cooperation from order release to raw material preparation, production and finally product delivery.

Figure 3.2: Current Order Fulfillment Process



Source: Author

Step 1: Master production Schedule Release: The quarterly order demand forecast is drafted by the customer planning team which includes 13 weeks of PCBA supply demand. The forecast base line reaches to three parties through email: customer material team responsible for ASICs component purchase; customer's hard disk drive (HDD) factory where the assembly schedule is made; ABC planning team responsible for ordering raw material and PCBA production schedule.

Step 2: Shipping commitment: Based on MPS, the ABC planning team needs to the confirm PCBA shipment schedule to the customer for the daily PCBA replenishment.

Step 3: Production schedule: According to shipment schedule, the ABC planning team checks the beginning stock on hand for the material available and makes the PCBA production schedule. The principle is to make sure that the customer's HDD factory has enough PCBA to assemble the hard disk drive to avoid customer stock out. (Also see in step 11)

Step 4: Material request planning: Systematically generating the pulling request to support the production, with the system calculating the logic of raw material inventory plus work in process minus the weekly production demand to check the material shortage.

Step 5: Material request transaction: Material request transaction is done through a system that generates numbers of material part and quantity pull list according to the bill of material (BOM) and is sent to the raw material hub by email. (Also see in step 10)

Step 6: Book container and arrange pickup: Tracking the material delivery from the hub to the factory after the raw material hub receives the pulling request, material is loaded and arranged to ship out. The ABC planning team needs to help to coordinate the material delivery estimate time of delivery (ETD) and estimate time of arrival (ETA) status with the import team and logistics for custom clearance by invoice and pack list.

Step 7: PCBA production: After receiving the material prepared for the production, the planning team arranges a production meeting with the manufacturing team to set up the detailed target of production plan regarding capacity, material issue to the production line, working hours, line conversion, model change point, and shipping date for each model.

Step 8: Ship to ABC's Finished Goods Hub: For the finished goods delivery, the PCBA is shipped out to ABC's finished goods hub which is near by the customer's factory by truck. For order to delivery process, this is the last step.

Step 9: Urgent supply request (Off cycle change): There are two major special cases from the customer raising up for specific PCBA model. First is demand ramp up by customer center feedback when the marketplace is changed. Second is the PCBA shortage due to the defects being detected and returned by end customer. Material suspension as poor quality needs re-test and the PCBA is returned to the factory. Once the urgent request is sent out, the customer planning team updates the MPS and sends to ABC planning team, then the ABC planning team is required to do additional material pulling and schedule changing.

Step 10: Additional material pulling: The team needs to loop the whole process again and checks with the raw material hub the current raw material inventory stock and starts the pulling process. For customer material team, as ASICs are the most essential components of PCBA. The ASICs need to be reallocated and all members need to wait for the final decision.

Step 11: Schedule change: The planning team needs to make adjustment of the current schedule to catch up with the shipment. When there is a change in the schedule the planning team checks with production team for the current line status and makes the decision on line conversion.

In addition, the ABC planning team is the center of the coordinator who arranges for the pulling of material to make sure of the continuous process of production and finally make sure that all of the PCBA shipments are delivered on time to the customer. When the order is changed from order receiving to order delivery and if the whole process does not make in time or on time, the final delivery is affected.

3.4 AS-IS Order Fulfillment Process Lead time and Efficiency

To calculate the current order fulfillment process cycle, based on lead time equation (Bartezzaghi, Spina and Verganti, 1994), to break down the whole process by the average time per process step. The data are recorded by observation each week when the planning team starts to schedule and do the material pulling until the finished goods are shipped out. Each process is segregated by six types:

The total process lead time is accumulated by each step:

1. Run time (R): the process or sub-processes from start until end of the time period.

2. Change (SU): process change time, the time period before the next process starts.

3. Queue time (Q): waiting parallels process by other department or trading partner.

4. Document (WTM): the time to generate shipping invoice, packing list, transaction system update, and email sent or received, etc.

5. Transportation (SY): physical goods movement lead-time, such as truck shipment of finished goods to hub, raw material shipment to ABC.

6. Overtime (PS): process delay, the time to solve the problem during the process.

As Table 3.5 shows, the process lead time is tracked by the process time record.

Table 3.5: Process Time Record

Process Time Record								
Hour		R	SU	Q	WTM	SY	PS	
Process	Total Time	Run Time	Change	Queue Time	Document	Transportation	Overtime	Remark
Order receive and confirm								
Production schedule								
Material request								
Schedule change and re-confirm the order								
Additional material pulling process								
Material request transaction(E-KIT)								
Material delivery								
FG delivery								
Total								

Source: Author

It is necessary to analyze the order fulfillment lead time, as each activity involves separate part work and there is less information to share, the whole order fulfillment is going on step by step, and the communication only concentrates on the material availability and demand confirmation. The single side information movement makes every activity affected by the information delivery latency and the process is also delayed by step.

Table 3.6 indicates the process lead time from shipping commitment to confirmation of material pulling in Q3FY14.

There are three types of operations that are undertaken. They are categorized into:

1. Non-value adding (NVA)
2. Necessary but non-value adding (NNVA)
3. Value-adding (VA)

Non-value adding operations are pure waste and involve unnecessary actions which should be eliminated completely.

Necessary but non-value adding operations may be wasteful but are necessary under the current operating procedures.

Value-adding operations involve the process of raw material delivery and the finished goods delivery, the process of production which is excluded.

Table 3.6 Process Activities Lead Time Tracking Q3FY14

Week\process time(hour)	w k1	wk2	wk3	wk4	wk5	wk6	wk7	wk8	wk9	wk10	wkl 1	wk12	wkL3	Mean Lead Time(hour)	
Order receive and confirm	0.5	0.5	0.4	0.3	0.5	0.7	0.4	0.6	0.4	0.7	0.7	0.6	0.8	0.5	N-non value added
Production schedule	0.7	1.3	0.7	0.9	1.6	0.6	0.7	0.8	1.6	1.1	1.5	1.0	1.7	1.1	N-non value added
Material request	0.4	0.7	0.5	0.6	0.4	1.1	1.3	1.1	1.2	1.3	1.4	1.2	1.3	1.0	N-non value added
Schedule change and re-confirm the order	3.8	3.1	3.1	3.4	3.7	3.3	4.4	4.7	4.6	4.5	42	4.3	5.0	4.0	N¯non value added
Additional material pulling process	4.5	4.7	4.7	4.6	4.1	4.7	4.8	5.0	5.3	5.5	5.4	5.8	5.2	4.9	N-non value added
Material request transaction(E-KIT)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	N-non value added
Material delivery	72.3	72.0	72.7	72.1	72.6	72.4	72.2	72.2	72.4	72.4	72.9	72.7	73.0	72.5 insignificant	N-non value added
FG delivery	6.1	6.7	6.3	6.8	6.2	6.2	6.0	6.5	6.3	6.8	6.2	6.0	6.8	6.4 insignificant	value added
Total	10.9	11.3	10.4	10.8	11.3	11.4	12.6	13.2	14.1	14.1	14.2	13.9	15.0	12.5	

Source: Author

Based on Table 3.7, the daily route process in lead time is approximately fixed. The transportation of raw material delivery lead time from Malaysia to Thailand by truck is about three days and by air is one day. For the PCBA finished goods delivery from factory to customer plant is about six hours. Thus, the transportation time and standard process time are considered as insignificant factors.

Order Fulfillment Process Mean Lead Time = (wkl-wk13 Total Process Time)/ The Number of Weeks

Thus, the current average process Lead time =

(9.9+10.3+9.4+9.7+10.3+10.4+11.6+12.1+13.1+13+13.2+13+14) / 13

=12.5 hours

Based on the throughput efficiency calculation (Btaithwaite & Christopher, 1989):

Total Order to Delivery Process Cycle Efficiency = Customer Value Added Time / Process Mean Lead Time

Total process cycle efficiency = (72.5+6.4) / (12.5+72.5+6.4)

= 91%

It takes 2.6 hours from the first shipment commitment to the production schedule process to the material shortage check (activity 1-3). It takes 9.9 hours when there is MPS change, because the schedule is adjusted and addition material request (activity 4-5). It takes 1 hour from material request transaction (E-kit) to raw material hub. Hence, from order confirm to material pulling to completed finished goods prepared to ship, the process lead time is 12.5 hours.

Table 3.7 Main Activities Lead Time

	Activities	**Lead time (hour)**
1	Order receive and confirm	0.5
2	Production schedule process	1.1
3	Material request process	1.0
4	Schedule change and re-confirm the order	4.0
5	Additional material pulling process	4.9
6	Material request transaction (E-kit)	1.0
	Total	**12.5**

Source: Author

To access the current business performance mentioned in chapter 1 figure 1.4, there are two main parts which are inventory control and on-time delivery performance. They are related to order fulfillment process and make the further improvement measurable.

3.5 AS-IS Business Performance Assessments

AS-IS Inventory control

Company total inventory consists of buffer stock (before ship), finished goods inventory (after ship), and beginning on hand (BOH).

Before the finished goods are shipped out to the customer, they can be tracked by daily production status in the actual output which is transacted to finished goods inventory in ABC to prepare the daily shipment. This balance quantity in ABC is considered as a buffer stock in preparation for the order change.

Buffer stock is based on the equation from ABC Company inventory team:
(n day) Buffer stock (BOH) = (n day) Shipment QTY + (n-1 day) Finished goods on hand (EOH) — (n day) Production QTY

Another part of finished goods is shipped to ABC finished goods hub near the customer factory. This part of physical stock is pulled by the customer for HDD assembly. The balance quantity is calculated by the point of sale (POS).

The calculation of hub beginning inventory on hand is based on the equation:
(n day) Begin Hub Inventory (BOH) = (n day) Shipment QTY + (n-1 day) HUB stock balance (EOH) — (n day) Consumption QTY

Inventory cost is based on both buffer stock and finished goods inventory cost, the equations are:
Total inventory = Finished goods BOH + Buffer stock
1 Pallet = 9600pcs

Weekly average pallet = Total inventory / 9600pcs

Cost per pallet= 217 Baht

Storage cost=Total pallet * cost per pallet * 6 days

Inventory turnover = cost of goods sold / average inventory

Table 3.8 shows the Q3FY14 the average inventory level which is 382,944pcs with 4lpallets and 52,781baht storage cost per week. The storage cost has increased at the end of Q3FY14 as a lot of PCBAs have not fulfilled the customer demand in time and have become idle stocks. Those stocks have stayed in both ABC finished goods hub and ABC Company are waiting to be pulled out by the customer. The idle PCBAs also have possibility to be affected by temperature and oxidation and become a potential risk of supply quality. Inventory turnover also indicates for the investor to check the cash flow of the company. When the inventory turnover rate is higher, it indicates the better liquidity. Especially after week 7, the turnover rate reduced by each week. Meanwhile, raw material needs to be at certain level and keep the production running, but when those PCBAs cannot be used by the customer on time, the material control becomes a negative section of inventory control.

Table 3.8: Q3FY14 ABC Total Inventory

Q3FY14	Total Inventory	Weekly average pallet	Storage cost (Baht)	Turnover rate(weekly)
weekl	192,638	21	27,342	10
week2	232,919	25	32,550	8
week3	306,225	32	41,664	6
week4	278,488	30	39,060	7
week5	232,875	25	32,550	8
week6	260,639	28	36,456	7
week?	241,048	26	33,852	8
week8	495,511	52	67,704	4
week9	589,859	62	80,724	3
week10	712,474	75	97,650	3
weekll	407,005	43	55,986	5
weekl2	563,890	59	76,818	3
weekl3	464,707	49	63,798	4
Average total	382,944	41	52,781	5

Source: Company data 2014-2015

AS-IS PCBA on-time production and delivery

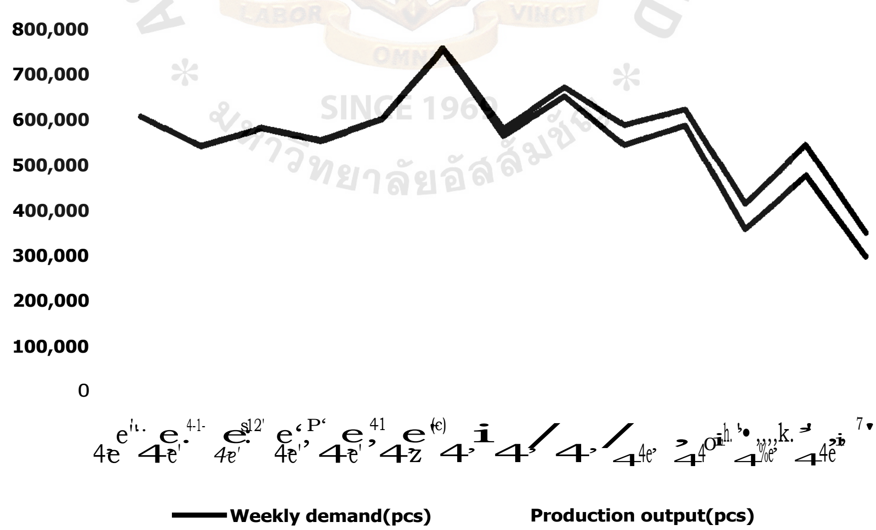
ABC delivery performance was evaluated by order hit point percentage and the de-commitment of production delay. Two parameters were measured by customer:

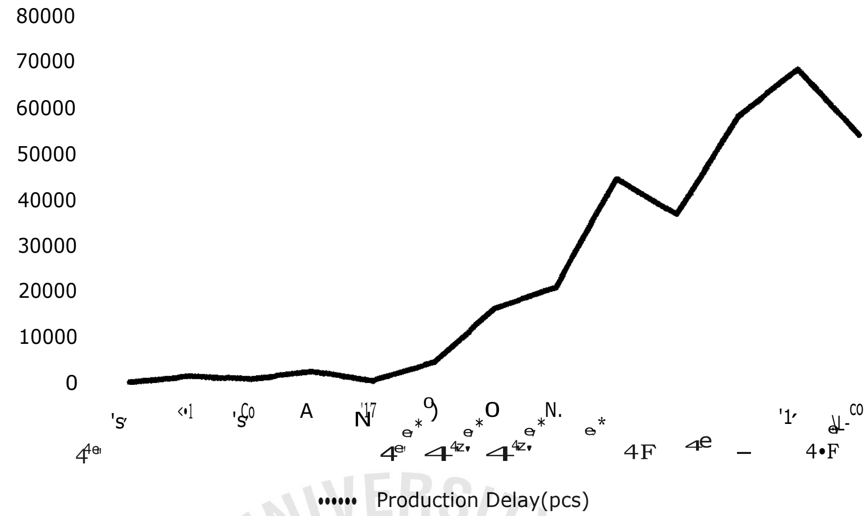
Production Delay = Weekly demand — Production output

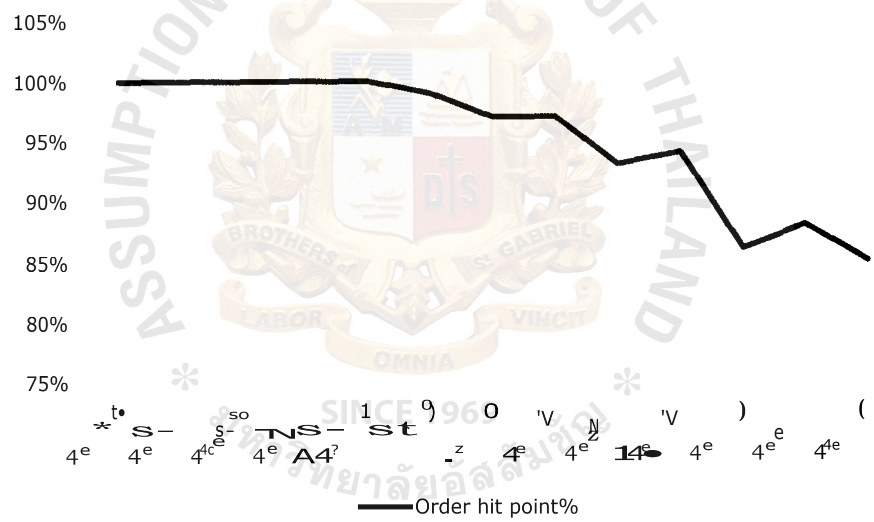
Order hit point % = 1 - Production delay / Weekly demand

Figure 3.3 shows the review of the weekly production output during weekl to weekl3. The ABC team found the problem on production delay by the processes before production, process lead time of schedule change and re-confirm the order, and additional material pulling consumed the critical production timing when customer needs specific models (refer to Table 3.11 activities 4 and 5), the gap between the weekly confirmed demand and production affected the delivery timing.

Figure 3.3: Q3FY14 PCBA Delivery Performance







Source: Company data 2014-2015

Summary for Business Assessment

The researcher overviewed the current order fulfillment process, internally interviewed the cross-functional team and trading partners, and externally recorded customer complaint, historical email and conference documentations when the new business was implemented. The researcher found the major issues as follows:

Buffer stock and inventory storage cost increasing: Inaccurate additional material pulling consumed the critical production timing leads planning to put more buffer to cover the "just in case" demand.

Production delay and order hit rate decreasing: Schedule change and re-confirm the order takes time leads to output lost when the urgent model needs to increase capacity.

Through the current ABC business performance assessment, the summary reveals that the ABC order fulfillment has a long process lead time and negative effect on company supply performance. Furthermore, the coordination during the order fulfilling, every decision made regarding confirmation of shipping schedule and material pulling timing are critical and directly affect the order fulfillment efficiency. Hence, it is necessary to analyze and measure the process lead time to deeply find out which parts of activities need to be improved.

Especially, when the order was ramped up, the ABC team missed the point to coordinate with the trading partners while taking time to confirm the schedule and pulling material. This chain reaction caused the delay of the material arrival to the ABC factory, till the production line had to take over time to cover the demand that the production line often stopped for line conversion. Eventually, the customer received the finished goods late. Above all which indicates that the order fulfillment process total lead time needs to be improved.

3.6 Summary

Under the new business the non-consigned material is handed over to ABC. When a demand off cycle occurs, all the departments are late to respond. The schedule change is late, the material pulling adjusts is delayed, the production line conversion is delayed. Consequently, the current order fulfillment process results to the production and finished goods delivery delay.

By following the BPI methodology, the researcher at this stage studied the current business requirement and how its impact to each of the ABC departments. Also, the researcher studied the current order fulfillment lead time by collecting data and documents from the company. Furthermore, the researcher interviewed the customer and reviewed the current supply operation related performances and its process.

The next chapter will focuses on the discussion of the gap in order fulfillment and how to reduce the current order fulfillment process lead time.

CHAPTER IV

PRESENTATION AND CRITICAL DEISCUSSION OF RESULT

This chapter presents the root cause of current order fulfillment lead time and how to improve the order fulfillment with concept of information sharing and BPI. There are four sections: (1) Analysis on the problem of the order fulfillment process lead time; (2) design of process improvement; (3) evaluation outcomes of new order fulfillment process; (4) Summary

4.1 Critical Activity Discussion and Root Cause Analysis

To solve the lead time problem, it is important to find out the root cause of the lead time issue. The ABC team has performed a critical activity discussion with the 5-whys technique. This analysis tool is from Toyota Production System which aims to reveal the root cause problem (Ohno, 1988).

Table 4.1: 5-Whys Analysis

5-Whys	Answer
Why dose current process takes a long lead time on schedule change and additional material pulling?	Each sub process spends long time.
Why does each sub-process take a long time?	Each sub-process has internal review and meeting which hold the next process or other parties waiting.
Why does each sub-process work separately and wait?	Key information does not share with each other.
Why can the information not be shared?	Some information goes internally; there is no discussion with each party.
Why can each sub-process not be jointed together?	There is no proper system to support the information to be exchanged.

Source: Author

The analysis found the root cause of the order fulfillment process lead time issue is lack of a proper information sharing process and system to link each sub-process. Thus, it is necessary to check each sub-process in order fulfillment to find solution.

Throughout the whole process, the identified two important activities, order confirmation and additional material pulling are the most time consuming. Figure 4.1 shows that it takes total 9.9 hours to complete the schedule change and additional material pulling.

Figure 4.1: Schedule Change and Additional Material Pulling — AS-IS

Lead time	**ABC Planning**	**Customer Planning Team**	**Raw Material Hub**	**Customer Material Team (ASICs)**	**HDD Factory**
	waiting	Off cycle (Start)	waiting	waiting	absent
2hr	Capacity Review		waiting	waiting	absent
2hr	Material shortage review	waiting	waiting	waiting	absent
1.5hr	Generate Ekit		Confirm pull request for Non-ASICs	waiting	absent
1.5hr	waiting	waiting		Advice for ASICs availability	absent
0.9hr	waiting	waiting	Confirm pull request for ASICs		absent
1 hr	Informed back order adjust schedule	waiting	Pickup	waiting	absent
0.5hr	Revise shipping commit	waiting	waiting	waiting	absent
0.5hr		Revise MPS	waiting	waiting	absent

Source: Author

It is an in-constant process which holds each part to wait when others inner process was activating. The information is only transferred from one to another to keep going to confirm the finalized schedule and the additional material pulling. If the information not fully leveraged by each party, the process activities are postponed through a narrow information channel.

4.2 Information Communication Gap

As previously analyzed, from order change to final commitment, the planning execution is delayed by an isolated and long process of information exchange The whole process is complex and with low efficiency. The long process lead time is unable the planning team to make the right decision in a short time, each part working separately, while there is a lot of waiting during the Information transact between limited parties. At the same time, trading partners also have to wait an internal long process to exchange information and present the final decision. To find out the critical control point and major concerns of each party, there has been an interview conducted regarding the new business with the question "what information we can share with for a better reaction about schedule change and additional material pulling?"
The key participants of brainstorming group are:

1. Supply chain material director of customer from Singapore.
2. Raw material hub senior supervisor from Malaysia.
3. ABC information management team and planning team
4. Customer hard disk drive plant planning team from Thailand.

There are several factors identified which block the information during the change in schedule and pulling material.

During Production review

The company planning team reviews the production capacity with the manufacture team that provides the Surface mounting technology (SMT) maximum capacity and function testing fixture status. The team also reviews the current shipping status whether it can fulfill the demand or not. Thereafter, the new weekly schedule is planned.

Information gap

- The customer planning team does not have a clear vision about the ABC production capability. The team only gets daily output update which does not include the final inventory update.
- Conversation is limited to material shipping availability.
- There is a lack of production scenario discussion.
- The customer HDD factory team does not join in the review; there is latency of urgent PCBA request update.

Potential risk: variance between actual demand and actual capacity make a confusion and suspension to both sides.

Table 4.2: Information Gap during Production Review

Information types	ABC Planning	Customer Planning Team	Raw Material Hub	Customer Material Team(ASICs)	HDD Factory
Daily output	A/	'4	x	x	x
Finished goods Inventory	-4	x	x	x	x
Shipping notice	x	x	-4	4	x
Production scenario discussion		x	x	x	x
PCBA request update	x	4	x	x	-4
Capacity review		x	x	x	x

available
unavailable

Source: Author

During material shortage review

Based on the projected schedule, the ABC inventory team checks the shortage by BOM list and raw material status to calculate the balance quantity, sends out a pulling request to raw material hub which includes ASICs and non-ASICs components.

Information gap

- The customer material team does not have raw material inventory status especially for ASICs components from, only waiting for ABC to send out the pulling request to raw material hub then get feedback and recheck the consign ASICs shortage.

- The ABC planning team does not have raw material hub inventory for all components. If there is not enough stock in the raw material hub, the Customer material team will check the best shipment date to replenish in the raw material hub , but during this period, the ABC planning team and the customer planning team can only hold the instruction pending.

- The ABC planning team lost ASICs component traceability once the raw material hub team shipped out the material.

Table 4.3: Information Gap during Material Shortage Review

Information types	ABC Planning	Customer Planning Team	Raw Material Hub	Customer Material Team(ASICs)	HDD Factory
ABC material Inventory	q	x	x	x	x
Hub material Inventory	x	x	V	V	x
ASICs Shipping Notice	x	x	V	g	x

.V available

unavailable

Source: Author

Potential risk: When the schedule has been fixed with pulling request and weekly demand, there is a deviation of ASICs availability instruction. The ABC planning team has to revise the schedule and request pulling by air. Material resource planning has to come all over again.

Limited information make the ABC planning team difficulty coordinating with the customer and raw material hub because there is no proper way to share information. As a result, it makes the purchasing procedure wait for further instructions either from the ABC planning team or from the customer and the raw material hub. Since the information is not fully leveraged, buffer stock increasing and finished goods delivery delay issues occur in AS-IS order fulfillment process phase.

4.3 Proposal for the Improvement of Order Fulfillment Process

Improvement action is expected to remove the non-value added activities, minimize each parties waiting time, leverage the information and let trading partner able to join the decision making, the order process confirm and additional material pulling processes are simplified by an integrated formalized information system. Information share and data exchange internally and externally will give achievable vision. The ABC Planning team is able to react to the demand change in a short period time and each party will get the information feedback at the same time, synchronized decision can help reduce the human error and misjudgment during the preparation of the production schedule and material pulling as shown in figure 4.2.

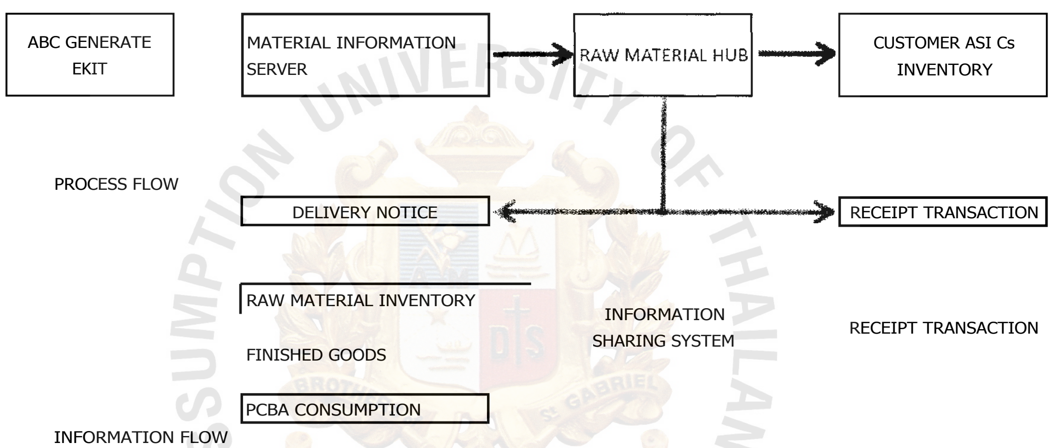
Figure 4.2: New Process Structure

Process Cycle	**ABC Planning**	**Customer Planning Team**	**Raw Material Hub**	**Customer Material Team (ASICs)**	**HDD Factory**	IT system
	Off cycle (Start)					Information sharing
Compress process Lead time	Capacity Review	ASICs availability	Material shortage	Revise shipping commit		
Expedite data transfter	Generate material request transaction			Confirm pulling request		

Source: Author

A cut-off time based system enables to shorten the lead time process which is constructed in the corporation between ABC IT team and customer IT team. The improved order fulfillment process will enable the flow of Information be shared and transferred throughout the ABC to the customer and raw material hub. The proposal for the improvement of the order fulfillment has been generated in a structure as shown in figure 4.3.

Figure 4.3: Information Sharing System Logic Structure



Source: Author

Order fulfillment information sharing system is designed to increase the information exchanges with customers and raw material hub by electronics data transfer between each other's information system. The system program process shows that each activity is tracked, the system data is packaged, and sent to the Information sharing server which gathers the entire database and updated by a fixed time. The system also receives the outer data package by a standard format from other trading partners, thus the information is leveraged by each party conveniently.

Information share system feature

- Real time visibility of pulling material from raw material hub via Point of Delivery (POD).
- Real time PCBA consumption update from customer via Point of Sale (POS).

- Data transaction update to information sharing system.
- Identification of ASICs inventory in both customer side and ABC.
- Flexible schedule update based on customer requirement.
- Systematic update of raw material hub inventory and ABC finished goods inventory.

4.3.1 Information Sharing System Development Purpose

ASICs component tracking purpose

The ASICs component and the end of life (EOL) PCBA are the critical control points for customer as the ASICs component is consigned to ABC. The real inventory for the component is actually untraceable once the physical parts have left the raw material hub in Malaysia, the raw material in ABC and on way data are easily lost and mistaken by human error. In the production, the component lost also causes redundant that the customer will charge to ABC with an equivalent amount. As one of the most important information, the material delivery notice is not fully leveraged. A visible system, with customer and its raw material hub, is able to track ASICs component inventory and transportation status and perform a better material control in new business.

Material exposure control purpose

Another concern about material handle cost is material exposure control. As each PCBA needs to use two ASICs components, if there is a model going to the last build, there will be a disposal for raw material and finished goods from the customer. The customer expected every model to approach a minimum ASICs stock and PCBA idle inventory quantity to repay the financial loss because the EOL model exposure is charged by ABC Company.

Non-ASIC and buffer stock control purpose

For the ABC company itself , too much of buffer stock and material excess become the potential cost, and the information transparency to customer planning and material team affects the ASICs replenishment does not tally with demand off-cycle change. The supply major issues are discussed in chapter 3.

The purpose of Information share system development is to provide a real time tracking data to ABC planning team and its trading partner to share the information while making decision for production and material control.

4.3.2 Information Sharing System Development Time Schedule

The information sharing system is developed by ABC and Customer and Raw material hub team, during the new order fulfillment process testing period, all the supply performance is recorded for process evaluation and this system was implemented in Q4FY14. The system construction follows certain period schedule. Table 4.4 shows the implementation schedule as follows:

Wkl - ABC planning team meets with IT department confirming the system flow chart, IT team group (ABC, Hub and Customer) discusses the implementation schedule time line and key testing point.

Wk2 to Wk4 - Start of the data exchange test log file between two parties.

Wk5 - First formal text log file is uploaded in Information share system server.

Wk6 - Complete Information share system is released to normal operation.

Wk7 to Wkl 2 - Data variance tracking and Accuracy evaluation.

Wkl 3 - Physical counting ASICs inventory, customer on site audit.

Table 4.4: Information Sharing System Implementation Time Line

Q4FY14	System Implementation schedule	
Time line	**Participants**	**Action**
WK1	All parties	Information share system construction and internal test
WK2	All parties	Data exchange test between Hub and ABC, HUB to customer, ABC to customer. Finished goods hub to ABC
WK3		
WK4		
WK5	All parties	Text log file upload in server
WK6	All parties	Information sharing system implementation
WK7	ABC and customer	Data Tracking and evaluation
WK8	ABC and customer	Data Tracking and evaluation
WK9	ABC and customer	Data Tracking and evaluation
WK10	ABC and customer	Data Tracking and evaluation
WK11	ABC and customer	Data Tracking and evaluation
WK12	ABC and customer	Data Tracking and evaluation
WK13	ABC and customer	Physical ASICs inventory check

Source: Company data 2014-2015

4.3.3 Formalizing the TO-BE Order Fulfillment Process

Supported by the Information sharing system and with customer and raw material hub team. A joint planning procedure has been formalized. The prime objective of this process proposal is to set up communication transparency and collaborative standard process with each party. Joint planning will link customer and ABC Company share and perceive information simultaneously thereby to generate proper material pulling request and schedule. Table 4.5 shows the key information to be shared within each party.

Table 4.5: Formalizing Critical Information Sharing

Planning activities	**Information owner**	**Information share**	**Share Objective**	**VIA**
Capacity and order review	ABC planning team	Daily PCBA buffer stock	All parties	Information Sharing System
Material shortage review	ABC planning team	Material daily inventory	All parties	Information Sharing System
Non-ASICs pulling confirm	ABC planning team	Weekly schedule	All parties	Email
ASICs pulling instruction	Material hub team	Hub daily consumption record	All parties	Information Sharing POS update
	Customer	A SIC weekly beginning stock	All parties	Email
	Material hub team	Receipt transaction of pulling	All parties	Information Sharing POD update

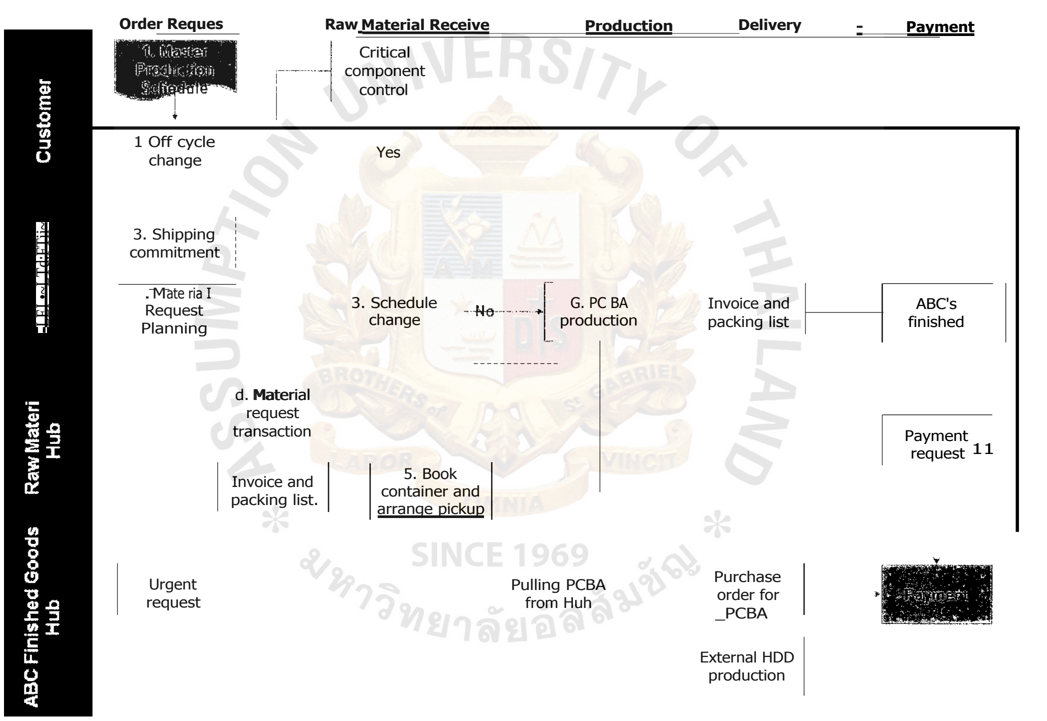
Source: Author

To eliminate current time consuming process and replaced with a joint planning will be available once the Information sharing system is set up and the information is leveraged by each party. Information gap will be broken down by a real time update Information share system; each party can get the more transparency to be more proactive. The objective is aim to reduce the order fulfillment lead time and increase customer responsiveness.

4.4 TO-BE Order Fulfillment Process

The purpose of order fulfillment improvement is to achieve information share and integrate with customer and raw material hub team to speed up the operation transaction within the whole order fulfillment process; It also helps the ABC team make an optimal efficient order commitment and reduce the Lead time with a quick response when each participant is able to share its key information and cooperation to solve the problem.

Figure 4.4: TO BE Order Fulfillment Process



Source: Author

On step 3 (Figure 4.4), material request planning, schedule change and material request transaction are combined to eliminate the waiting time for the next process. The decision and confirmation in previous process is replaced with collaborative way to expedite the order fulfillment. Compare to the AS-IS process total 11 steps, the new process takes only 8 steps to complete one order fulfillment. ABC Planning team can make a quick response to customer demand change. The time saving process also enables the production and material requirement to be more accurate.

4.5 Order Fulfillment Performance Evaluation and Results

The new order fulfillment process has been revalued by the ABC and the customer on the total process lead time. The record is from Q3FY14 until Q4FY15. After implementing the new order fulfillment process, the ABC Company has kept tracking on the process and found a significant reduction in the average order fulfillment lead time and improved in the supply performance of time delivery and material control.

Increase flexibility of order fulfillment.

As table 4.6 shows, Q3FY14 order commitment lead time is 12.5 hours compared to the improved lead time of 3.9 hours, there is a reduction of 8.6 hours. The improvement point is found in schedule change and additional material pulling which eliminate the non-value added time of 8.4 hours in Q4FY15.

Table 4.6: Compare Result of Current Process and Improved Process

	Activities	**Q3FY14 Lead time (hours)**	**Q4FY15 Improved Lead time (hours)**
1	Order receive and confirm	0.5	0.5
2	Production schedule process	1.1	0.9
3	Material request process	1.0	0.9
4	Schedule change and re-confirm the order	4.0	1.6
5	Additional material pulling process	4.9	
6	Material request transaction	1.0	
	Total	**12.5**	**3.9**

Source: Company data 2014-2015

For each party the waiting time is eliminated and critical information can be shared within supply members and less complexity operation process. Moreover, the ABC planning team is able to make production schedule based on an optimal scenario which takes less time for arrangement and preparation while to meet customer requirement.

Process Improvement Contributed on ABC Supply Performance

Table 4.7 indicates the performance tracking and evaluation result of TO-BE order fulfillment process which is supported by information sharing system and standard process. It is obviously identified that with the same shipping volume, the new process can fulfill the customer request with minimum lead time and maximum process cycle efficiency. Hence, the TO-BE order fulfillment under the new business is more favorable than the AS-IS order fulfillment.

Table 4.7: Improvement Results from Q3FY14 to Q4FY15

Improvement	Q3FY14	Q4FY14	Q1FY15	Q2FY15	Q3FY15	Q4FY15
Total process cycle time (Imur)	12.5	7.9	3.9	3.9	3.8	3.9
Weekly Buffer stock (Million pcs)	0.4	0.2	0.1	0.1	0.1	0.1
On-time delivery (%)	96.0%	98.3%	99.6%	99.8%	99.8%	99.7%
Total process cycle efficiency (%)	86.3%	90.9%	95.3%	95.3%	95.4%	95.3%

There are two main benefits of the TO-BE order fulfillment process:

(1) Reduce the redundancy of function across departments then share key information to each party during schedule change and material pulling.

Table 4.8: Information Gap during Production Review-After

Information types	ABC Planning	Customer Planning Team	Raw Material Hub	Customer Material Team(ASICs)	HDD Factory
Daily output	"V	"V	x	V	V
Finished goods Inventory	"V	V	x		
Shipping notice					x
Production scenario discussion	"V	V	x		
PCBA request update	V	A/	x	Ai	A/
Capacity review	"V	•V	x	V	"V

available
unavailable

Source: Author

(2) The ASICs traceability is achieved by Information sharing system for a better control on material managing performance.

Table 4.9: Information Gap during Material Shortage Review -After

Information types	ABC Planning	Customer Planning Team	Raw Material Hub	Customer Material Team(ASICs)	HDD Factory
ABC material Inventory	4	4	x	4	4
Hub material Inventory	-\/	Ai	4	"I	4
ASICs Shipping Notice	'I	A/	A/	4	4

available

x unavailable

Source: Author

4.6 Summary

From analysis of problems in AS-IS order fulfillment, two critical planning activities are identified. First, the AS-IS order fulfillment problem has a long process lead time on schedule change and additional material pulling because of the information gap. Setting up an information share order fulfillment which is supported by Information share system aims to create transparency for accurate order commitment and ASICs traceability from material pulling. An ongoing data tracking to evaluate the order fulfillment process improvement has been done.

CHAPTER V

SUMMARY FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

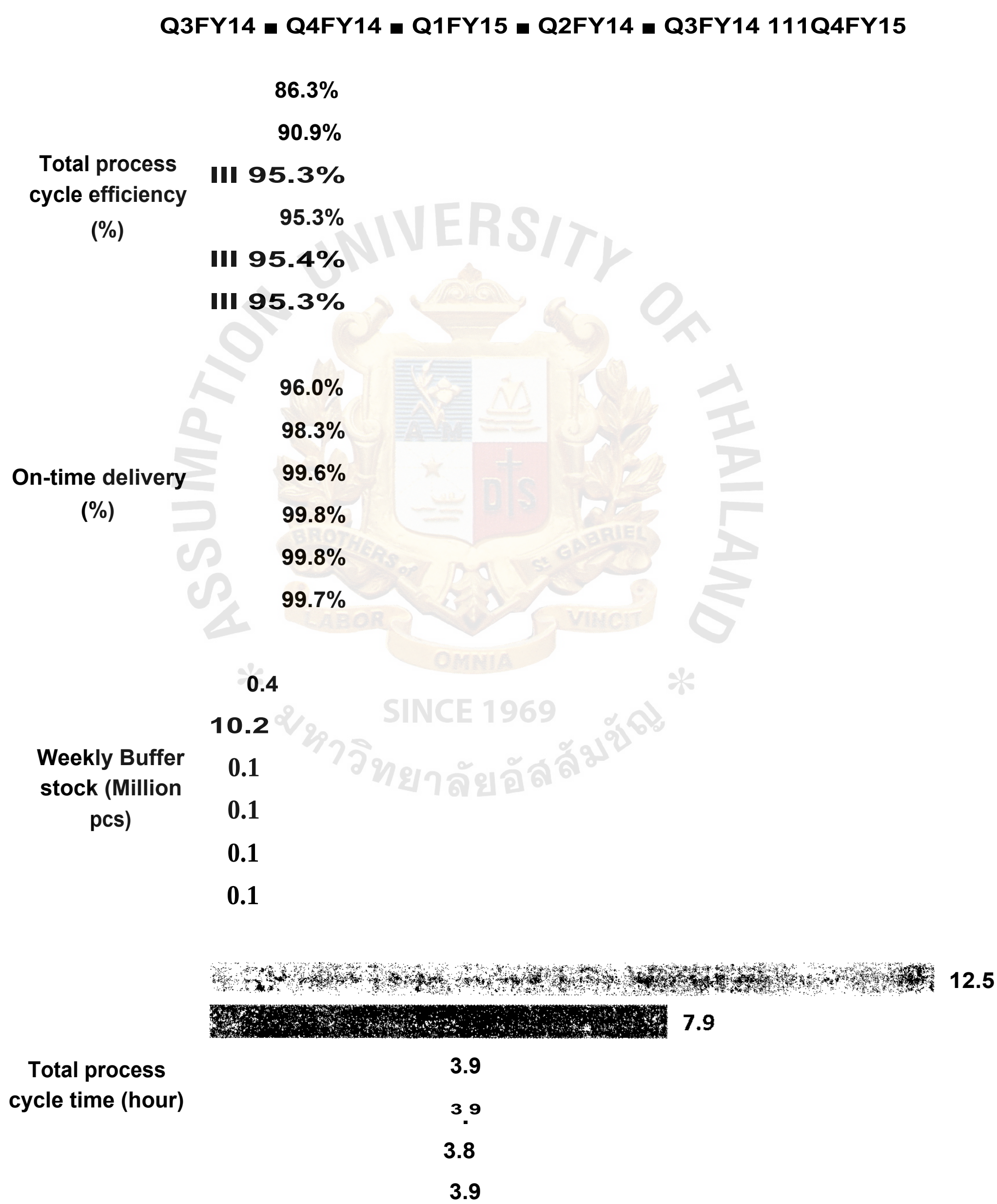
This chapter gives the summary of all the improvement results and conclusions of the previous research. There are three sections in this chapter. First is conclusions and summary of the findings, second part presents the theoretical and managerial implications, the last section is the recommendations for future research.

5.1 Conclusions and Summary of the Findings

Compared with AS-IS order fulfillment process, the total process time of TO-BE order fulfillment process in Company ABC has reduced from 12.5 hours to 3.9 hours, sub-processes of schedule change and additional material pulling have been changed from step by step process to a joint information sharing process. Each party has been able to share the usable information with others, the decision making regarding the demand change and confirm order has been completed in a very short time. Thus, for ABC Company, the production line is able to get the material on-time and the schedule change is handled accordingly by the ABC planning team.

Furthermore, the ABC supply performance has leveled up to a better delivery on-time rate from 96.0% to 99.7%, it has totally eliminated the case of the shipping delay. A low level of buffer PCBA stock has also improved from 0.4 million piecesto 0.1 million pieces, ABC has less pressure on holding too much idle inventory in the future. The TO-BE order fulfillment process efficiency has increased by the information sharing system from 86.3% to 95.3%, non-value added activities are eliminated from AS-IS order fulfillment process. For customer and third party raw material hub team, the information sharing process also make their internal operation become smooth. From order release by customer to the final products delivery, the visible data has been tracked properly and the whole process has become flexible. ABC supply performance has improved by a fast feedback order fulfillment process and has achieved the customer's satisfaction under the new business.

Figure 5.1: Order Fulfillment Improvement Results



Source: Author

5.2 Theoretical Implications

This research aimed to improve the order fulfillment process on the long lead time problem. The concept of BPI (Baines, 2005) was applied for this process improvement as a guideline. This study reviewed the current ABC order fulfillment process lead time and business performance. Also, this study reviewed the related concepts about the sub-processes under the order fulfillment and business performance (Forslund, 2007). The lead time measurement followed the total lead time equation (Bartezzaghi et al, 1994). Following the steps of BPI, the order fulfillment process issues on examined information gaps, the new information sharing system could achieve a better process lead time and performance under the time-based competition (Bozarth & Chapman, 1996).

5.3 Managerial Implications

This research was based on an electronics manufacturing company in Thailand, which is under the background of business changing. Material control and finished goods delivery are two critical portions regarding customer satisfaction. A short lead time order fulfillment process is achieved by enabling the information sharing to each trading partner hence to avoid the issues of unnecessary material inventory and finished goods shipment delay. The order fulfillment process is not a single process under one company or department, as it is more complicated than internal or external process. It needs supply chain management to build up a closed relationship with each joint party to share its available information. Nevertheless, sharing information is not easy to get the trust or the willingness of the trading partner, but by getting the strong support of the customer and the company management. It ensures the process execution towards the final target. The person who is involved in the business process change should have experienced the work knowledge in all order fulfillment process. Business process improvement (BPI) is a non-stop procedure, and the time based competition should also explore the internal and external business environment to identify the major problem and continuously improve the weakness point.

5.4 Limitations and Recommendations for Future Research

This research was limited to the case study of the order fulfillment process improvement in an electronics manufacturing company in Thailand. The study was intended to reduce the order fulfillment process lead time in the new business mode. The research data were limited on the period of business mode change in six quarters between 2014-2015 of ABC and customer.

Since the case study has focused on the electronics manufacturing industry, it is suggested to explore the other products industries which companies face the similar lead time problem by using BPI methodology to analyze the business performance and identify the critical issue to make the improvement on the current process.

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APPENDICES

APPENDIX A

ORDER FULFILLMENT LEAD TIME RECORD

Order fulfillment Lead time record in Q3FY14

Week \process time(hou r)	wkl	wk2	wk3	wk4	wk5	wk6	wk7	wk8	wk9	wk10	wkll	wk12	wkI3	Mean Lead Time(hour)	
Order commit	0.5	0.5	0.4	0.3	0.5	0.7	0.4	0.6	0.4	0.7	0.7	0.6	0.8	0.5	N-non value added
Production schedule	0.7	1.3	0.7	0.9	1.6	0.6	0.7	0.8	1.6	1.1	1.5	1.0	1.7	1.1	N-non value added
MRP running	0.4	0.7	0.5	0.6	0.4	1.1	1.3	1.1	1.2	1.3	1.4	1.2	1.3	1.0	N-non value added
confirm off cycle	3.8	3.1	3.1	3.4	3.7	3.3	4.4	4.7	4.6	4.5	4.2	4.3	5.0	4.0	N-non value added
Material top up	4.5	4.7	4.7	4.6	4.1	4.7	4.8	5.0	5.3	5.5	5.4	5.8	5.2	4.9	N-non value added
E-kit generate	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	N-non value added
Material delivery	72.3	72.0	72.7	72.1	72.6	72.4	72.2	72.2	72.4	72.4	72.9	72.7	73.0	72.5 insignificant	N-non value added
FG delivery	6.1	6.7	6.3	6.8	6.2	6.2	6.0	6.5	6.3	6.8	6.2	6.0	6.8	6.4 insignificant	value added
Total	10.9	11.3	10.4	10.8	11.3	11.4	12.6	13.2	14.1	14.1	14.2	13.9	15.0	12.5	

Total Order to delivery process Cycle Efficiency = 86.3%

Order fulfillment Lead time record in Q4FY14

Week \process time(hou r)	wk 1	wk2	wk3	wk4	wk5	wk6	wk7	wk8	wk9	wk10	wk 1 1	wk12	wk L3	Mean Lead Time(hour)	
Order commit	0.2	0.4	0.4	0.3	0.9	0.7	0.7	0.5	0.5	0.6	0.4	0.5	0.3	0.5	N-non value added
Production schedule	1.5	1.1	1.0	1.2	1.3	1.5	1.7	0.9	1.0	1.1	0.9	1.3	1.2	1.2	N-non value added
MRP running	0.7	1.2	1.0	1.7	1.2	1.3	0.4	1.1	1.4	0.5	0.9	1.3	1.1	1.1	N-non value added
confirm off cycle	2.9	2.4	3.1	3.3	2.2	2.9	2.5	2.2	1.5	2.3	2.7	2.8	1.1	2.5	N-non value added
Material top up	1.3	2.7	1.8	2.5	2.8	2.2	1.6	0.6	1.8	2.3	2.8	1.2	1.9	1.9	N-non value added
E-kit generate	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	N-non value added
Material delivery	72.9	72.9	72.5	72.8	72.6	72.6	72.1	72.4	72.3	73.0	72.5	72.1	72.4	72.5 insignificant	N-non value added
FG delivery	6.1	6.1	6.9	6.6	6.2	6.9	6.1	6.8	6.0	6.0	7.0	6.6	6.5	6.4 insignificant	value added
Total	7.2	8.4	8.0	9.6	9.0	9.3	7.5	6.0	7.0	7.5	8.4	7.9	6.3	7.9	

Total Order to delivery process Cycle Efficiency = 90.9%

Order fulfillment Lead time record in Q1FY15

Week \process time(hour)	wkl	wk2	wk3	wk4	wk5	wk6	wk7	wk8	wk9	wk10	wkll	wk12	wk13	Mean Lead Time(hour)	
Order commit	0.5	0.6	0.3	0.5	0.4	0.6	0.6	0.4	0.4	0.4	0.3	0.3	0.5	0.4	N-non value added
Production schedule	1.1	1.2	1.2	1.1	1.2	0.9	1.1	0.8	1.1	0.7	0.9	0.8	0.8	1.0	N-non value added
MRP running	1.2	1.5	1.0	0.7	1.5	1.4	0.8	0.6	0.7	1.1	0.7	0.8	0.9	1.0	N-non value added
confirm off cycle	0.4	0.5	0.4	0.5	0.4	0.4	0.5	0.5	0.5	0.4	0.4	0.5	0.4	0.4	N-non value added
Material top up	0.5	0.5	0.6	0.6	0.5	0.5	0.6	0.6	0.5	0.5	0.6	0.6	0.5	0.6	N-non value added
E-kit generate	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	N-non value added
Material delivery	72.3	72.0	72.7	72.1	72.6	72.4	72.2	72.2	72.4	72.4	72.9	72.7	73.0	72.5 insignificant	N-non value added
FG delivery	6.1	6.7	6.3	6.8	6.2	6.2	6.0	6.5	6.3	6.8	6.2	6.0	6.8	6.4 insignificant	value added
Total	4.3	4.8	4.0	3.8	4.6	4.3	4.0	3.5	3.7	3.7	3.3	3.4	3.7	3.9	

Total Order to delivery process Cycle Efficiency = 95.3%

Order fulfillment Lead time record in Q2FY15

Week \process time(hour)	wkl	wk2	wk3	wk4	wk5	wk6	wk7	wk8	wk9	wk10	wkll	wk12	wk13	Mean Lead Time(hour)	
Order commit	0.4	0.5	0.4	0.5	0.4	0.5	0.3	0.5	0.6	0.5	0.5	0.4	0.6	0.5	N-non value added
Production schedule	1.1	0.9	1.0	1.1	1.0	1.0	0.9	0.9	1.0	1.1	0.9	0.9	0.8	1.0	N-non value added
MRP running	1.0	0.8	1.0	0.9	1.0	0.9	0.9	0.8	1.0	1.0	0.9	1.0	1.0	0.9	N-non value added
confirm off cycle	0.4	0.5	0.4	0.5	0.5	0.4	0.4	0.4	0.4	0.4	0.5	0.5	0.4	0.4	N-non value added
Material top up	0.7	0.6	0.7	0.6	0.7	0.5	0.5	0.5	0.6	0.7	0.6	0.6	0.7	0.6	N-non value added
E-kit generate	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	N-non value added
Material delivery	72.5	72.2	72.5	72.2	72.3	72.3	72.4	72.5	72.5	72.2	72.3	72.4	72.1	72.3 insignificant	N-non value added
FG delivery	6.5	6.3	6.1	6.4	6.4	6.5	6.7	6.5	6.5	6.2	6.5	6.2	6.5	6.4 insignificant	value added
Total	4.1	3.8	4.0	4.1	4.1	3.9	3.5	3.6	4.1	4.2	3.9	3.9	4.0	3.9	

Total Order to delivery process Cycle Efficiency = 95.3%

Order fulfillment Lead time record in Q3FY15

Week \process time(hour)	wkl	wk2	wk3	wk4	wk5	wk6	wk7	wk8	wk9	wk10	wkll	wk12	wkL3	Mean Lead Time(hour)	
Order commit	0.2	0.3	0.4	0.4	0.3	0.2	0.3	0.5	0.6	0.5	0.3	0.6	0.5	0.4	N-non value added
Production schedule	0.9	0.9	0.8	0.8	0.9	0.9	0.9	0.8	1.0	0.8	1.0	0.8	0.9	0.9	N-non value added
MRP running	0.8	0.9	1.0	0.9	0.9	1.0	0.9	1.0	0.9	0.8	1.0	0.9	1.0	0.9	N-non value added
confirm off cycle	0.5	0.5	0.4	0.5	0.5	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.4	0.5	N-non value added
Material top up	0.7	0.6	0.7	0.7	0.7	0.6	0.7	0.6	0.6	0.6	0.6	0.6	0.7	0.6	N-non value added
E-kit generate	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	N-non value added
Material delivery	72.1	72.0	72.4	72.5	72.1	72.2	72.1	72.1	72.5	72.4	72.0	72.5	72.1	72.2 insignificant	N-non value added
FG delivery	6.4	6.4	6.5	6.6	6.1	6.0	6.4	6.2	6.3	6.0	6.1	6.0	6.2	6.2 insignificant	value added
Total	3.6	3.7	3.8	3.8	3.8	3.6	3.8	3.9	4.1	3.7	3.9	3.9	4.0	3.8	

Total Order to delivery process Cycle Efficiency = 95.4%

Order fulfillment Lead time record in Q4FY15

Week\process time(hou r)	wkl	wk2	wk3	wk4	wk5	wk6	wk7	wk8	wk9	wk10	wkl 1	wkl2	wkl3	Mean Lead Time(hour)	
Order commit	0.7	0.3	0.4	0.6	0.4	0.6	0.3	0.4	0.7	0.7	0.4	0.6	0.5	0.5	N-non value added
Production schedule	1.0	0.9	0.8	0.9	0.9	1.0	1.0	1.0	0.8	0.8	0.9	0.9	0.9	0.9	N-non value added
MRP running	0.8	0.9	1.0	1.0	0.8	1.0	1.0	0.1	1.0	1.0	1.0	1.0	1.0	0.9	N-non value added
confirm off cycle	0.5	0.5	0.4	0.5	0.4	0.5	0.5	0.4	0.5	0.5	0.4	0.4	0.4	0.5	N-non value added
Material top up	0.7	0.6	0.6	0.7	0.6	0.6	0.7	0.6	0.6	0.7	0.7	0.6	0.6	0.6	N-non value added
E-kit generate	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	N-non value added
Material delivery	72.5	72.3	72.3	72.3	72.1	72.1	72.2	72.1	72.5	72.2	72.4	72.4	72.3	72.3 insignificant	N-non value added
FG delivery	6.6	6.3	6.5	6.2	6.6	6.4	6.2	6.1	6.1	6.4	6.3	6.2	6.5	6.3 insignificant	value added
Total	3.6	3.7	3.8	3.8	3.8	3.6	3.8	3.9	4.1	3.7	3.9	3.9	4.0	3.9	

Total Order to delivery process Cycle Efficiency = 95.3%

APPENDIX B

INVENTORY AND DELVIERY PERFORMANCE

Q3FY14 ABC Total Inventory

Q3FY14	Total Inventory	Weekly average pallet	Storage cost (Baht)	Turnover rate(weekly)
weekl	192,638	21	27,342	10
week2	232,919	25	32,550	8
week3	306,225	32	41,664	6
week4	278,488	30	39,060	7
week5	232,875	25	32,550	8
week6	260,639	28	36,456	7
week7	241,048	26	33,852	8
week8	495,511	52	67,704	4
week9	589,859	62	80,724	3
week10	712,474	75	97,650	3
weekil	407,005	43	55,986	5
weekl2	563,890	59	76,818	3
weekl3	464,707	49	63,798	4
Average total	382,944	41	52,781	5

Q4FY14 ABC Total Inventory

Q4FY14	Total Inventory	Weekly average pallet	Storage cost (Baht)	Turnover rate(weekly)
weekl	240,062	25	32,558	6
week2	245,983	26	33,361	5
week3	196,312	20	26,625	6
week4	192,555	20	26,115	6
week5	203,474	21	27,596	4
week6	231,881	24	31,449	4
week7	157,350	16	21,341	8
week8	213,095	22	28,901	6
week9	240,316	25	32,593	7
week10	154,811	16	20,996	6
weekll	157,673	16	21,384	9
week12	155,932	16	21,148	8
weekl3	248,137	26	33,654	6
Average total	202,891	21	27,517	6

Q1FY15 ABC Total Inventory

Q1FY15	Total Inventory	Weekly average pallet	Storage cost (Baht)	Turnover rate(weekly)
weekl	77,545	8	10,517	7
week2	71,350	7	9,677	5
week3	75,869	8	10,290	6
week4	59,711	6	8,098	9
week5	62,247	6	8,442	7
week6	50,121	5	6,798	10
week7	65,277	7	8,853	6
week8	62,019	6	8,411	7
week9	85,014	9	11,530	7
week10	51,141	5	6,936	9
weekll	80,179	8	10,874	6
weekll	52,912	6	7,176	6
weekl3	79,125	8	10,731	11
Average total	67,116	7	9,103	7

Q2FY15 ABC Total Inventory

Q1FY15	Total Inventory	Weekly average pallet	Storage cost (Baht)	Turnover rate(weekly)
weekl	52,051	5	7,059	6
week2	59,112	6	8,017	7
week3	51,716	5	7,014	6
week4	64,827	7	8,792	11
week5	53,140	6	7,207	10
week6	54,820	6	7,435	9
week7	57,914	6	7,855	6
week8	66,525	7	9,022	9
week9	68,804	7	9,332	6
week10	54,441	6	7,384	6
weekll	63,689	7	8,638	9
week12	60,984	6	8,271	8
week13	66,442	7	9,011	7
Average total	59,574	6	8,080	8

Q3FY15 ABC Total Inventory

Q3FY15	Total Inventory	Weekly average pallet	Storage cost (Baht)	Turnover rate(weekly)
weekl	51,621	5	7,001	10
week2	59,349	6	8,049	8
week3	66,497	7	9,019	6
week4	52,997	6	7,188	8
week5	68,431	7	9,281	7
week6	54,607	6	7,406	9
week7	50,820	5	6,893	11
week8	69,498	7	9,426	7
week9	64,014	7	8,682	8
week10	62,023	6	8,412	9
week11	50,966	5	6,912	9
weekl2	68,490	7	9,289	8
week13	51,505	5	6,985	9
Average total	59,294	6	8,042	8

Q4FY15 ABC Total Inventory

Q4FY15	Total Inventory	Weekly average pallet	Storage cost (Baht)	Turnover rate(weekly)
weekl	63,339	7	8,590	9
week2	60,255	6	8,172	9
week3	63,499	7	8,612	7
week4	51,816	5	7,028	6
week5	56,424	6	7,652	6
week6	57,174	6	7,754	8
week7	57,589	6	7,810	6
week8	53,437	6	7,247	9
week9	64,571	7	8,757	7
week10	50,039	5	6,787	6
weekl 1	57,955	6	7,860	11
weekl2	68,584	7	9,302	6
weekl3	51,988	5	7,051	11
Average total	58,205	6	7,894	8

Q3FY14 PCBA Supply Performance

Q3FY14	Weekly demand(pcs)	Production output(pcs)	Production Delay(pcs)	Order hit point%
weekl	606,528	606,528	0	100.0%
week2	540,840	539,520	1,320	100.0%
week3	580,067	579,467	600	100.0%
week4	553,728	551,568	2,160	100.0%
week5	599,896	599,776	120	100.0%
week6	755,320	751,240	4,080	99.0%
week7	578,145	562,545	15,600	97.0%
week8	668,088	648,048	20,040	97.0%
week9	584,376	540,576	43,800	93.0%
vveek10	620,218	584,218	36,000	94.0%
weekly	413,181	356,061	57,120	86.0%
week12	541,160	473,960	67,200	88.0%
weekl3	347,808	294,768	53,040	85.0%
Total	7,389,355	7,088,275	301,080	Average 96.0%

Q4FY14 PCBA Supply Performance

Q4FY14	Weekly demand(pcs)	Production output(pcs)	Production Delay(pcs)	Order hit point%
weekl	605,659	630,013	30,000	95.0%
week2	539,432	565,303	9,480	98.2%
week3	576,250	598,122	15,600	97.3%
week4	552,392	573,905	9,240	98.3%
week5	579,838	607,082	10,440	98.2%
week6	617,556	637,491	6,720	98.9%
week7	412,128	419,659	7,200	98.3%
week8	536,943	539,703	2,640	99.5%
week9	595,289	609,885	3,840	99.4%
week10	753,677	763,881	18,720	97.5%
weekll	575,342	582,348	6,000	99.0%
weekl2	664,734	688,655	3,600	99.5%
week13	444,092	461,822	5,040	98.9%
Total	7,453,330	7,677,868	128,520	Average 98.3%

Q1FY15 PCBA Supply Performance

Q1FY15	Weekly demand(pcs)	Production output(pcs)	Production Delay(pcs)	Order hit point%
weekl	587,825	601,240	240	100.0%
week2	523,882	527,716	720	99.9%
week3	550,691	567,316	1080	99.8%
week4	547,902	548,839	2,040	99.6%
week5	563,721	580,351	3600	99.4%
week6	592,523	603,869	3,600	99.4%
week7	461,608	471,359	5,160	98.9%
week8	512,721	522,196	3,240	99.4%
week9	571,169	575,254	3,360	99.4%
week10	619,007	637,774	3,120	99.5%
week11	546,919	555,920	3,000	99.5%
week12	655,112	662,243	0	**100.0%**
weekl3	441,321	446,130	0	100.0%
Total	7,174,400	7,300,208	29,160	Average 99.6%

Q2FY15 PCBA Supply Performance

Q2FY15	Weekly demand(pcs)	Production output(pcs)	Production Delay(pcs)	Order hit point%
weekl	577,674	613,436	600	99.9%
week2	510,294	510,694	0	100.0%
week3	522,573	561,379	840	99.8%
week4	575,306	594,540	0	100.0%
week5	538,829	565,009	0	100.0%
week6	505,345	510,413	1,680	99.7%
week7	526,161	520,501	1,080	99.8%
week8	575,061	582,195	960	99.8%
week9	571,248	537,494	3,600	99.4%
week10	527,366	562,140	0	100.0%
weekll	569,805	612,825	240	100.0%
weekl2	565,606	606,957	5,160	99.1%
weekl3	533,266	568,256	240	100.0%
Total	7,098,535	7,345,838	14,400	Average 99.8%

Q3FY15 PCBA Supply Performance

Q3FY15	Weekly demand(pcs)	Production output(pcs)	Production Delay(pcs)	Order hit point%
weekl	595,504	637,147	4,320	99.3%
week2	634,170	642,221	3,600	99.4%
week3	522,549	563,267	1,200	99.8%
week4	614,789	635,541	840	99.9%
week5	650,258	671,821	960	99.9%
week6	511,118	513,356	0	100.0%
week?	685,938	622,110	2,160	99.7%
week8	540,060	564,509	1,320	99.8%
week9	614,535	545,685	0	100.0%
week10	510,217	510,429	1,680	99.7%
week11	548,187	560,268	360	99.9%
weekl2	562,114	544,645	720	99.9%
weekl3	588,140	592,953	0	**100.0%**
Total	7,577,580	7,603,951	17,160	99.8%

Q4FY15 PCBA Supply Performance

Q4FY15	Weekly demand(pcs)	Production output(pcs)	Production Delay(pcs)	Order hit point%
weekl	532,382	612,190	3,360	99.5%
week2	650,606	537,268	3,480	99.5%
week3	501,708	640,295	0	100.0%
week4	567,703	676,694	2,880	99.6%
week5	580,559	655,142	960	99.8%
week6	619,679	611,412	0	100.0%
week?	533,912	678,520	3,240	99.5%
week8	687,651	756,397	0	100.0%
week9	766,812	588,614	3,120	99.5%
week10	727,185	694,134	3,000	99.6%
weekll	600,518	625,085	840	99.9%
week12	608,116	647,653	1,080	99.8%
weekl3	694,159	471,112	0	100.0%
Total	8,070,990	8,194,516	21,960	99.7%

APPENDIX C

ACRONYMS LIST

ACRONYMS LIST

ASICs — Application specific integrated circuits are programmable logic devices which have their internal logic configuration determined by the user (Davies, 2003).

BOM — Bill of material includes information on materials, parts, subcomponents, production sequences, and subassemblies, as well as their hierarchy, to build the finished product (Martin, 2014).

BOH — Beginning on hand inventory.

INFORMATION SHARE SYSTEM — Business to Business, a system which link the data server to share the data base between Customer and ABC and Raw material Hub.

EOH — Ending on hand inventory.

EOL — End of life products, mean product is going the out of phrase, stop build onwards.

E-kit — Electronic signal send from ABC to customer or material hub to request raw material specific model.

HDD — Hard disk drive is a data storage device used for storing and retrieving digital information.

SMT — Surface mounting technology, the machine which produce PCBA.

PCBA — Printed circuit board assembly, the electronic products build by ABC Company.

POD — Point of delivery, the time of the raw material be departure from raw material hub and PCBA be delivered from ABC Company.

POS — Point of sale is the time and place where the PCBA transaction is completed, including customer pull PCBA from ABC finished goods hub. ABC pull ASICs and normal components from raw material Hub.