PROCESS IMPROVEMENT VIA IMPLEMENTATION OF ELECTRONIC DATA INTERCHANGE & BARCODE SYSTEM

By
YA NAN XIANG

A Proposal of the Six-Credit Course
SCM 2202 Graduate Project

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

Martin de Tours School of Management
Assumption University
Bangkok, Thailand

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January 2013

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Declaration of Authorship Form

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

Process Improvement via Implementation of Electronic Data Interchange & Barcode System

I confirm that:

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ADVISOR'S STATEMENT

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

Signed _____

(Dr. Wuthichai Wongthatsanekorn)

Date 15 MAY 2013

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ABSTRACT

This research is conduction to improve the production process and reduce operation cost via implementation of an EDI systems and barcode systems. EDI and barcode systems are popular in manufacturing which is applied in various fields. The systems could help a firm improve the production process, reduce operation cost and improve accuracy and efficiency.

In paper all relevant data such as current HDDs information, logistics information, demands, manpower cost and new systems cost are collected and analyzed for developing a new production process to help improve existing process. Excel sheets are created to control the whole investment such as calculated NPV, IRR and Payback Period to check if the investment is valuable. All steps for how to implement EDI system.

After analyzing are described current process mapping and applying the situation, Excel sheets cost analysis is conduction are. The results of in EDI and barcode systems are compared with the previous process flow with the purpose of indicating improvement. The results are not only solving the existing issues but also help improve the production process and reduce operation cost, replace manual operations in with automatic operations. Make communication easier and reliability, and response quick to deal with urgent issues. After implementation of EDI and barcode systems the company can reduce costs for industries; improve competitive position; closer relationship with trading partners and ability to broaden trading horizons. These are all the benefits that have significance for the company after implementation.

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I, Asst. Prof. Dr. June Bernadette D'Souza, have proofread this thesis/project entitled Process Improvement via Implementation of Electronic Data Interchange & Barcode Automatic System

Ms. Ya Nan Xiang

and hereby certify that the verbiage, spelling and format is commensurate with the quality of internationally acceptable writing standards for a master degree in supply chain management.

Signed

(As June Bernadette D'Souza

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CHAPTER I

GENERALITIES OF THE STUDY

This chapter includes a brief introduction of the case study, the back ground of the studied company, and describes the current manufacturing process, the root cause of the problems, identifies the statement of the problem, shows the research objectives, discusses limitations of the research, and the definition of terms.

1.1 Background of the Study

Electronic data interchange (EDI) also been called as paperless trade which is developed by transportation and automobile industry at North America, England and Japan in 1970, the historical record shows that via the implementation of EDI the cost of each car has reduced by 200 USD. EDI is a technical representation of a business conversation with the structured data transmission between two or more business partners by electronic means, either internal or external with a rigorously standardized format of electronic documents from one server system to another server system without human intervention. It is a very useful tool for supply chain management.

A lot of data and documents can be transmitted by the EDI, such as invoices, price lists, orders, delivery notes, credit notes and so on. The major benefit of EDI is reducing the process lead time, reducing the error and increasing the efficiency. Implementation of EDI is very costly; there are three major categories of cost. 1 Development cost; 2. Implementation cost, such as equipment and testing; 3. Running maintenance cost and further development cost. EDI systems are not suitable for small companies, due to cost concerns and other limitations such as limited of message standards, system compatibility, trading unit code alignment and fear of change and implementation. However, with appropriate understanding and evaluation, there are several reasons to encourage the implementation of EDI for the reduction in lead time and for increasing the accuracy of information in decision making.

Bar-coding was developed in the United State more than 20 years ago. The first application area was rail car identification. In a short period it quickly spread and was applied to supermarkets and industries stock control and sales, library circulation systems and blood banks areas for collection of data. During the last 10 years, bar-coding developed rapidly and is more complicated, with a range of bar cording symbol logic (languages) and reading equipment available. It is also a popular tool in the supply chain and more organization use it to help capture data quick.

1.2 Statement of the Problem

Shenzhen ABC Technology Co. Ltd. (ABC Company), the company which as the basis of the case study, was established in China in 1985. This company is the major focus on Research and Development (R&D) and Electronic Manufacturing Services (EMS), their major product is advanced electronic products, such as storage device, Hard Disk Driver (HDD) and Solid State Driver (SSD), and other products such as Measurement Systems, Payment Terminals, Digital Home Products and Light Emitting Diode (LED). ABC Company has several facilities located around the world. The facilities and located in China, Hong Kong, Singapore, Italy, the United States and Australia. Production and R&D facilities are located at Suzhou, Dongguan, Huizhou and Shenzhen with a total of 10,000 employees.

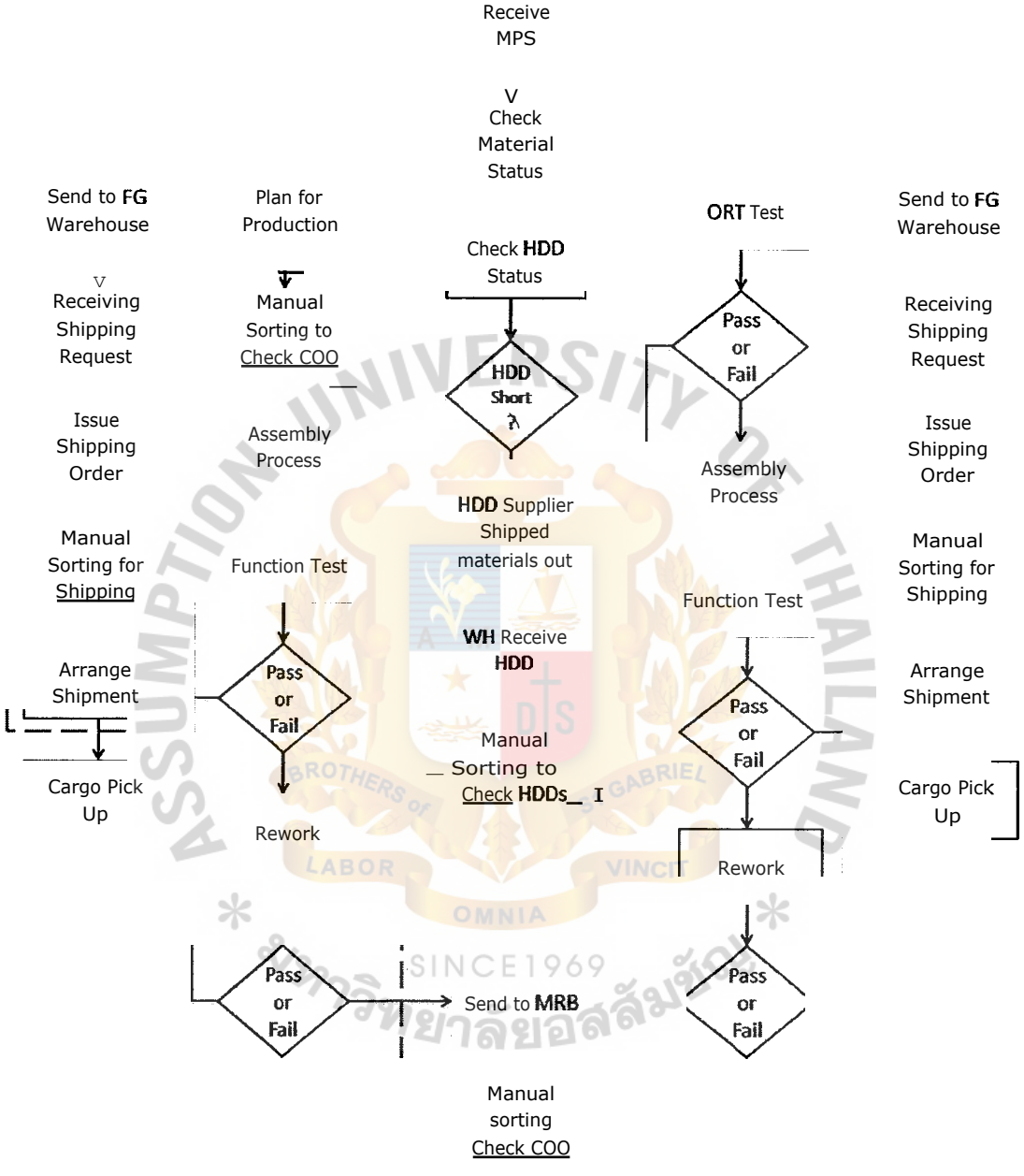
The company provides Original Equipment Manufacturer (OEM) and Original Design Manufacturer (ODM) to the worldwide customers. They are also provided the different form of EMS integration services, such as technology support and logistics support services.

One of their products digital television set boxes are from Poland customers. They already produce for these customers for over 5 years, and currently they are experiencing a challenge of process change which was requested by their customers. One of the most important and expensive component of this product is HDD, which is consigned from the customer to ABC Company. Previously they have only one source of this component which is from the Western Digital (WD) the world leading hard

disk drive producer. In 2011 Thailand experienced a serious flooding issue for over half year. Many industry parks were impacted and had been forced to shut down and stopped production, the biggest manufacturing site of WD which is located in Ayutthaya has been impacted as well, the supply of HDD was stopped, and the world HDD market also faced the shortage of HDD supply, and the price was increased dramatically. This impact leads to the high material costs and sales loses at ABC Company and their customers. Therefore the customer decides to extend the source of HDD from one supplier to multiple suppliers. Now they plan to use WD HDD which are produced from Thailand and Malaysia and also HDD from Seagate, another leading producer of HDD in the world which is produced from China and Thailand.

Customers specifically requested to use different sources of HDD due to financial requests and quality concern. Production and shipment cannot be mixed, meaning that HDD from WD Thailand, WD Malaysia, Seagate Thailand and Seagate China has to be separated in receiving process, manufacturing process and shipping process. At present average monthly demand is approximate 600,000 units, the daily demand has four scenarios as 6,000 units; 10,000 units; 15,000 units and 20,000 units according to customer forecast demand information which was provided by the customers. Now the average daily demand is 10,000 units and the customers expect on increase percentage of 50% during the next 5 years. Faced with this big amount demand, manufacturing only depend on manual sorting to separate all product one by one. When supplier finishes the preparation for shipping, they will send shipping information of all shipping HDDs to the ABC Company for reference. For manual sorting, after the company receives the shipping information list, the warehouse operator needs to print all information lists out and take the list to the receiving area to do checking and sorting HDDs. They have to check each HDD if it is matching this information on the list of serial numbers and Country of Origin (COO). In this whole process without any automatic machine is used. Therefore this changing request becomes a big challenge for ABC Company due lack of system control and experience of this process. It will be occurred more costs of manpower and product quality control problems.

Figure 1.1 AS-IS Manufacturing Shop Flow



Source: Company data 2011

Figure 1.1 shows the current manufacturing shop flow. There is no specific control for HDD, from receiving Materials Planning Schedule (MPS). The company has to check the material situation and if find matches customer demands. If HDDs amount matches this demand then the production plan can be set. If HDDs amount is less than

demand, the company needs to request suppliers to consign materials for production. Therefore after receiving the HDD materials from the supplier there are first sorting to do by manpower. Warehouse operators need print all HDDs information lists and take it to the receiving area to check each HDD's information and see if it matches the data which is on the list. When sorting operations are done then plans for production and issue material to the process line do assembly or do On-Going Reliability Test (ORT) are caused an since some materials need the ORT test to make sure of quality guarantee. Before materials into the assemble line there is another manual sorting to do, in order to check if each assembly HDD's COO matches or not. During the assemble process a function test to inspect HDD function is done. If tested HDDs pass the test, it is sent to the FG warehouse for shipment, if it failed in function test, it needs to rework and repeat function test until it qualified then send to the FG warehouse is prepare for shipping. Through rework cannot repaired HDD will be sent to Materials Reject Board (MRB) and do manual sorting to check HDDs COO, serial number and all information related with down state HDD, since these HDD should be sent back to the suppliers. After the ORT test the process is the same with the production process, includes assembly, function test and rework operations. All regular HDDs after the assembly and test will be sent to FG warehouse for shipment. After receiving shipping the request from the customer, the finish good warehouse operators must be issue shipping orders then do manual sorting to check each HDD for shipping to make sure all HDDs meet the request. Next, is arranging the shipment to shipping to do the cargo pick up and finish whole process. Between the manufacturing process operation has a four times manual sorting to check HDD information, such as HDD serial number, HDD's COO and all information related to the HDD. Highlighted parts are show a as the manual sorting process.

Currently, there are 19 manpower do sorting operation. Based on the new request of the process, at the beginning phase, at least need 10 more operators are needed to do the manual sorting from WD and Seagate and return from manufacturing, also more area requested for keeping the different HDDs. For shipping department have are more serious problems, when the export staff issue invoices they need use different title of invoices for processes, the custom clearance for the HDDs which belong to

different organizations, so there is another process of sorting and finding out the numbers. This process will be more complicated and require more management attention.

Table 1.1 Manpower Cost Analysis

Item	**Cost (Baht)**			
Manpower cost Analysis	**Forecast Scenario 1**	**Forecast Scenario 2 (Current)**	**Forecast Scenario 3**	**Forecast Scenario 4**
Average Daily Demand	6,000	10,000	15,000	20,000
Total Sales Amount (per month)	48,042,000	80,070,000	120,105,000	160,140,000
Total Req. Working Time Per Operator	180,000	300,000	450,000	600,000
Receiving Manpower Required	6	10	16	21
Shipping Manpower Required	13	21	31	42
Total Required Manpower per Day	19	31	47	63
Salary per Operator per Month	11,000	11,000	11,000	11,000
Total Manpower Cost	209,000	341,000	517,000	693,000
Cost Percent	0.4293%	0.4293%	0.4293%	0.4293%
Profit per Unit	18.6830	18.6830	18.6830	18.6830
Total Profit (per month)	3,362,940	5,604,900	8,407,350	11,209,800
Net Income (per month)	3,156,690	5,261,150	7,891,725	10,522,300

Remark: 1.The cost Percent = Total Manpower Cost/Total Sales Amount

2. Sorting per unit need 30 seconds

Source: Company financial data 2012

Table 1.1 shows that there are four scenarios (6,000 units; 10,000 units; 15,000 units; 20,000 units) of forecast demand from customer forecasting. The total sale amount is depends on these four scenarios multiplied per unit price. The manpower requirement dramatically increases with the increased demand. The average sorting time per unit needs 30 seconds. Therefore four demand scenarios respectively need 180,000 seconds, 300,000 seconds, 450,000 seconds and 600,000 seconds for matching. For worker's working time specific as: process operators who work 8 hours per day, shipping process operator who work 4 hours per day since the shipping sorting process must be done before 12pm. Because forwarders cutoff at 2pm for booking, the shipping department needs to get the correct number of and generate shipping documents within one hour. For as-is manufacturing process, currently all demands depends on manual sorting. Manpower of receiving process will be increased from 6 to 21 operators; shipping process will be increased from 13 to 42 operators, shipping sorting process needs more manpower because of less working time compared with the receiving process. According to total manpower increases from 19 to 63 operators, so the total manpower cost will be increased from 209 thousand baht to 693 thousand baht per month with 11,000 baht per manpower and total manual cost approximately accounting for 0.4293% of total the sales amount per month. And need special indicated this net profit only deduct sorting manpower cost and does not include other costs, finance cost and tax yet. For this project, at present each unit could get 18.6830 baht profit but material cost is approximately 93%. The profit before deducting operation costs and finance costs and tax a closed was 7% only, so with the increasing demand, the manpower costs will be higher result in unpredictable data for the future. Therefore according to current situation, the company decided to use IT technology solve this problem.

Management decided on several alternatives that can be applied to solve the problem, like use of manual controls with additional manpower, re-layout production area, bar code automation system, and both EDI systems and Barcode systems. Some of these alternatives may only be able to solve the issues in the short term and cause long term negative effects for the company. Comparison of the four alternatives, the advantage

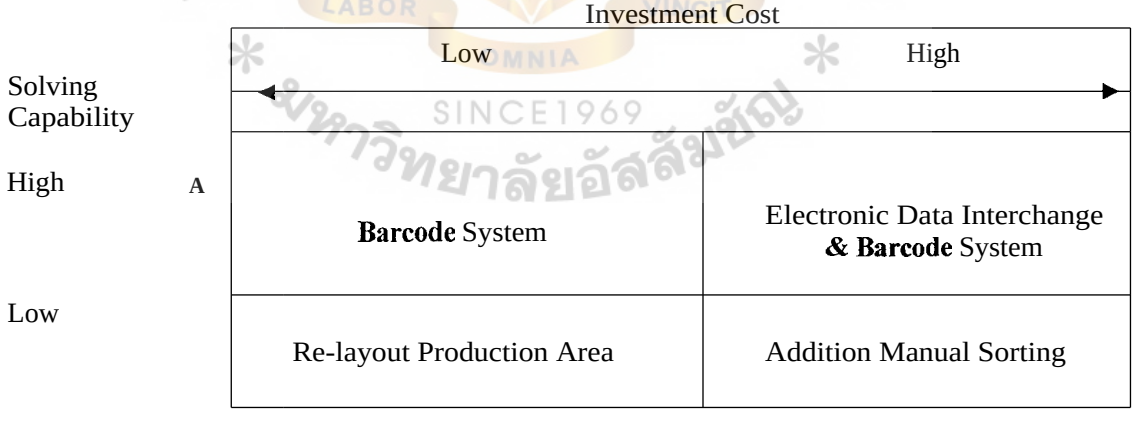
and disadvantage for each alternative and impact on the company are shown in table 1.2 and Figure 1.2.respectively.

Table 1.2 Comparison of Alternative's Merit and Demerit

Alternatives	Merit and Demerit
1. Addition manual sorting	Avoid investment capital Increase manpower cost Increase human error Increase inefficiency
2. Re-layout Production Area	Good for management Reduce flexibility Reduce space utilization Lead to high capital investment in the future
3. Bar-Code System	Lowest investment Increase human error Increase manpower cost Quality issue and inefficiency
4. EDI system & Bar code system	Capture data without human intervention Increase efficiency and reduce human error Increase flexibility and reliability Fulfill requirement with minimum investment Improve collaboration of entire trading partners

Source: Author

Figure 1.2 Alternatives Impact on Company



Source: Author

For example, if management wants to avoid the investment of capital they can choose to increase additional manpower. Cost of manpower will clearly increase. In order to achieve the processing request, ABC Company needs to hire an additional to 4 operators in the raw material warehouse to separate the receiving of HDD from

suppliers and production lines. The manufacturing department needs to add 4 operators for each production line to control the work in process (WIP) unit. Currently ABC Company has 9 production lines. The finish good warehouse needs to increase 8 operators to handle the shipping process. The total increase of 48 operators is needed, monthly salary of each operator is 11,000 baht excluding overtime expenses, total cost will increase to 528 million per month, a disadvantage is human error cannot be eliminated and high turnover rate of employment in Original Equipment Management (OEM) business caused the company difficultly to keep the experienced operators to prevent the error and ensure the efficiency. Re-layout warehouse and manufacturing area are separated by the country of origin (COO) of HDD. This alternative is good for management but lacks flexibility due to uncertainty of supply chain and portion of HDD that customers decided to allocate to their also needs high capital investment. Bar code systems can be implemented with current Enterprise Resource Planning (ERP) systems with the lowest costs compared to previous two solutions, but required human involvement, scanning operators are requested, the manpower cost increase may higher than the system application costs, and the human error during labeling and scanning cannot be prevent. In order to standardize the barcode of different COO of HDD, relabeling are requested, during this process, re-label error and scan missing will occur as well. In the end, operations may need to delete all records in the system and rescan new labels for all. it will lead to the quality issue and inefficiency in the production.

With those reasons, EDI systems & Barcode systems have been chosen as the best solution to eliminate the limitations and solve the problems. Both systems have several advantages compare to those alternatives. 1. Capture data quick and simple; 2. Efficiency can be increased with less human error during the operation process; 3. Automatically data transaction provides great flexibility and reliability; 4. The process changing request can be fulfilled with minimum of the investment; 5. Improve the data exchange among ABC Company; customers and suppliers improve the collaboration of entire supply chain.

With this decision the statement of problem is "How can the company implement the EDI systems and barcode systems to save costs as of customer's request". And this project aims to answer this question by designing a new process and implementation plan for the use of **EDI** system and barcode systems.

1.3 Research Objectives

EDI systems and barcode systems can increase the efficiency and accuracy of the process, also could reduce human intervention. It is a very useful tool for the supply chain management. Barcode system is a very popular and simple system to implement, but EDI system is very a difficult to set up. Therefore, this research focuses on implementation of **EDI** system before starting implementation of the EDI system. There are several steps that must be completed, such as coding standard, writing the problem, data collection, format conversion, server set up and so on. There are many issues will occur alone with the system go live as well, the capability of problem solving are very crucial for the project as well as system maintenance and ongoing change also needed. Therefore in order to successfully apply EDI systems and barcode systems, the objectives below needs to be achieved and together with the cost analysis.

1. To understand the benefits and impact of the implementation of the EDI & barcode systems.
2. To understand the detail components of the implementation of the EDI & barcode systems, then comes out the implementation plan for ABC Company according to the requirements of with customers.
3. To analyze the possible outcomes; provide the solution of possible issues that occurs with the implementation.
4. To do a cost analysis and compare the financial advantages of the implementation of EDI systems & barcode systems.

1.4 Scope of the Research

3?31

This project mainly focuses on the implementation of EDI systems and barcode systems and compares the total cost variance with the process which doesn't implement these systems. The data of the research will be collected from real practice and company document; the process flow will be reviewed and modified after analysis.

1.5 Significance of the Research

The research studies the EDI systems and barcode systems, are provides the appropriate solution to solve the current problem in the company, improve the efficiency of the process, reduce the human error and as operation costs. The research includes the detail study of EDI systems and barcode systems, and studied and explains how to implement the EDI systems and barcode systems effectively using the real case. It also includes further recommendations and solutions for the systems. The case studied here may be used as the reference by other projects and companies.

1.6 Limitations of the Research

The research specifically focuses on the case of ABC Company. The data and requirement of system is based on the real data, real practical situation and customer's requirement. It may not able to implement to other project or companies. The one of implementation of EDI system cannot be done by ABC Company only. It needs cooperation of other parties in the whole chain and depends on the company's management decision.

1.7 Definition of Terms

Bar Code System: A network of hardware and software, consisting primarily of mobile computers, printers, handheld scanners, infrastructure, and supporting software.

Electronic Data Interchange: The structured transmission of . data between organizations by electronic means. It is a technology used to transfer electronic documents or business data from one computer to another computer by standardized format to structure the data, i.e. from one trading partner to another trading partner without human intervention.

Internal Rate of Return: A rate of return used in capital budgeting to measure and compare the profitability of investments.

NPV: An economic standard method for evaluating competing long-term projects in capital budgeting. It is a time series of cash flows, both incoming and outgoing. It is defined as the sum of present values of the individual cash flows of the same entity.

Payback Period: In capital budgeting refers to the period of time required for the return on an investment to "repay" the sum of the original investment. It intuitively measures how long something takes to "pay for itself'.

CHAPTER II

REVIEW OF RELATED LITERATURE

This charter comprises of the definition of EDI and barcode systems, barriers and benefit of implementation of the EDI and barcode systems. Since the EDI systems implementation has more technology problems it needs prepare and concentrate, therefore EDI implementation was analyzed in two groups, strategic and tactical. The readiness of the necessary element before starting the EDI project and barcode systems will be introduced, and finally the literature review for successful implementation of the EDI and some assumptions of EDI standard code language before it execution will be presented.

2.1 Definition of EDI

Companies can through improve their supply chains to reduce their total costs and increase revenues. Companies need to use effective control of supply chains, between the whole trading chains, good quality and accurate information to create efficient communication. Standard article numbering provides the practical foundation for these requirements (Andrew, 1993).

During the late 1980s and early 1990s various observers predicted explosive growth in the adoption of electronic data interchange (EDI), believing that the vast majority of businesses in the USA would be using it by the end of the century_ Though EDI has spread rapidly and large, high profile companies like Wal-Mart and General Motors did achieve high levels of vendor participation in their EDI systems, many companies of various sizes have made little progress. Hewlett Packard had only seven partners on its EDI program after several years of recruiting (Senn, 1992).

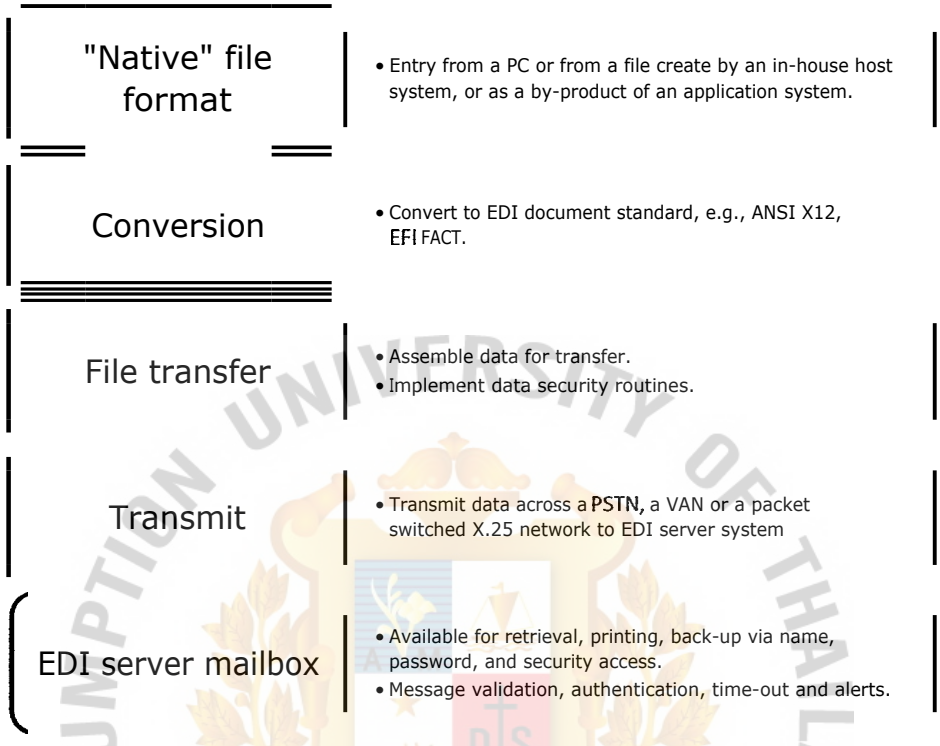
David (2007) said that Electronic data interchange (EDI) is defined as using electronically transmit data from one computer to another computer with an agreed

common standard to structure the data. EDI provides broad areas and new methodology for communication within all business members. It has been run around in the many kinds of formats for a lot of years and has been implementation in variety of fields with paperless technology to deal with trading information.

(Leon, Thomas, & Ray, 1996) stated that EDI consists of four major components as: standards, hardware, software and a communications network. If it has no common standards of protocol, procedural, and data format, it is difficult to operate EDI for companies. Transaction-set standards include three components: functional team, transaction set 'and data element. A functional team is a combination of transaction sets, a transaction sets includes a set of information occurs that between two or several trading partners. Such as shipping status report, invoices, product log files and function acknowledgements.

EDI hardware and EDI software could apply to any kind of hardware platform. For instance, a small Company that has few trading partners and bit volume of transactions, microcomputer with modems will be enough support. For big firms according to their big volume transactions and more trading partners they may needs mini-computer or mainframe-based systems. For EDI hardware implementation the company has to provide software to support it deal with and transmit EDI transactions. In a general way, software involves three types such as translator software, management software and communication software. The function of translator software is transmitting the internal data format to a common standard format to other trading partners. Management software function manages EDI data transmission and inductive collection data is used for further audit review. Communication software is use to communicate with each partner within the whole business processing.

Figure2.1 EDI Process Flow



Source: Paul (1991)

EDI communication networks means that all EDI trading partners use the private or public switch networks to communicate with each other. Value-Added Network (VAN) uses electronic mailbox, functions like a communication server to support stores and forwards data within trading partners. At present, In North America has more than 20 VAN providers. The company which is linked their partners by leased lines, public switch work or private network does not need the VAN. When the EDI documents are sent through the EDI software, the document data will be stored in the VAN until the receiver accepted and read the documents. Generally, companies often do not use more than one VAN for saving and backup convenience. Except for providing communication servers, VAN also provides the paid service, such as translator data format to help receiver convert document without more redundant conversion. It more EDI user demand increases, the EDI service is also added.

(Ghobadian, Liu, & Stainer, 1994) said EDI technology could pull electronic data transaction into the central computer system easily by using software interfaces at the end which converts input data into flat files. According to the specified EDI coding standard, once the system logical and link setup is correct, the manufacturing process can be ran smoothly as normal and data can be captured without any extra operations. The developing of new supplier relationships based upon operational and organizational change made by both parties is very necessary for the successful implementation of EDI. Close coordination can be achieved if suppliers can adopt their manufacturing and inventory systems enabling them to make a rapid response to retail needs.

2.2 Benefit of Barcode system and EDI

Barcode systems and EDI systems are very useful tools at present. These two systems can be used in combination in the same company. Since they are the advanced and popular technologies, so many fields and enterprises introduce these to their work to help improve efficiency and reduce resources.

2.2.1 Benefit of Barcode System

Revill's (1993) study found that Barcodes were developed from railway wagons as a means of identifying and counting those huge trains which wind their way across the Rockies to and from the American west coast ports. In the past the early codes had limited capability but the principle of data by black bars on a background being 'read' by a scanning device was established.

Barcode technology is basic for 'data capture'; it is recorded and known data is put into a computer system. The same data is repeatedly entered into computer systems by some form of transaction. Pre-recording of the data into a machine readable form of some high transaction rate data is done. In this way when re-entry or capture of the data is required it can be achieved quickly, at low cost and without errors.

Peter (1993) said that using barcode systems to recode data can reduce prints is easy to print using standard printers can record data effectively and efficiently id easy to read has wide character set has low cost readers has high packing density possible and is important for barcode systems but not for human readable, it can improve efficiency and reduce errors, and reduce human resources and reduce costs.

2.2.2 Benefit of EDI

The activities in a firm and between the collective customers and suppliers which are connected by linkages are inbound logistics, operations, outbound logistics, marketing sales and services. The control of products and information are required in each linkage. Now days, the competitiveness between manufacturing industries is very higher, and meeting customer demands is no more the only criteria of success. Technology is developed extremely fast than before but benefits and profit margins are become less, therefore management has started to focus on cost management, such as less inventory on hand, shorter lead time, higher inventory turnover rate, high information exchange efficiency and accuracy. In order to achieve this, IT investments becoming important and EDI systems are relevant for the economic, efficiently and reliably of operations of linkages.

There are many benefits those come alone with the implementation of EDI systems. Research by Bamfield (1994) indicated that the main benefits of EDI are saving of time, reduce from of operation costs and inventory management. For example, data will be updated once generate from the operation process by the rekeying process, invoice and document can be managed and handled easily, also accuracy can be improved as well, faster responsiveness and availability of data transactions can enhance the planning and control.

The most important benefits of EDI systems is help "Increase the firm's competitiveness and aids in achieving strategic goals", "provides more timely information and less information processing and management cost" (Paul & James, 1999; Millen, 1992).

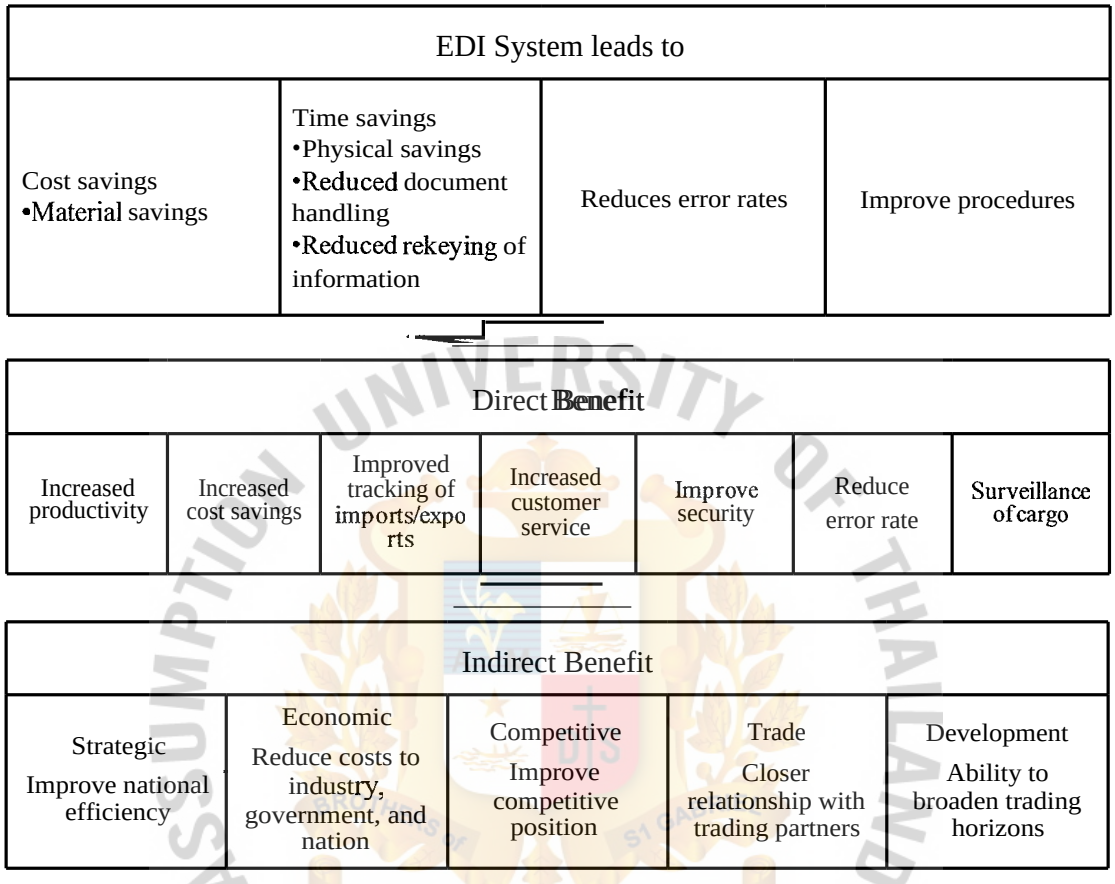
Dave (1996) indicate that the benefits of EDI systems has been in terms of the efficiency gain by using electronic documents and stock saving from shorter order cycle time and JIT supplies. Leon et al. (1996) stated that originally EDI systems aims at reducing the cycle time and documents transmission in paper between two trading partners.

Banerjee and Golhar (1993) stated that for just in time (JIT) manufacturing companies to get more benefits than non JIT manufacturing companies. Especially point out "improvement controlling of the data" and "reduction of clerical errors." Other benefits included data accuracy, time efficiency by minimizing the manual data, improve communication with shippers and customers and improve the customer service.

(Ferguson, Hill, & Hansen, 1990) had also identified in his survey that the potential benefits of EDI to a manufacturing firm are:

1. Quick access to the information
2. Better customer service
3. Reduced paperwork
4. Better communications
5. Increased productivity
6. Improve tracing and expending
7. Cost efficiency
8. Stay ahead of competitors
9. Accuracy
10. Improved billing

Figure 2.2: Benefit of EDI



Source: Paul (1991)

Sokol (1995) and Terence (1999) mention that when a firm redesigns its operational process to take advantage of EDI systems, the saving they get can be many times the size of the initial investment. With implementation of EDI systems, the manufacturing firm may move towards JIT operations, and minimize or eliminate the excess inventories to reduce the cost and also minimize the human intervention.

2.3 Barriers of EDI Systems

Ngai and Gunasekaran (2004) said that when many companies implemented the EDI systems, they only focused on the benefits from EDI systems and the competitive advantage of EDI systems. However successful implementation still has to consider system's barriers that might cause a bottleneck in the implementation of EDI systems.

According to management, and others who conduct research on EDI systems the barriers are lack of top management support implementation, inappropriate professional technique knowledge, insufficient investment on IT, lack of trust and confidence, and inadequate security.

Top management support was recognized as the most important factor of successful implementation of EDI (Angeles, 2001; Emmelhainz, 1988; Scala and McGrath, 1993). Firstly, some companies use their traditional trading ways Top management doubts and worries about the new technology results which will bring gain or loses. Secondly, EDI at the prepare stage needs top management investment for purchasing equipments and software to support. If the top management rejects investment for EDI systems, it will be a failure. Thirdly, considering the professional issues and technology, the company might need IT teams to support and reorganize the structure, and then allocate the resource.

Inappropriate professional technique knowledge depends on the IT department. EDI systems are complicated and uses advanced electronic technology. Documents and data from other parties will be decoded and uploaded to the in house application system, once the EDI system has been plugged into the system, operation process will fully depend on the system capability. Therefore all EDI related IT members need to be trained for understanding the EDI technology and message format standard, recognizing team capability in order to setup the system successfully and responsed to errors and issues occurs during implementation.

Insufficient investment on IT is the highest cost of the total cost. Many companies would not like to do nonprofit investment in the beginning. Furthermore, software needs to be maintained on time and updates timely. These activities need funds.

Lack of trust and confidence, this include internal and external two parties. In internal members doubt find the new technology is immature and using new innovation involves a lot of risks. If it fails, original profit and reputation will be losing. In external, afraid losing currently benefits and competitive advantage. They don't want

other competitors. However trust is very important in collaboration either internal or external. It is a core condition to ensure successful EDI implementation.

Inadequate security is a fierce dispute issue; so many companies don't accept EDI systems since of security. They think exchange information by networks is very dangerous. It might be divulge important information and breach of confidence. This problem actually is very important for each company, because security is required to ensure their private information and a core competency does not become public.

2.4 Readiness of EDI and Barcode System

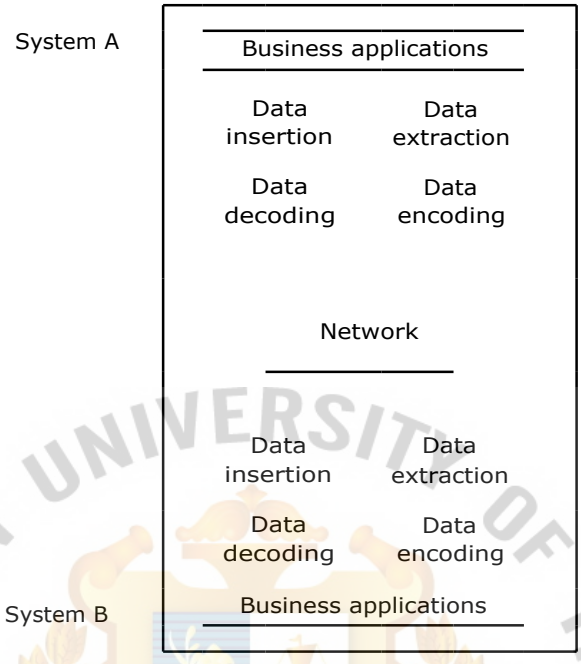
EDI systems and Barcode systems are comprised software part and hardware parts. Before implementation of these systems, there is so much preparation needed to be understood and follow step by step, like any other new area of consideration that can easily be misunderstood, if there is no agreed basis for discussing and organizing.

2.4.1 Application Interface

Parfett (1990) mentioned that in house business application formats have to be well defined because interface enables to update the data to the EDI systems. It needs to be able to retrieve the data for consolidate on which has been received and decoded from the EDI formats. The approaches of the process will decide what kind of interface needs to be used. For example, the data send out from in house application to EDI system in real time or event sequenced, depends on the need of data and business processes.

Figure 2.3 indicates that the data received from **EDI** partner will be decoded to in the house format and loaded to the respective application interfaces. The system will flag it and prevent it from duplication to cause data error. On another hand the system can get the data which are generated by several applications from the operation process to a specific file. The file will be used as a data source for the business activities and sent to the partner by the EDI systems.

Figure 2.3 Basic Function of EDI Software



Source: Parfett (1990)

EDI users should prepare following equipment for EDI application:

Hardware Requirements

1. Personal Computer: for application interface and EDI translator package.
   a) Microprocessor Pentium 166 or over
   b) Hard disk at least 500 MB of available space (for application and data)
   c) RAM at least 16 MB
   d) Windows 3.11 or MS-DOS version 5.0 or later
2. MODEM or VDM: for data transmission between user's promise and provider's for EDI.

Software Requirements

1. Application Interface: customers can develop their own application, purchase software packages, or outsource the software for tailor-made applications.
2_ EDI Translators.
3. Communication Software: provided by service providers.

2.4.2 Preparation of Data for Transmission

Parfett (1990) stated that after data has been received to an in house format, there are several stages to prepare for the data transmission. The data can be transferred via a Value Added and Data Service (VADS) network or a direct link between two parties. If data is needed to go through VADS, some commands or addressing needs to be provided by the VADS suppliers. Usually VADS will be chosen rather than use direct link to transfer the data, since different parties or companies may use different operation systems, and the data format will not be the same. If data is transferred by the direct link, receiving party will not be able to capture data.

Data will be generated by the application systems and sent by the EDI in real time, several times a day or combined into a batch and sent out one time per day depending on the requirements. Once the data are been batched, the next factors to consider is the construction of networks to address the information. The data package will be attached with an EDI header to identify the sender and recipient on a VADS network.

Once data has been collected and validated, the next step is to processes conversion from in house format to EDI syntax format. EDI software must be able to support the conversion of different formats due to the available range possibility and standards of message format.

2.4.3 Standard of Document

Document standard is the real heart of EDI technology. To make one invoice be recognized by all computer applications in the system as being an invoice from a particular organization is the factor to consider. One simple way to solve the problem is to ignore them and to place an electronic envelope around each individual message type. Many EDI providers prefer to use this approach. Paul (1991) has summarize the main standard had currently exist as following: The formal need for document standards was identified by two separate bodies in the early 1970s and developed by American National Standards Institute (ANSI) at 1979s , the standard named is ANSI or ASC X12. ASC X12 expanded to take account of industry oriented requirements by the introduction of a number of subcommittees as shows in Figure.2.4.

Figure 2.4 Structure of ASC X12.

ST COMM ES	
X12C Communications	X1211 Material management.
X12D Education and implementation	X 121 Transportation
X12E Product Data	X12J Technical assessment.
X12F Finance	X12K Purchasing.
X12G Government	X121.. Industry Standard transition

Source: Paul (1991)

This research will use part of ASC X12H Materials Management and X12K Purchasing Subcommittees.

The principle responsibilities of X12H is development and maintenance of EDI standards and guidelines associated with the management of material management. The EDI code standard of X12H is as follows:

- Consignment Inventory Practice
  - EDI857 – Shipment and Billing Notice
  - EDI866 – Production Sequence
- Maintenance
  - EDI830 – Planning Schedule with Release Capability
  - EDI846 – Inventory Inquiry/Advice
  - EDI856 – Ship Notice/Manifest
  - EDI861 – Receiving Advice
  - EDI862 – Shipping Schedule
  - EDI867 – Product Transfer and Resale Report
  - EDI869 – Order Status Inquiry
  - EDI870 – Order Status Report

The principle responsibilities of X12K is development and maintenance of EDI standards and guidelines associated with the procurement and acquisition of products

and services related is pricing information. The EDI code standard of X 1 2K is as follows:

- Maintenance
    - EDI832 – Price/Sales Catalog
    - EDI840 – Request for Quotation
    - EDI843 – Response to Request for Quotation
    - EDI845 – Price Authorization Acknowledgement/Status
    - EDI850 – Purchase Order
    - EDI855 – P.O. Acknowledgement
    - EDI860 – P.O. Change
    - EDI865 – P.O. Change Acknowledgement

2.4.4 Management Function

The function of management associated with EDI systems is more important. Parfett (1990) has identified that the management functions would cover the following:

Audit – This is first prime requirement, especially at the early stage of the development. A thorough audit trail capability with the EDI systems will be help to find out and debug the system errors and overcome the accountants' nightmare.

User interface – A friendly user interface will allow variance of interaction, such as data table creation, accessibility to trading partner's profiles to improve data visibility, and print out hard copy of data table for inspection. Security features in order to prevent unauthorized interference.

Document and archive and database —There are necessary with electronically stored information in order to keep the record of paper based business transactions. EDI systems have a very useful feature which is a flexible document archive and database facility in order to meet the different requirements of an organization.

Manual and automatic send and receive facilities —This should set up automatic procedures for network access, because VADS networks are used on 24 hours a basis.

2.4.5 Software Selection

For the company who sees there is a expanding of EDI range of trading partners in the future they should ensure that any EDI software that selected should be multipurpose. The system and software cannot be tied with a specific syntax standard or network. Because in further there is a very strong possible that the trading partners who has been taken on board will have different message requirements or may be use different VADS networks. It is a fact that when a company is committed to EDI and involved with additional trading partners they will be required to have support on an increasing number of standards and networks. This aspect must be kept in mind at any stage of EDI implementation and purchasing of software.

2.4.6 Application of Barcode Systems

Andrew (19931) mentioned that facilities have lead to focus on strategic facilities management tasks. A number of tasks within the facilities management department that are carried out on a day-to-day basis using a large amount of data which is laborious to collected and process either manually or in a computer. If there is a big volume of data or inventory that need to be track, the data can be captured full-time manually. As a data increases, the human error will increase as well.

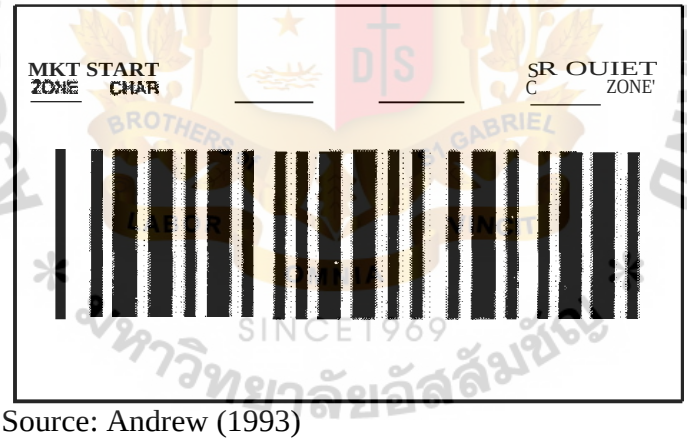
The bar coding system components contains the label, label printer, menu-cards, barcodes readers and data analysis program/software. It will conclude by looking an advanced form of automatic identification technology.

Label is the most important component to any barcode system. It could instantly recognized series of bars and spaces from a train of characters and number that can be decoded by a barcode reader and to a computer. While barcodes all look similar there are actually a wide range of code types (symbol-logy) to choose from (for example: Code 11, Code 39, CODABAR, UPC Symbol, Two of Five, Interleaved Two of Five, Nixdorf, Plessey). It is important to select an appropriate one for the task at hand. A barcode consists of a quiet zone, a start character, a number of alphanumeric characters, a stop code and a final quiet zone. Figure 2.5 shows variety of labels and Figure 2.6 shows elements in the code.

Figure 2.5 The Label as the Vehicle for the Barcode systems

Source: Andrew (1993)

Figure 2.6 Elements in the Code



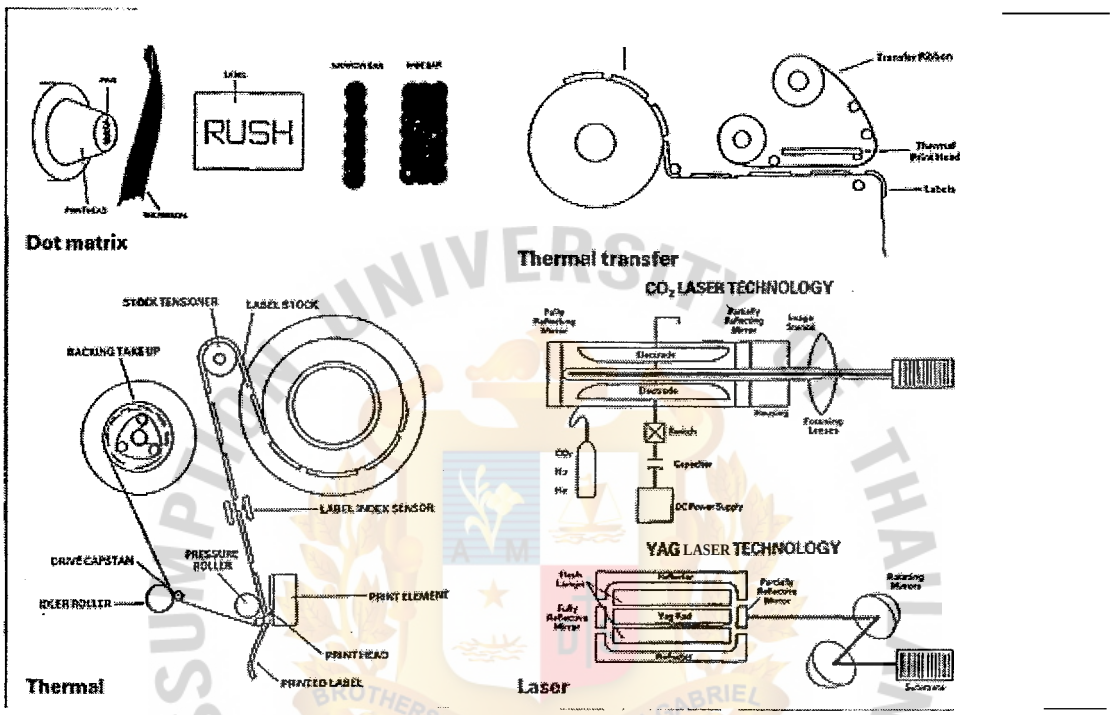
Source: Andrew (1993)

Only one piece of information is essential for smart bar codes, and that is the call number. The call number is the one unique feature of this item and it appears on (or near) the spine in able to quickly matching a bar code label to the goods. These codes are usually on item menu cards which the operator selects from the inventory

In the large scope of barcode system application, it is usually necessary to produce the labels in-house. New products need to be re-labeled, because the labels include information about date that cannot be predicted beforehand. Therefore, this situation,

the firm should offer printers to a print label for pasting. Figure 2.7 summaries the printer's working principle as show below:

Figure 2.7 Operation Principle of Printer



Source: Keith (1993)

For barcode readers there are many options available. The choice should be more carefully since it will have a major impact for capturing data fast and accuracy, inappropriate choice will lead to frustration and dissatisfaction between the people doing the inventory if it is difficult to use or difficult download into the computer. The main disadvantages of contact readers are that the reader actually has to touch the barcode to scan it which may possibly damage the surface of the label and also make it difficult to read codes located on curved or awkward surfaces.

Barcode data analysis process is the easiest part of the whole process. All barcode scanners generate an ASCII file (plain text characters). If a programmable reader has been used the data will already be in the correct format and order. The text file can be loaded into most database programs to convert the codes into their English equivalents and produce their ports.

2.5 Implementation of EDI

Successful implement of EDI systems need systematic approach as and integrated program support. Without implementation planning, it cannot be completed. In the past, there are a lot of research articles to show how to implementation EDI systems successfully.

2.5.1 Planning of EDI

Stainer (1994) had addressed several factors need to be consider before EDI systems are implemented. He said that at beginning the organization knows very litter for the EDI and this project must be support by top management. There are several factors that must be cleared before making decision of implementation.

- Which division or department will be the priority to implement EDI?
- Will they be passive users?
- What will be the organization structure for the EDI team?

Tactically there are several issues the need to be addressed and solved. Considerate about the changing of management, the impact of changes in work practices, and additional tasks that need to be carried out may be significant. The investment costs and affects of cash flow, accounting and auditing issues cannot be avoided as well. Related members need to be trained and the relationships with new supplies for ensuring the transmission is smooth and high responsive for urgent issues need to be managed. The advance system may cause organization change. Some people may loss the job. The process may need to be re-evaluated and changed, and management must be prepared.

2.5.2 Cost of Implement EDI

The cost of implementation is the major concern of management, Ghobadian and Stainer (1994) has classified the cost of EDI implementation into three categories. The first is development cost; this category includes the cost of sufficient critical factors to get EDI underway. The second category **of cost** is associated with the cost of investment of equipment, testing and implementation of the system. The third

category of cost is ongoing running, maintenance and security checks cost of the system.

Paul (1991) agrees that, the major elements of cost involve the following:
Hardware – this item include either upgrading to a mainframe if extra power of the translation task is necessary or using a dedicated microcomputer.

Communication hardware – this will be a request for a typical user, which ranges from $250 to $1,000 for the error correcting exercise.

Software – EDI software may be used for internal customizing, documenting, matching and exception handling and so on, with a cost range from $15,000 to $30,000.

Communication – If third party EDI provider are be used, there will two methods that can be chosen for linking into a VADS, (1) by dial up on the local PSTN or (2) by a leased line; the cost will be different respectively. Dial up costs is $500 to $1,000; but leased line is $1,000 to $3,000.

EDI service – This cost has the greatest variance and usually includes the service provider's own network cost, log on charge, registration cost, data translation and processing cost, data storage cost and technical supporting cost. The cost range is from $5,000 up to $50,000.

Consultancy – The cost occurs at the developing stage, and the range of cost typically varies from $800 to $1,500 a day.

Education – user training course usually which take 2 days and cost ranges from $300 to $500 per person.

Miscellaneous -- This cost involves investigative EDI systems through seminars, books and magazines or others methods. Cost range from $1,000 to $5,000.

Table 2.1 Cost Analysis of EDI Implementation

Type	Small user	Medium user	Large user
	One time		
DP hardware	1,666	0	0
Communicaiton hardware	333	0	0
EDI Software	1,500	10,000	16,666
Consultancy (first year)	1,000	3,000	10.000
Education (first year)	2,600	4,000	6,000
Miscellaneous expense (first year)	1.000	2.000	5.000
Total (one time)	8,099	19,000	37,666
	Repetitive		
Communicaiton	500	1,500	3,000
Software maintenance	500	3,000	5,000
EDI service	5,000	12,000	50,000
Miscellaneous expense	1.000	2,000	3,000
Total (repetitive)	7,000	18,500	61,000
Three years total	29,099	74,500	220,666

Source: Paul (1991)

Table 2.1 indicates that tells that in a three years period cost of small users will be $29,000, medium users will be $74,500 and large user will be $220,000 respectively.

Gallier (1991) explained that successful implementation of strategic information systems is based on a process of strategy formulation, which is embedded into a business strategy that includes a socio-element. Table 2.2 shows the model:

Table 2.2 Stage of Growth Model

Stage	Strategy	Management	Staff
Stage 1	Acquisition of hardware and software	Senior management concern	Programmers
Stage 2	IT audit find out and meet user needs	Cooperation	System analysts manager
Stage 3	Environmental scanning and opportunity seeking	Opportunistic; Entrepreneurial	Business analysts information resource manager
Stage 4	Maintain comparative strategic advantage monitor futures interactive planning	Interactive planning	Business planner

Source: Gallier (1991)

2.5.3 Cost of Implementing the Barcode Systems

The basic barcode pen has changed little considering the enormous increase in computing power, barcode printers have increased rapidly in their field, in team of efficiency and flexibility.

Peter's (1993) research said that EAN codes, printed in their millions, identically on packages, are reproduced by printing from one-off master costing about £50. Technical barcode printers are fully angel worded as 'fully-formed' complete characters. Cycle impact brings the required character to the print position and the print principle impresses the character onto the paper through a carbon ribbon.

High quality, high density printing is the basic advantage of this technology but because the printers are specially built for bar-coding they are about £5,000 to £8,000 and compare with other technologies, and inflexible since they only print barcodes with a small amount of text and usually only on labels.

The late 70's saw the development of intelligent, graphics capable, dot matrix printers capable of producing good quality barcodes. Their low cost of £600 and flexibility have made them the ideal way of producing barcodes in large or small quantities. Both labels (any size) and full documents may be printed with barcodes fully integrated with text.

Thermal-head barcode printers have appeared recently in response to the demand by retailers for one-off label supply to high quality EAN standards. These printers require special paper whose longevity has yet to be established but potentially they are a useful source of high quality density barcodes, at a lower cost of about £2,000 than the traditional drum machines.

Laser printers are the most recent technical breakthrough and promise flexibility, speed and quality at a reasonable cost per barcode. Their high capital cost at present of £250,000 has meant that utilization is via computer service bureaus but these organizations can take magnetic tape databases, and manipulate the data to produce

high quality documents, book labels, orders etc., at a reasonable cost of €0.10 per A4 sheet and at a great speed.

Barcode labels can be printed on a range of materials using a variety of printing techniques and it is important to select the right one otherwise all the time and effort put into the initial setup phase will be wasted. The lifespan of are more important selection criteria than label cost which are generally insignificant (£30 -£100 per 1000 labels).

In the future, barcode printing technology will bring lots of developments in the shape of inkjet printers and desktops and, low-cost laser technology. Barcodes will become easier and cheaper to produce on high quality, high density and high volume.

2.5.4 Successful of EDI Implementation

A study by (Ghobadian, Liu, & Stainer, 1994) used implementation of EDI systems to three markets that were of different origins with price weakness problems. During via implementation of EDI systems could help these markets: (1) reduction in order cycle time, (2) reduction in stock holding requirements, (3) reduction in telephone and stationery cost, (4) accurate and efficient order transmission, (5) sharing of management information and (6) integration of order-invoicing matching system.

Research conducted by the E-Centre (E-Centre, 1999) examined that implementation EDI systems supports indirect advantages even direct advantages, provides more information and opportunities to a company to check their current business trading and detect the inefficiency process.

Fearon and Philips (1999) research **was** part of a larger study identifying the need for evaluating the benefits of **EDI** systems and related initiatives. This case pointed out the significance within EDI is (1) Benefits Success, include benefit state outcome and realized benefit outcome; (2) Implementation Success, involved measuring technical and diffusion attributes; (3) Information systems (IS) development approach; (4) A sense of EDI-enabled competitiveness.

Leon et al. (1996) agreed that EDI systems can provide more opportunities to get many competitive advantages to a company by reducing cost, decrease lead time, improving efficiency and advance accuracy and so on, and suggested the firms need to plan will and execute development processing and implementation processing this two technical and human components of EDI to adopt new technology.

Ngai and Gunasekaran (2004) work on certain companies before the implementation of EDI systems. The benefits are different form after the implementation of EDI systems. Successful implementation of the EDI needs a framework. These elements will contain: (1) Top management support, Angeles (2001) and Emmelhainz (1988) said that top management support is recognized as one of the most important elements necessary for the successful implementation of EDI; (2) Technological infrastructure, Kappleman (1996) and Hodgson (1995) pointed out successful implementation of EDI has four major components which are standards, hardware, software and communication networks; (3) Strategic planning, need to considers both external press and internal press; (4) Education and training, Carter (1987) and Moynihan (1997) also suggested education and training is necessary for successful implementation of EDI systems.

In conclusion, the successful implementation of EDI from previous studies, identify barriers of implementation EDI, benefits of implementing EDI and critical successful factors for each particular case by the company.

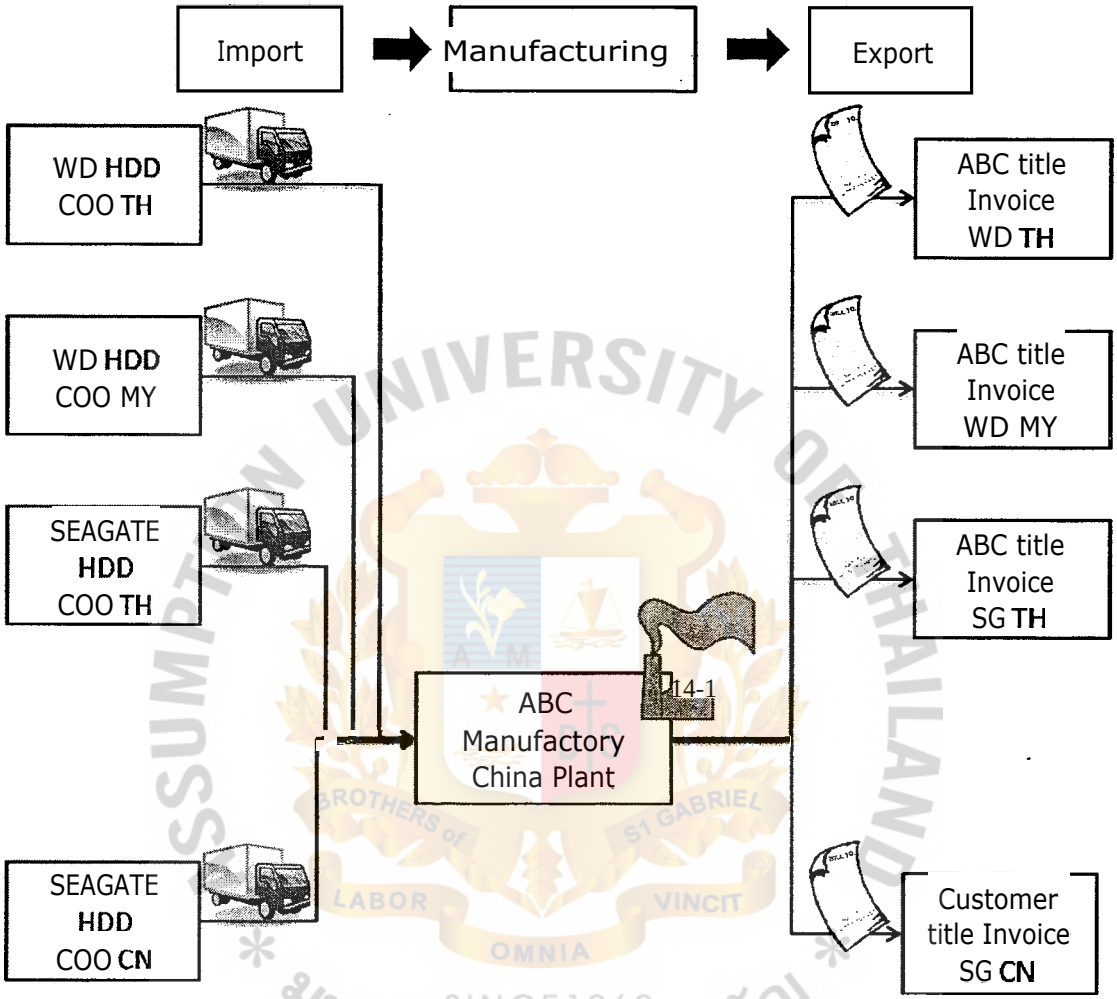
2.6 Assumption before Implementation of EDI Systems and Barcode Systems

As mentioned before in chapter I, customers decided to increase the sources of HDD in order to reduce or avoid the impact of flooding issues. HDD of WD and Seagate will be delivered to the manufacturing base from Thailand, Malaysia, and China respectively, since import and export regulation are different for the different countries of origin, HDD must be separately produced and shipped out from the manufacturers. The sorting process is required in order to achieve their requirement. This process is the constraint of the entire process **flow** and need to be improved.

Currently sorting operation need to be done by operators manually. They operators need to bring the serial number list to the warehouse to find the unit which matches with the serial number provide in the list. It needs a lot of paper print and manpower. The revenue of this project could be seriously impacted by the manpower cost of this process. By using manual sorting methods, manpower cost will increase 0.4293% out of total sales amount per month. More human resources not only means increase in cost other problems, such as security problems, related security cost increases as well, and reliability of manual sorting methods cannot be guaranteed.

In this research EDI systems were the important element proposed to be used for achieving the requirement. The reason is that all HDD suppliers use EDI systems for tracking their product and they have the record of all serial numbers in their systems. Instead of providing the serial number to the ABC Company through mail the data can be transferred by the EDI systems if ABC Company is able to implement the EDI system. Second, current manufacturing flow specifically request scanning for HDD for quality control, so the serial number can be captured by barcode systems when it been scanned, if serial number been uploaded into the system through the EDI systems. It is possible to do online sorting and prevent the mixture of different source of HDDs. Third; there is no additional manpower request. By using EDI systems, operators need to read the serial numbers and how paper list required, during the material issuing process. Only requested COO of HDD can be issued. The current operators and manpower in the warehouse is sufficient to hand it. Fourth, after receiving the shipping notice, planers can query the inventory data from the system and provide to it the shipping department to issue the invoice and then send the booking request to forwarders, operators of the FG warehouse also use barcode scanning to control the HDD according to the shipping requirement. There will be no additional operators required for sorting. All process as will be used instead of automation systems as EDI and Barcode systems.

Figure 2.8 Export Requirement of Different COO of HDD



Source: Company data 2012

There are several assumptions that need to be clarified for the EDI planning. Figure 2.8 shows the basic requirements of the new process. HDDs will be imported from the different organizations to the manufacturing side, which is located in Shenzhen, China. After production, finished goods will be shipped to the end customers. Customers specifically request the document of shipment which must be sent to the country of origin of HDD respectively. If HDD is import from outside the country of China, after manufacture the product need to ship out with ABC Company title invoice and separate according to the ownership of the organizations. If HDD is delivered to the

ABC Company from Seagate China manufacturing plant, the product shipped out it must be attached with customer's title invoice.

To enable the system to identify the country of origin of each serial number of HDD, there will be a partner ID to identify the COO of each single HDD. The ID identification will be the key of entire EDI system. The partner ID of each organization is shown in Table 2.3:

Table 2.3 Partner ID

Organizations	Partner ID
WD Thailand	WDHDOT
WD Malaysia	WDHDOM
Seagate Thailand	SGHDOT
Seagate China	SGHDOC

Source: Company data 2012

Table 2.4 Code of Forwarder Information

Forwarder Code	Forwarder	Mode	Service Level
UPSSCS A DEFER	UPS SCS	Air	Deferred
UPSSCS A CONSOL	UPS SCS	Air	Consolidation
UPSSCS_A_EXPR	UPS SCS	Air	Express
UPSSCS 0 OCEAN	UPS SCS	Ocean	
UPSSCS_T_GND	UPS SCS	Truck	
CEVA_A_DEFER	CEVA	Air	Deferred
CEVA A CONSOL	CEVA	Air	Consolidation
CEVA_A_EXPR	CEVA	Air	Express
CEVA_O_OCEAN	CEVA	Ocean	
DDAOD A DEFER	DHL	Air	Deferred
DDAOC A CONSOL	DHL	Air	Consolidation
DDAOD A_EXPR	DHL	Air	Express
DDAOO_O_D2D	DHL	Ocean	

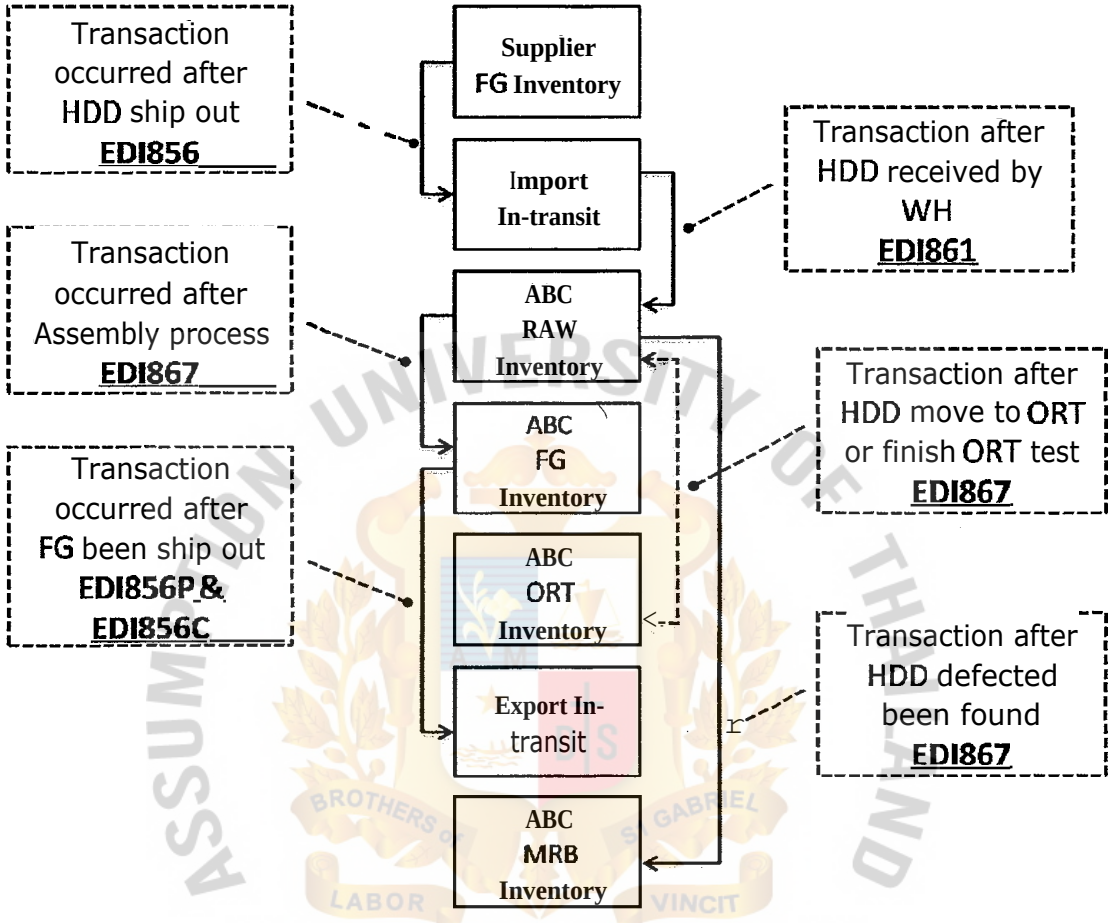
Remark: "Deferred" = Slow Speed, "Consolidation" = Normal Speed, "Express" = Fast Speed

Source: Company data 2012

The shipment of the final product will be delivered to customers worldwide, and shipping term is EX Work (EXW). There will be several forwarders and different types of transportation models are going to be used based **on** the customer's requirement. Therefore another group of codes will be needed for indicated the shipping information in the EDI signal as shown on Table 2.4 above.

The third assumption is to build the inventory location for EDI systems in order to improve the inventory control of HDD. There are seven inventory accounts need to be built up in the EDI system. The transaction flow is indicated in Figure 2.9 on the next page:

Figure 2.9 Transactions of Inventory Data

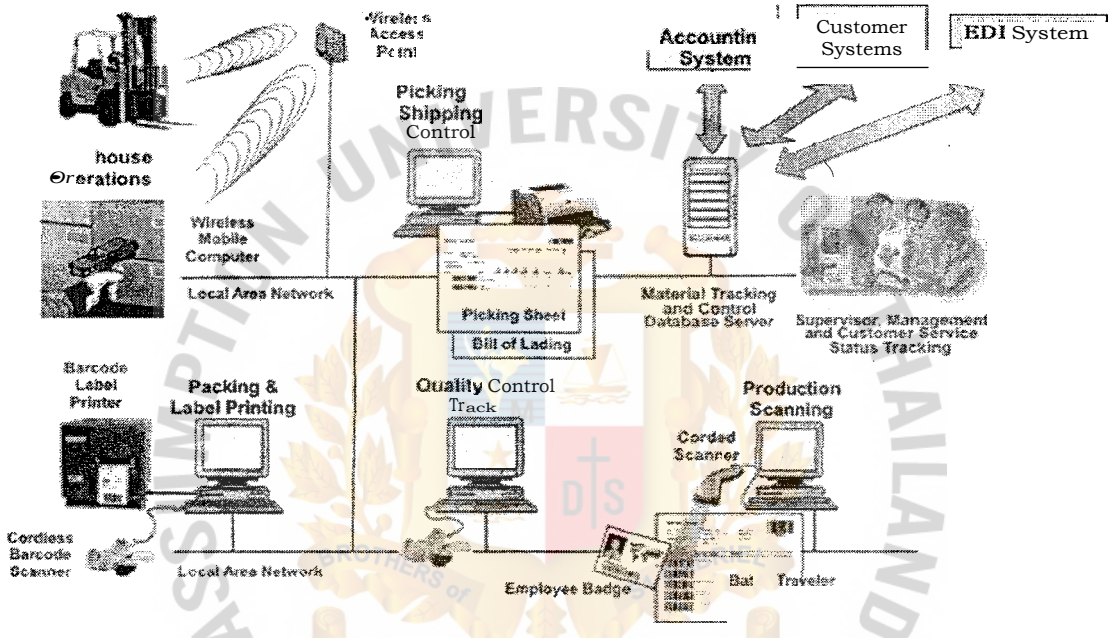


Source: Company data 2012

- Supplier Finished Goods (FG) Inventory, which indicates the inventory quantity data on the HDD supplier side.
- Import In-transit, which indicates the quantity data of HDD has been shipped out from the suppliers side.
- ABC Company Raw inventory, which indicates the inventory quantity data at the ABC Company warehouse.
- ABC Company Finished Goods (FG) inventory, which indicates the inventory quantity data in the ABC Company finished goods warehouse.
- ABC Company On-Going Reliability Test (ORT) inventory, which indicates the inventory quantity of the ORT test.

- ABC Company Material Reject Board (MRB) inventory, which indicates the inventory data of the rejected HDD
- Export In-transit, quantity data of HDD has been ship out from ABC Company side.

Figure 2.10 Operational Processes of Barcode, EDI and ERP Systems



Source: Company Data 2012

When suppliers need to send materials to the ABC Company, they have to send EDI files to the ABC Company before shipping out the problem which includes HDD serial numbers, HDD country of origin, HDD volumes, HDD status and any other request information until waiting for the ABC Company confirmation information. From the EDI file is sent, the EDI transaction will start to track each HDD's status. After the ABC Company receives the EDI files for HDDs' information, the information will be recorded and back up in company's system. While the barcode systems scan the information which belongs to scanned HDD will be send system to the data sever to compare, if their information matches EDI existing files which is sent by the supplier the ABC Company. After company got database their ERP system will help them to manage the data and given out production plans, shipping plan and other guidance plans. After being scanned if we match has its information,

satisfactory HDDs will wait for the production by the ERP systems. Otherwise it will be return and rescan to search its matching information. ERP will give appropriate schedules also, which means the ERP will manage and plan all internal data and information of the ABC Company. During the whole process from HDD sent from supplier until sent to customer, all request HDDs has tracked and monitored by EDI system. Similarly, when ABC Company wants to ship out finished goods to the customers it also needs sent the EDI file which includes HDD information, forwarder information, and customer information to the partners. Figure 2.10 shows barcode systems, EDI systems and ERP system operational processes.

CHAPTER III

RESEARCH METHODOLOGY

This chapter aims to address the problem and methodology of the research. This chapter contains 5 sections which are research plan, implementation strategy of EDI & Barcode system, data collection, proposal process flow model and the summary. These five sections indicate implementation plans of the EDI systems explains how and why EDI systems can meet the customer's requirement and what is the new process will be.

3.1 Research plan

This research is about ABC Company. The company's is major focus on Research and Development (R&D) and Electronic Manufacturing Service (EMS). The major product is advanced electronic products. This research only involves one product of advanced electronic products which is television boxes, and its important component is Hard Disk Drive (HDD).

To manage sorting HDDs and reduce sorting HDD manpower is the concern of this case study. The methodology is applied in the research assumption. After analyzing the company's problem EDI and barcode technology is implement. Thus assumption is necessary for implementation and could help design and suitable plan for implementation as mentioned in Chapter two. The second factor is implementation by appropriate implementation planning. The third step is data collection. All data gathered from the ABC Company needs to be related to research and authentic information. The fourth step is process mapping. After implementation and modify as-is process mapping, the to-be process mapping of manufacturing needs. Then compare as-is flow and to-be flow is to compared show the difference and advantage. The sixth step is issue and solution. From the start to the end of implementation there are occurred various problems, to focus on and the company will find solutions to solve them. The seventh step will show end of implementation results and change in

cost by analysis NPV, IRR and Payback Period. Finally is finding of the new system and conclusions.

Ngai and Gunasekaran (2004) pointed out that successful implementation of the EDI needs to construct a framework. In the framework there are four components which are top management support, technological infrastructure, strategic planning, education and training.

Gallier (1991) suggested that successful implementation of strategic information systems is based on a process of strategy formulation and the business strategy should be included as a socio-element.

Figure 3.1 Research Plan

Step 1.	Assumption
Step 2.	Implementation
Step 3.	Data Collection
Step 4.	Process Mapping
Step 5.	Flow Chart Comparing
Step 6.	Issues and Solution
Step 7.	Result and Cost Analysisi
Step 8.	Conclusion and Recommendation

According to the Company's issue, this research will deal with 8 steps as shown in Figure 3.1 which includes the assumption before implemented EDI and Barcode systems; new system implementation process; data collection; process mapping; complete process flow and compare with the prior process flow's solution and recommendation, cost analysis of implementation EDI system and Bar code system by NPV, IRR and Payback Period, and conclusion. And the explanation of each step is as follow.

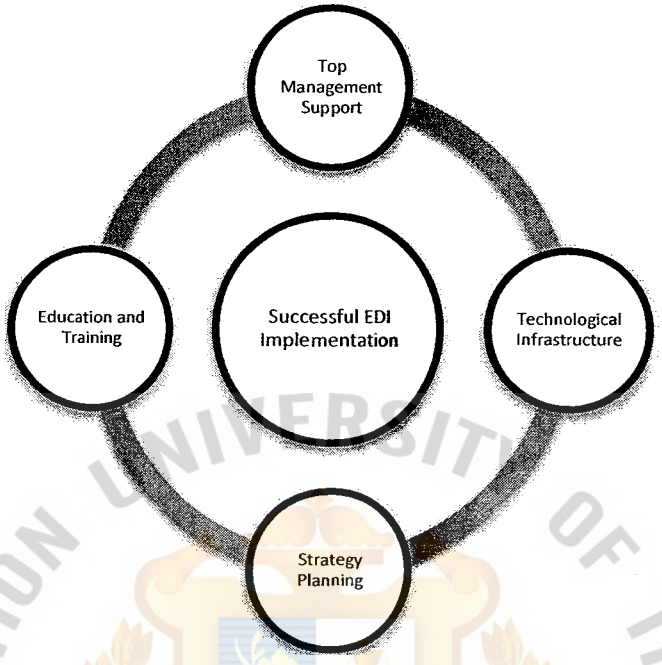
3.2 Implementation Strategies of EDI and Barcode System

EDI is not just a technological innovation: it also provides a new way of doing business. Use of EDI not only results in increased efficiency and effectiveness also facilitates the re-engineering of business processes. However, the benefits of **EDI** cannot be recognized without proper implementation strategies, both technically and organizationally.

3.2.1 EDI System Implementation Strategies

There are two approaches required for the implementation of EDI; one is the technology issue and another one is the organizational and cultural issue. Technologically EDI is not complex, the standard of **EDI** structure, software, network and technological implementation issues need to be understood by the firms using EDI. However, technical issues are not significant to most firms. Organization and cultural issues are significantly more difficult for the firms to deal with. It is the depth of change efficiency and use of technology that cause difficulty to use of EDI. The use EDI changes the relationship and interactions both internal and external the organization. Process management very difficult and complete integration request the cooperation of different departments, like import, purchasing, transportation, manufacturing, management of information system (MIS), and exports. All of this requires a careful planning and management.

Figure 3.2 Framework for the implementation of EDI



Source: Company Data 2012

The framework includes four elements which are : (1) Top management support is the most important element in framework, since top management can provide sufficient financial support and building successful EDI systems, (2) Technological infrastructure is difficult to integrate since it has four major components and need to integrate and use these components to plan technological goals, (3) Strategic planning is a difficult and complex problem for the company to implement because the organization should focus on both external and internal factors to planning the external strategy and internal strategy, (4) Education and training is essential to the organization with respect to the benefit and implementation of EDI in their organization. Work teams can understanding the concept and develop the technology to design and conduct EDI.

Figure 3.3 Steps in Implementation of EDI

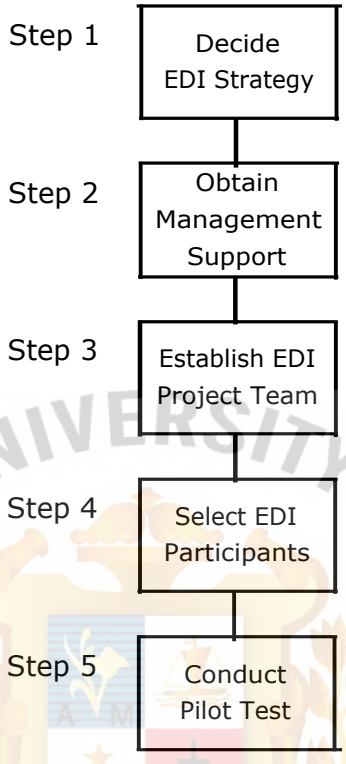


Figure 3.3 shows the steps to implement EDI with, detail which are as follows:

Step 1, Decide EDI Strategy. At first, the firm needs to decide the overall approval and strategy for the implementation of EDI. There are two components involved: (1) How comprehensive the EDI effort be; (2) How integrated will the EDI be.

The level of comprehensive means, how widely the EDI use corporation, EDI could be implemented for just one transaction within one department of it could be used for multiple transactions with many divisions. For this study, multiple transactions will be chosen. These transactions that occur between are parties given below:

1. HDD supplier, WD and Seagate
2. Customer logistics department
3. Customer planning department
4. ABC Company logistics department
5. ABC Company planning department
6. ABC Company manufacturing department

The integration level represents how EDI is linked with in-house application programs. There are also two approaches:

1. Door to Door approach, means data transfer between trading partners are electronically but manually linked to the in-house application program
2. Complete integration means that data transfer between trading partners is application to application, and all application programs are linked.

The complete integration will be chosen for the studied company. For this step, the company needs to start a meeting to design details, after discuss the plan is reviewed and modified. When design plan, the configuration information is suggested. Configuration information suggestions should include EDI configuration and network configurations. The whole process needs around 14 days to complete_

Step 2, Obtain Management Support. EDI system implementation may cause major organization changes, and it requires interdepartmental coordination, therefore the support from top management is very necessary as soon as possible. The implementation of EDI usually affects a numbers of functions especially when a using the integration model. In ABC Company's case, affected departments include IT, import, warehouse, manufacturing, quality, export as well as sales and marketing. The support from those departments is the key for the success of EDI implementation. If the top management accepts the design plan and configuration information suggestion, the implementation can go on. This permit activity needs around 7 days to complete.

Step 3, Establishing EDI Project Teams. After top management support, establishing EDI project team is very important. An EDI team with members from across the organization is very crucial and necessary for the success of EDI. The team with total responsibility for the implementation of EDI must include representatives from to five areas below:

1. Function areas such as logistics, manufacturing, transportation, financing
2. Staff areas such as auditing
3. Implementation areas such as program application and operating
4. Technical areas such as information systems and data processing

5. Liaison areas such as sales, customer service and marketing

The team leader is essential follow successful implementation of EDI. EDI is seen as a new computer technology, but most firms with successful EDI implementation found that team leader should not be from the IT field since EDI is such a boundary spanning activity. The leader must have broad business perspective and visions. For a manufacturing company, logistic manager will be the most suitable person to be selected as the leader of the project.

For establishing an EDI project teams internal simulation is needed and, information verification and cross checking to attack if this simulation suitable for design. Review and modify simulation on time. This step needs around 28 days to do.

Step 4, Select EDI Participant. After EDI concept been settled and the EDI teams have been formed, operational decisions must be made. These decisions include:

1. The third party network.
2. Software of EDI will be developed by ABC Company's IT teams based on Oracle ERP systems.
3. Transaction sets will include HDD import data transactions, HDD issue transaction, and manufacturing data transactions, return to finish good warehouse transactions and finished shipping transactions.
4. Trading partner involved will be HDD suppliers, Seagate and WD, and customers.

This step should confirm at West Digital and Seagate about EDI configuration and network configuration, after unified configuration management, tracking the overall process and feedback from suppliers. Feedback information is needed to modify documents, for finalization. After these activities, pre-operation and internal preparations are done. VLAN network, 3rd party's software is setup and antivirus setting. Still needs on-site deployment: client network set up, end user administrator training and EDI basic operations. This step is called the execution the step, and is so complex and important, because it needs about 42 days.

Step 5, Conduct Pilot Test. Once the system has been designed, a pilot test needs to be conducted. There are three stages: transmission of dummy data, parallel test of electronic and paper transmission and electronic transmission with no paper backup.

1. Dummy data will be used for checking whether the linkages of the system have been correctly.
2. Parallel test is used for testing the transmission of actual purchasing documents. Transmission will be run in parallel with the paper documentation, electronically through EDI system.
3. The last test is use of EDI systems to do limited number of transactions without paper back up.

This step will need about 7 days. Actually all of these steps will be repeated possibly since the entire process should review and modified more times till it matures. Table 3.1 shows the actual implementation schedule for ABC Company:

Table 3.1 EDI Implementation Detailed Schedule

Main Task	Detail Task	Lead Time
Start up meeting	Design sheet Review & modify	14 Day
Configuration information suggestion	EDI configuration Network configuration design	7 Days
Internal simulation	Simulation Information verification Cross checking	28 Days
Confirmation at WD and Seagate	EDI configuration Network configuration	14 Days
Feedback from supplier	Supplier **WD** feedback Supplier Seagate feedback	3 Day
Document Modification	Document configuration and revise	3 Day
Finalization	Confirm all configuration Adjust	1 Day
Pre-operation and internal preparation	VLAN Network 3rd Party's software setup Antivirus setting	14 Days
On-site deployment	Client network setup End user administrator training EDI basic operation	7 Days
Pilot Test	Dummy data test Parallel test Electronic test	7 Days

Source: Company Data 2012

3.2.2 Implementation Strategies of Barcode system

In any company, basic data collection and transmission are very important for apply ERP or MRP systems. If errors occur within this process the related data will became meaningless. Barcode systems comprised of bar code designing, barcode generating and barcode scanning. Barcode system could integrate bar code identification technology and modern logistics management technology with ERP systems.

Barcode systems include two parts which are hardware and software. Software has a data acquisition unit program, backstage data exchange service and barcode printing program. In some special situation it is not necessary the need all of these, such as some systems can direct use barcode scanner to complete input data into the program without the data acquisition program. Data exchange service with ERP data real-time

exchange complete automatically, like read basic data from ERP system, document data, and business configuration data and so on. Real operation data from the data in received acquisition unit, then checked and controlled has data validity and legitimacy. Feedback data to ERP system and generate inventory documents. Barcode printing program read data from the ERP system, according to the default label format to print barcode labels. Hardware comprised either wired or wireless connects the mobile computers. Handheld scanners and printers store are analysis the data by the system. At some level there must be some software to support and manage the system. The software will be as simple as code that manages the connection between the hardware and the databases or as complex as an ERP MRP, or some other inventory management software.

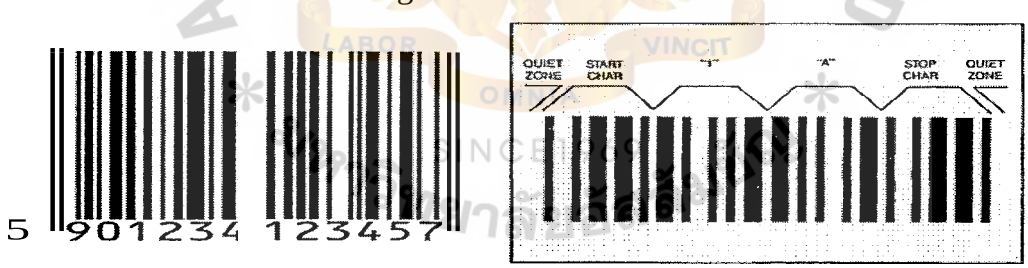
In the research, ABC Company needs through the research to decide which hardware and software of bar code fit into company's application situation and capital situation then choice the best one. Currently ABC Company has ERP system to manage firms so that when bar code systems are used it should be combined with existing systems. According to current problems and exercise situation, the company decided to adopt U8V10.0 Barcode system as data acquisition unit program by UFIDA Software Co. Ltd to manage barcode.

Since ABC Company is concerned product manufacturing for television set boxes, the main component is HDD consigned by suppliers. ABC Company assembles the HDD into television boxes and sends the back to the suppliers or to the suppliers named place. When suppliers send materials to the ABC Company, it also sends all related HDD information at the same time. Each HDD has its unique barcode to identify information. After received information ABC Company has inputs and backup all HDD information which is sent from the supplier with a through scan HDD barcode to record and check this information with ERP system. Therefore the factory could use the original barcode instead of designing a new barcode. The company does not need to generate new codes except some special situation as when the original barcode was damaged or contains errors. Each HDD has its unique serial number, part

number and some basic information. When the scanner scans the barcode, all information that belongs to HDD will be displayed.

Barcode has a lot of modes for choice. In the research all barcode were adopted from European Article Number (EAN) 13 Code. EAN comprised by prefix code, manufacturer identification code, commodity project code and check code component. Prefix EAN code is on international organization that identification each member organization code. Manufacturer identification code is distributed by EAN code organization based on prefix codes. Commodity project code is established by manufacturers. Check code for checking the correctness of the code. When establishing the commodity project code the compare needs to abide by the commodity code basic principle: commodity code for the same goods must establish the same commodity code and different goods need to establish different commodity code. Guarantee product project and its identification have code one-to-one correspondence, namely a commodity project only one code and an code identification has only one commodity project.

Figure 3.4 EAN 13 Codes



Source: Company Data 2012

EAN 13 barcode includes the left blank area, initial character, the left character data, middle separator, the right data character, calibration operator, termination , the right blank area and for identification characters. As Figure 3.4 shows all barcode numbers are '5901234123457', among it '590' is prefix code, '1234' is manufacturer identification code, '12345' is commodity project code and '7' is check code. When the barcode scanner scans it, all information as goods coding, serial number, part number, good name, product specification, lot number, color, unit, volume, weight

and producing area will be displayed. After scanning all information will be checked with ERP system data which was send by the suppliers. This information is very important for identically each HDD, and helping all member management and control.

3.3 Data Collection

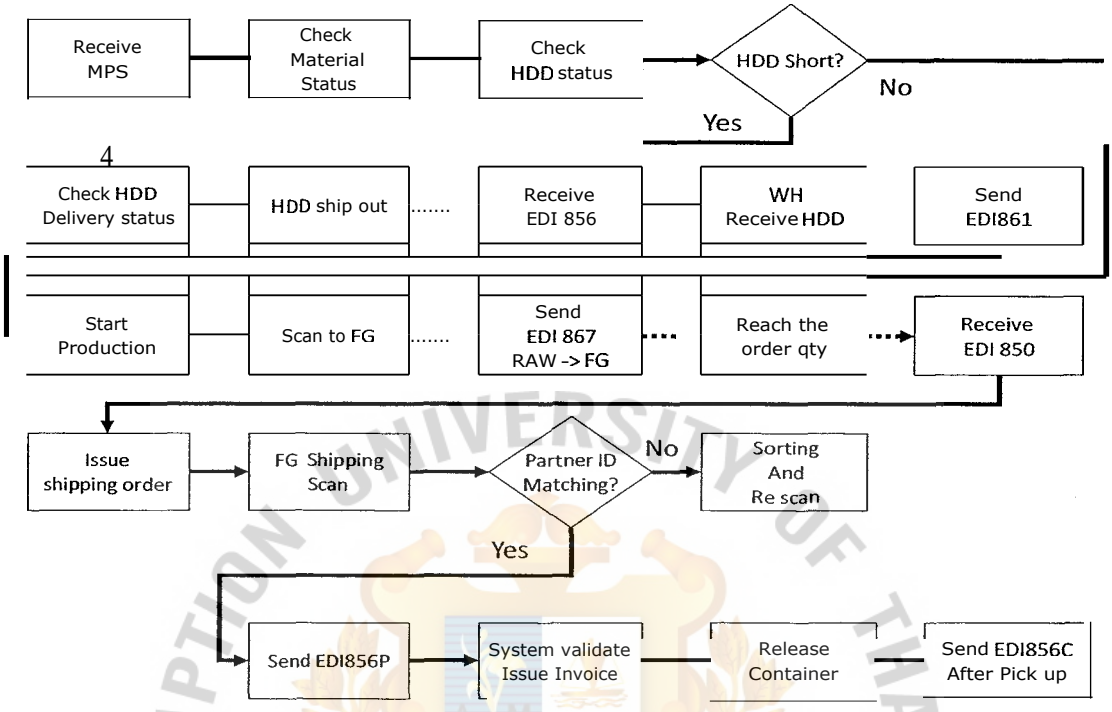
The data that needs to be transferred by EDI system must be identified. The purpose of the research is to identify the COO of HDD, improve the inventory control of HDD and prevent the mistake of shipment and, ensure the good to be picked for shipping match with shipping request and documents. The data to be required will include the detail information of HDD and shipping information:

1. HDD information includes HDD part number, firmware version, serial numbers, and partner ID.
2. Related logistic information also needs to be include shipping invoice number, air way bill (AWB) number, pallet **ID,** and carton ID.
3. After the assembly process, HDD will move to FG inventory location from raw inventory and mapping with finished goods part number and finished serial number, which are needed to EDI transmissions as well.
4. The last information is shipping information; EDI must include shipping details in order to ensure the accuracy of the shipping process. The information are include shipper numbers, finished good numbers, partner ID, shipping address, bills of the compare, forwarders information, purchasing order numbers and shipping quantities.

3.4 Process Mapping

The process affected by EDI systems and Barcode systems will be from the import process until export process. According to research and development, proposed process flow model will based on to be mapping model. The model is shown as Figure 3.5:

Figure 3.5 Proposed Process Flow Model



Source: Company data 2012

The EDI signals been used in the new process are EDI856, EDI861, EDI867, EDI850, EDI856P and EDI856C. At the beginning of the process, the ABC Company planning team will receive master planning schedules and check the material inventory status and HDD inventory status. If the HDD is insufficient to support the demand, the planning development will give feedback to the customer and suppliers and confirm the HDD delivery schedules. Once HDD been ship out from supplier, EDI856 will be sent out at once, and planning will be noticed by an alter mail. After EDI856 had been sent, HDD inventory data will be deducted from the supplier inventory and added up at in-transit inventory. All parties will see the data and monitor it clearly.

After HDD had been delivered to the manufacturer, EDI861 will send out for the confirmation that they have receive the products, and then inventory data will be moved from in-transit to ABC Company raw inventory accordingly.

EDI867 will control the production process. If HDD can finish process and pass all the qualification tests, it will be moved to the FG inventory. An EDI signal will be

sent after packing station scan. In real practice there will be some defects to be found. Those defected HDD will be scanned and moved to the MRB inventory using the same EDI signal. For this production, the customer request to have ORT test, so the sample unit will be moved to ORT room for 28 days, during the testing period those unit cannot be consider ship able finish good, with the similar process as MRB control, testing unit will be scanned and move to the ORT inventory location from RAW of inventory location.

Customers will see the inventory data based on the data transmission of EDI867, and release the shipment to the manufacturer if FG inventory quantity is sufficient to meet the end customer's demand. The Shipping details will be included in EDI850. Manufacturer will download the EDI report from the system and arrange the shipment. FG operator will pick up the product according to the shipping details and scan for the shipment, system will validates the serial number and partner ID of the product to check whether it is the right product to be shipped.

In general, suppliers send all shipped out HDDs' information to ABC Company by EDI systems. This data is transferred to ABC Company's data server, then to the ABC Company's warehouse through barcode scanners to scan each HDD to check if all information matches with what supplier sent. After data is recorded, materials sorting and managing inventories. Next using ERP System gives BOM, management plans, production planning, shipping planning and so on. After products are shipped out from ABC Company's warehouse, ABC Company sent all shipped HDDs information to the trading partners by EDI systems.

3.5 Summary

The methodology to be used has been explained in this chapter. First the objective of the new process has been clarified, Second the details of required data such as product information, shipment information and engineer information are been identified. Third the new process flow has been designed and explained in detail, such as, when and what EDI signal will be used

CHAPTER IV

PRESENTATION AND CRITICAL DISCUSSION OF RESULTS

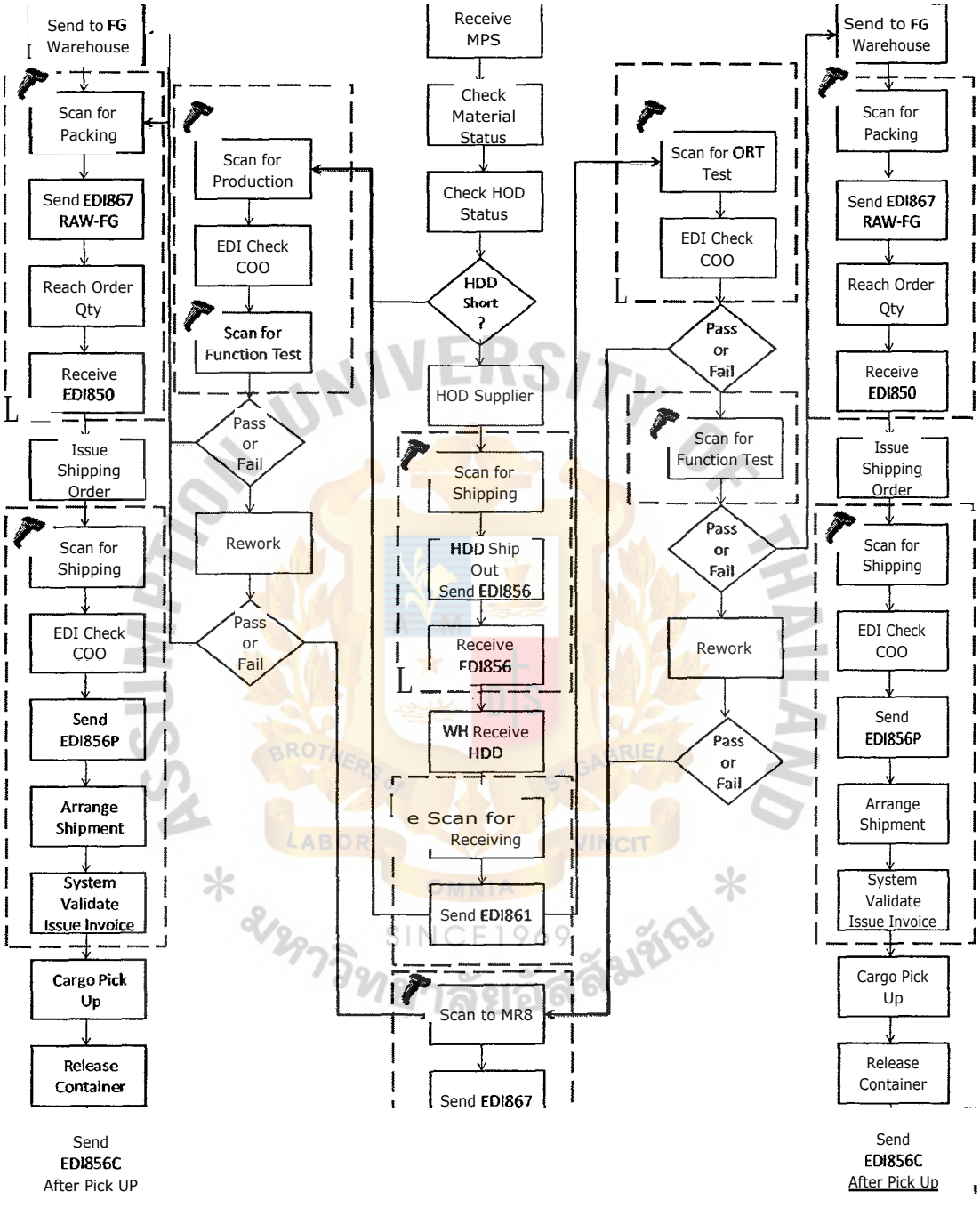
This chapter includes the analysis of the results which consists of the comparison of entire process flow and previous process flow. The implementation and cost analysis between the process implemented barcode and EDI system, and process without implemented EDI and barcode systems is further explained.

4.1 Complete Process Flow

The complete process mapping contains barcode systems, ERP systems and EDI systems to track and monitor each HDD from the supplier to the customer side. Between the entire processes, all supply chain partners could see the status of HDDs from upstream to downstream. This entire process mapping is conducted according to the assumption of inventory data transactions and proposal model.

After implementation of the EDI and barcode systems, the process changes a lot and many stations are add for scanning by the barcode scanner. It is necessary to enable the system to capture the serial number of each HDD combined with existing ERP systems and link it with the EDI data base to indentify the country of origin (COO) of HDD and check its information. Using the new process will be reduce human intervention and, in the meantime improve accuracy and efficiency.

Figure 4.1 To-Be Process Flow



Source: Company data 2012

Figure 4.1 show that after receiving MPS, warehouse operators will check material status and HDD status. This includes checking quantity and COO of HDDs. If HDD were enough for production it would entrance normal the production line, but if not sufficient to match MPS, ABC Company needs to ask suppliers for more raw

materials. When suppliers send the materials, they must scan all units which are ready to ship, in order to send out EDI856 to the ABC Company along with the respected Invoice no., this is the most important EDI signal. It includes the combination of HDD serial numbers and COO, and it will be used as the criteria of sorting the HDDs. EDI856 will be uploaded to the ABC Company server for back up and warehouse operators and inventory planners will see the information and start tracking the HDD accordingly. Once the HDD reaches the warehouse, they will proceed with scanning and sending out EDI861 automatically after scan is completed. Suppliers and customers will see the inventory transaction from in-transit to ABC Company. Those HDDs can be used for production, if HDD that was scanned does not match with EDI856. This HDD can't to be used and needs feed back to the suppliers. The process will be split into two lines, one is normal production, and another one is ORT test.

For normal production, the warehouse is requested to scan all HDD and issue it to the production according to the plan by ERP. For the production of each day ABC Company the ERP system will generate a manufacturing no. (MO) to track the quantity and cost of production, EDI system is combined with the ERP system for sorting and control of the HDD. Different COO of HDD cannot exist in one MO. During normal production, assembly units will be requested to do the function test. If the test passes, the unit will directly go to packing station to be scanned again. Scanning is goes for preventing the un-test unit loss of the finished goods and for quality issues. The scan for packing is used for sending out the EDI867 in only to do the transaction from Raw to FG. Once the units had been scanned at packing station, customers will see the finished good quantity and trigger ABC Company for the shipment. If this function failed, the failed unit needs to be move to the station for analysis and rework. If it can be done, the product can be will moved to packing station and sent to finished good warehouse, if not, the fail unit will not be assembled and scan to MRB. The scanning station here is used for sending out the EDI867 to do the transaction from RAW to MRB. Once the failed unit has been scanned, customers and suppliers will see the MRB quantity increase and plan for returning the failed unit back to the suppliers. At the packing and MRB scanning station, sorting jobs still required, because the ABC Company must ship out the FG or MRB units according to

the COO that serial numbers that belongs to, the documents and quantities must matches exactly with the physical part.

After the HDD has been issued from the warehouse and assembled, the unit will be scanned before moving into ORT test room. The purpose is to send EDI867 to conduct the transaction from RAW to ORT, so customers will see the ORT quantity increase in the ORT inventory location. After ORT testing is completed, failed units will be moved to the MRB directly. The process will be the same as normal production, but transactions will be different. The EDI867 generated here is to conduct the transaction of ORT to MRB. If the ORT test is passed, the unit will be moved to do the function test again. If it failed, the unit will be moved to rework process and the rest of the processes will be the same as the normal production rework process. If this pass the function test, the unit will be moved to packing station, scanned and send EDI867 to conduct the transaction of RAW to FG.

Finally, once the FG quantity reaches the customer's order level, the EDI850 will be sent to ABC Company for triggering the shipment. Invoice no., part no, quantity, forwarder to be chosen, serial number and country of origin will be included in the EDI850 signal. The ABC Company will pick up the matching FG for scanning according EDI850 and send EDI856P to customer for verification and generate invoice for the shipment. After verification is passed and invoice has been completed, FG warehouse operators will pass the documents to the forwarders and load the goods into the container. Finally, goods shipped out sent out EDI856C for closing the shipment and deducting the inventory out from ABC Company respectively.

In this process mapping, total has 11 scanning stations but in practical operations only 10 scanning stations. That's because the first scanning station belongs to the supplier's side, thus ABC Company does not include. It packing scanning station, ABC Company just has one line that generates unique packing scanning stations to scan for the packing operations.

Although the MRB test consist of one line, it gathers normal production line fail units and ORT test line fail units and, the EDI867 signal must be sent to each other, so that each line needs their scanning station respectively to scan their attachments. Therefore MRB test must have two scanning station to finish this operation for helping all trading partners monitor each HDD's status. All related barcode systems and EDI systems processes are highlighted.

Compare as-is model with to-be model, in the as-is process mapping is done, ABC Company uses manual sorting to separates HDDs' COO and serial numbers for matching customer's requirements. Actually it does sorting it times. The first time is when it receives raw materials from supplier; the second time is before the entrance assembly process should separated each HDD of COO; the third time is MRB test, and the last time is for finishing all assembly processes before shipment. All finish goods which are on the shipping order need to do sorting and matching each serial number and COO. It must need lots of labors but it easy to make mistakes and it needs more time also and leads to higher human cost. During the entire process there is no systematic tracker to track and monitor all units' for quality and security.

After implementation of barcode systems and EDI system, all manual sorting will be done automatically. Form a long-term point view it also reduces a lot of manpower costs and resources. The to-be process mapping is designed by combining barcode systems, EDI system and existing systems to improve the whole process and solve firm's problems. At first ERP systems as suppliers offer EDI files which include all information of each HDD to generate the manufacturing planning for production. After barcode readers' read all HDDs information and transfer it to the terminal system, the EDI system does the sorting and recording for tracking and monitoring. It adds more scanning stations to track each HDD from receiving the shipping transaction that can cause all information transparency for all trading partners and, help to analyze HDD state and generate appropriate plan only timely basis.

To-be process mapping using three systems to improve accuracy and efficiency and also reduce manpower cost to match customer requirements. EDI systems and

barcode systems are completely merged with the ERP systems and conduct the online tracking and sorting activities. Each scan station has been set to check the COO of each signal serial number by receiving the EDI856 signal and EDI850 signal. It also has EDI867 transaction signal. It can efficiently and effectively improve the process to achieve the goal. It also increases the accuracy of inventory control. Without the EDI system, inventory accuracy will decrease obviously. There are total have 10 scanning stations on the supplier side. Once HDD has been scanned the information will go through the ERP systems transfer to the computer records, and database. After ERP system plans, the EDI system will tracks all information and monitor each HDD status. Different lines have own scanning station to monitor the attachment to prevent another line unit mix up. This action can improve unit quality inspection and accuracy.

4.2 Critical Factors and Issues of Implementation EDI System

EDI systems are popular and useful technology at present, but implement EDI system successfully a lot of details should be focused on. EDI systems is a complete system, must be connected with each other for operation. Therefore, when company design and change processes they need to considerable the whole chain.

4.2.1 Critical Factors of Successful Implementation EDI System

EDI implementation means that a fundamental change in the way the business operates, including considerable investment in hardware, software, training, maintenance, value-added network services and any other related EDI.

In general, top management support is the most important factor to successfully implement EDI. It decides this program to proceed because of investing in EDI. After this, the project team should prepare and conduct it by their design planning. The whole implementation process is usually divided into two parts which are preparing and management. The preparation stage contains enabling business applications to use EDI, translating transactions into EDI standard messages, forming a network connection to trading partners via value-added networks or directly, providing consistent management and auditing between application by trading link, and

performing service validation tests. The management stage, requires drawing up of trading partner profiles, checking the system is working, regular archiving of transactions, inspecting error logs and changing passwords, on-demand updating of trading profiles, restoring transactions, stopping/starting EDI link to VAN or partners.

All these details are critical factors for implementation of EDI systems. Every detail has its role in EDI implementation at the same time they need to connect with each other to help EDI normal operations. Occurred issues lead to system shut down, in the event that one of the components has a problem. That means the company which implemented EDI system must review and adjust the whole chain timely way.

4.2.2 Issues Occurred During Implementation of EDI

The previous sections mentioned that successful implementation EDI must focus on a lot of details and be set up into a harmoniously unified unit. Once one part has a problem, the system will be shut down. In ABC Company implemented the EDI of system, many issues occur to prevent the system from proceeding and starting implementation. This section aims to explain ABC Company enterprise's issues.

At the initial stage, ABC Company's customer demand increased. Supplier requested ABC Company to implement EDI system to align with their system to help HDDs transaction and monitoring to improve product quality and business efficiency. Thus ABC Company decided to implement EDI, but this technology must be combined with all trading partners' business processes and changing company's original business flow. It is a new program for ABC Company due to no experience of it, so top management plans to abandon the program. This shows lack of awareness of EDI benefits. That means high set up cost to invest it. To one enterprise, high capital investment will impact their business and cash flow, so when making decision. For this reason, when project teams want to keep it up, they need spend more time and cost to research it. Then reason offer **to top** management to believe that the investment is good for business and that it could **help** improve relationship with trading partners. Within the implementation process, design and configuration is very important. It needs company's own process and needs to combine with each trading partners'

process to design and configuration, then review and modification by feedback is done.

ABC Company found several issues that occurred in this stage which are: incompatibility of hardware/software, because ABC Company has old software and hardware already, implement of the new system needs to align old and new systems including software and hardware; lack of standard formats, every trading partner has their own system format but when using EDI transmit of data needs set up to be according to a standard format and include all partners' format; lack of customer resistance and corporate culture, within the whole flow chain, every trading partner should be offered relevant information for partners, that means their information will have no transparency. Some customer would not like to support real information to collaborate.

Faced with these general issues, solving the problems should be: 1. Identify the functional areas within the company which may be affected and to determine the applications from EDI integration; 2. Identify hardware and software, as well as VAN for communication; 3. Make sure that the EDI application can interface and communicate with existing applications, also include selected networks; 4. Modification of existing applications to contact with trading partners; 5. Focus on the whole chain; 6. Based on requirements defined, the communication standard are finalized, then infrastructure is designed; 7. Security, agreement between partners, back-up, disaster recovery, error recovery should also be addressed.

After the implementation of EDI system, when company does the pilot test, more issues many exist. During the pilot test period, the company records all problems, and how to fix each problem. The list below includes hardware, software and management problems.

1. Problem: Seagate server failure leads to EDI signal failure and lack of transmission.

Solution: Feedback to Seagate, after Seagate fixes the server, to provide Seagate for tracking and resending missing EDI.

2. Problem: Performa invoice which cannot be generated because EDI signal is missing.

   Solution: Checking for the root cause and waiting for MIS to fix the system, and resending the signal.

3. Problem: MRB error, transaction RAW to MRB, at CURRENT PN and NEW PART wrong use of Kitting PN

   Solution: Any transaction that occurs at RAW to MRB must use CUST PN. Do system modification and on monitoring.

4. Problem: Rework unit cannot be scanned and sending out EDI856P, due to data conflict with historical records.

   Solution: Manually modify the system and release the trigger. Process will continually change.

5. Problem: Not able to receive Performa invoice for shipment within one hour. There is no error message feedback suspect WD system issue.

   Solution: Mail connection problem, but didn't receive invoice on time

6. Problem: Abnormal ORT transaction found internally before sending it to the customer, error is: ORT to RAW, but dedict01 shows ORT location.

   Solution: Found out immediately corrected and confirmed. In the future correct process will be: RAW to ORT; ORT to FG, if defect find ORT to RAW.

7. Problem: ORT variance has been found from Seagate report, 38 units need to move into ORT, and 104 units need move out from ORT to FG.

   Solution: Issue caused by old ORT unit without proper transaction process, solution is manually generating EDI867 to Seagate for the correction.

8. Problem: The Pre NPI unit SN that was provided to Customers was wrong for 7 units, and is under verification.

   Solution: MIS already found out last record, NPI needs to check the physical part to match with the System and resubmit it to the customer.

9. Problem: Customer complains about the pre NPI unit pending issue, since at the first time NPI provides the wrong information to the customers. The information

provided to the Planning and MIS also not match with the information they provide to customers.

Solution: Sort out the wrong SNs and verify with the NPI teams. Resent EDI for transaction immediately. In the future no off line work is allow and SN provided to the customer must be correct.

10. Problem: HDD inventory discrepancy between ABC Company and Seagate system is caused by two reasons as 1. In proper transaction, EDI been sent out but server of Seagate doesn't upload. 2. Old unit on hand at CCET side didn't do proper transaction.

    Solution: Sort out the effected SNs, and manually generate corrective EDI file for inventory correction.

These issues that occur in the company's pilot stage during a short period to pay attention to, therefore it has more limitation.

4.3 Investment Analysis

Investment could help enterprise through operations to improve their business and get more benefits from investing. There are so many kinds of investment that apply in all business fields, and each one has their own roles and effects. Likewise, investment could bring positive effects and also negative effects. Therefore, when the company needs to invest they have to analyze if the investment operation is valuable or not to help them make a decision. Generally, the company will calculate carefully NPV, IRR and Payback Period for investment.

4.3.1 Benefit of Implementation EDI and **Barcode** System

Chapter I had mentioned, the current status of ABC Company needs more operators to support soaring demand, but it will increase cost on operator salary and impact the company's cash flow. Demand is uncertain, sometimes it will be high and sometime it will be low. Faced this with problem, the company decides to implement EDI and Barcode system to solve this issue to reduce manpower costs and improve the process. That means the benefit of implementation EDI and Barcode systems occur from the

present sorting manpower cost per year. Table 1.1 indicates that the present the average daily demand is 10,000. Currently the Company has 19 employees to do sorting and each person salary is 11,000 baht per month. It shows clearly, that these 19 employees only used to do the sorting operation. They needn't to anything else, such as recording and typing in the computer. Record work will be done by staff. So the total sorting manpower cost is 209,000 baths per month. After implementing the systems will be instead of automation absolutely, but other apartments and staffs will never change. That means just these 19 employees cost impact on firm's benefit for implementation new systems. Therefore according to present the situation, this 19 employees' total salary of each year will be recognized as company implementation benefits. The benefit of implementation of EDI and Barcode systems as:

The benefit per year = manpower cost per month * Number of employees *12 months.
The benefit per year = 11,000 baht/ month * 19 employees * 12 months
= 2,508,000 baht/ year

4.3.2 Expense of Implementation EDI and **Barcode** system

Implementation of EDI and Barcode systems must invest on software, hardware, consultancy, training, maintenance, and any other expenses. These expenses totally account as investment cost for implementation. This section indicates EDI and Barcode system's every cost including fixed cost and variable cost. This data is come from ABC Company's financial Data. Implemented of Barcode and EDI systems should be adopted with existing ERP systems, so for Barcode system of software, can direct use ERP software as software platforms only necessary to adjust the system structure. Using systems need maintenance, review and adjust system timely. When software has problem it should be reviewed and maintenance, moreover if there is a new system join, the system structure needs to revise and rebuild for fix all systems. Generally these costs are put into software maintenance costs. If the hardware has a problem and cannot be repaired, it will be changed. Normally Hardware like barcode scanner, barcode server, barcode printer and EDI hardware needs at least 5 years. Software usually in needs use 5 to 10 years. Table 4.1 and Table 4.2 shows the fixed costs and variable costs as below on the next page:

Table 4.1 Fixed Costs of Implementation

Items	Cost
Barcode Scanner (10 units: 30,720 baht/unit)	307,200 Baht
Barcode Server (3 units: 69,120 baht/ unit)	207,360 Baht
Barcode Printer (1 unit: 68,160 baht/ unit)	68,160 Baht
EDI Software	523,312 Baht
Barcode Software	239,040 Baht
Consultancy (Barcode & EDI)	314,000 Baht
Education (EDI)	188,400 Baht
Miscellaneous Expense	157,000 Baht
Total Fixed Cost	2,004,472 Baht

Source: Company Data 2012

Since the Barcode system operation is not difficult and software servers offer some service staff training does not need to pay extra, therefore Education fee is not include barcode part. Education -is user training course usually take 2 days usually and the costs is around 15,700 Baht per person. Miscellaneous Expense in the first year is involved with investigation of EDI through seminars, books, magazines etc.

Table 4.2 Variable Costs of Implementation

Items	Cost
Miscellaneous Expense	94,200 Baht
Communication	94,200 Baht
Software Maintenance	157,000 Baht
EDI Service	1,570,000Baht
Total Variable Cost	1,915,400 Baht

Remark: this table shows ABC Company's annual cost

Source: Company data 2012

Some costs need to be identified respectively as: Consultancy usually occurs in the developing stage, all cost related with system consultancy is counted as consultancy

expense. Miscellaneous Expense involved with investigation EDI and Barcode systems through seminars, books and magazines, and some infrequent penny utilities expenses such as barcode print paper, ink cost and so on. Suppliers and customers use the same standard code label to scan, so ABC Company does no need to design new labels, re-label excepted label damaged or label error. Thus this cost is penny cost and is counted as miscellaneous expense. Software Maintenance has corrective maintenance, adaptive maintenance, perfective maintenance and preventative maintenance. EDI service function is translation, communication, management and coordination. The EDI application layer provides the documents information translated into standard EDI documents then transferred to the EDI switching system. EDI service expense has the greatest variance, usually includes the service provider's own network costs, log on charge, registration costs, data translation and processing costs, data storage cost and technical supporting costs. All data are come from the ABC Company's documents.

4.3.3 Calculation

In the previous section it was mentioned evaluated investment to be valuable or not should be calculate its Net Present Value (NPV), Internal Return Rate (IRR) and Payback Period to determine. In finance, NPV of a time series of cash flow both incoming and outgoing, it is defined as the sum of the present values of individual cash flow of the same entity.

NPV is an indicator of how much value an investment adds to the firm. Usually it includes three situations. (1) NPV more than 0, means that the investment would add value to the firm; (2) NPV less than 0, it means the investment would subtract value from the firm; (3) NPV equal to 0, means that the investment would neither gain nor lose value for the firm. Accordingly this case the length of the Company investment is 4 years by source of 10%, due to in China Business Taxation indicated all merchandising enterprises' interest rate from 5% to 10%, and accounting departments referenced past operational programs. The same industry benchmarking shows investment usually selects 3-5 years to analyze, and accordingly those information

and combines with firm's real situation. Accounting department decide to use 4 years and 10% for interest rate to analysis by experience.

NPV formula shows below:

$$NPV = \sum_{t=o}^{T} \frac{Nt}{(1+i)^t}$$

Table 4.3 NPV Calculation

Year	Cash Inflow	Cash Outflow	Net Profit	PV (10%)
1	2,508,000 Baht	3,919,872 Baht	-1,411,872 Baht	-1,283,520 Baht
2	2,508,000 Baht	1,915,400 Baht	592,600 Baht	489,752 Baht
3	2,508,000 Baht	1,915,400 Baht	592,600 Baht	445,229 Baht
4	2,508,000Baht	1,915,400 Baht	592,600 Baht	404,754 Baht
NPV				56,215 Baht

Table 4.3 achieves NPV which is positive which means the investment would add value to the ABC Company. This research current issues and situation force the implementation of EDI systems to solve the problem. Implementation of EDI could bring more benefits in future such as helping the company improve its competitive position, closer relationship with all trading partners, ability to broaden trading horizons and so **on.** It not only reduces sorting manpower costs and solve current problems. The detail benefits come from the implementation of the prospered system that could be summarized as intra-organizational benefits and inter-organizational benefits. Intra-organizational benefits have four aspects: 1. Costs Benefits includes reducing paperwork, reducing document processing costs, reducing manpower, reducing inventory also inventory costs and increase efficiency. 2. Time Benefits includes reducing processes cycle time, eliminating or reducing data re-entry, improving timely availability of product/service. 3. Information Management Benefits are improving planning, monitoring and control, increasing traceability, increasing information accessibility and timeliness, increasing document accuracy. 4. Organizational Benefits contain increasing effectiveness, improving intra-firm

business processes, maintaining or gaining competitive advantage and improving customer service. Inter-organizational benefits such as enhance coordination between trading partners, establishing long lasting trading relationships, improving and enforcing internal processed and policies, reducing suppliers base, leading to vertical integration and added value through supply chain. The company use saves 19 employees' manpower cost who do sorting operation only and no impact with other operational activities as this project evaluation benefits, so that the results of NPV is small. It is brings more benefits from implementation of the prospered system.

IRR is a rate of return used in capital budgeting to measure and compare the profitability of investments. Because the IRR is a rate quantity, it is an indicator of efficiency, quality, or yield of an investment. It is contact with NPV. IRR has many formulas, in the research will adopt IRR Excel calculation is used to calculated IRR. After Excel formula is used mode will use the IRR to check if the NPV is equal to 0.

IRR Excel Formula: IRR (sum of net, 0.67)

IRR = 12.4715 %

Table 4.4 IRR Calculation Data

Year	Cash Inflow	Cash Outflow	Net Profit
1	2,508,000 Baht	3,919,872 Baht	-1,411,872 Baht
2	2,508,000 Baht	1,915,400 Baht	592,600 Baht
3	2,508,000 Baht	1,915,400 Baht	592,600 Baht
4	2,508,000Baht	1,915,400 Baht	592,600 Baht

NPV **Double Check:**

Table 4.5 IRR **Calculation**

Year	Cash Inflow	Cash Outflow	Net Profit	PV (13.7689%)
1	2,508,000 Baht	3,919,872 Baht	-1,411,872 Baht	-1,255,315 Baht
2	2,508,000 Baht	1,915,400 Baht	592,600 Baht	468,465 Baht
3	2,508,000 Baht	1,915,400 Baht	592,600 Baht	416,518 Baht
4	2,508,000Baht	1,915,400 Baht	592,600 Baht	370,332 Baht
NPV				**0** Baht

Table 4.5 indicates that when set the capital rate is set at 12.4715 % for NPV to check NPV value, the NPV equals to 0, that means IRR equal to 12.4715 % is could accept **by** ABC Company.

Payback Period means the period from project invested date to account until the total original investment cost will be repaid by net profit of the project. The time value of money is not taken into account. Payback period intuitively measures how long something takes to pay for itself. All else being equal, shorter period is preferable to longer period.

Table 4.6 Payback Period Calculation Data

Year	Cash Inflow	Cash Outflow	Net Profit	Cumulative
1	2,508,000 Baht	3,919,872 Baht	-1,411,872 Baht	-1,411,872 Baht
2	2,508,000 Baht	1,915,400 Baht	592,600 Baht	-819,272 Baht
3	2,508,000 Baht	1,915,400 Baht	592,600 Baht	-226,672 Baht
4	2,508,000 Baht	1,915,400 Baht	592,600 Baht	365,928 Baht

The Payback period formula is shows as below:

Payback Period = (the first year of positive cumulative net profit – 1) + the value of last year of negative cumulative net profit' / the value of first year of positive net profit

Payback Period = (4-1) +1-226,6721/ 592,600 = 3.38

= 3 + 0.38 * 12 = 3 years and 5 months

4.4 Results of Implementation of EDI and Barcode System

After implementation of EDI and Barcode systems, ABC Company will gain more benefits by using new systems. While new systems can bring positive effects to the company there are also negative effects. This section will be discussed these affecting factors.

4.4.1 Direct and Indirect Effects the New Systems

Standing in the ABC Company's position, the benefit of the enterprise obtained can be divided into direct benefits and indirect benefits. Direct benefit can be reflected in saving, for instance time saving, manpower cost saving, paper cost saving, reducing stock and reducing information transaction costs. The indirect benefits are mainly improving enterprise advantages, improving customer satisfaction, better management information sharing, offering better supply chain management to make the firm express competitive advantages and avoid disadvantages.

Direct benefits include: (1) saving massage processing cost. EDI is a paperless trading, so it can reduce paper consume and reduce paper stock, depending on the volume of trading transaction; (2) saving manpower cost. When using electronic trading instead of paper trading, lots of staff will be replaced; (3) Saving inventory and space, reducing inventory is a typical use of EDI and Barcode systems. After implementation the trading cycle time decreases and safety stock level will be decreased, thus space will be saved; (4) Saving time value, Difference times of payment will help firm return capital timely; (5) Improve working efficiency in order to improve customer service level.

Indirect benefit: Indirect benefits are impact of EDI adoption on business practices and relationships of an organization. Implementation of EDI could reduce the whole logistics process cost. Five aspects show more impact for the company. There are

strategic: improve national efficiency; Economic: reduce costs to industry, government, and nation; Competitive: improve competitive position; Trade: closer relationship with trading partners; Development: ability to broaden trading horizons.

Larger firms have lower transaction costs, when multiplied by many thousands of such typical business documents as purchase orders and invoices. These savings alone can be enormous. More accurate data means that the entire supply chain is more efficient. Some estimates suggest that EDI can result in 30% faster delivery time for customers. Automating paper-based tasks frees staff to concentrate on higher-value tasks. It provides them with the tools to be more productive. The prompt processing of accurate business documents leads to less re-working of orders, fewer stock outs and fewer cancelled orders. Buyer can take full advantage of better payment terms and discounts. Sellers benefit from improved cash flow and reduce order-to-cash cycle. It shortens the order processing and delivery time and organizations can reduce their inventory level.

Enable real-time visibility into transaction status. This in turn, enables faster decision making and improve responsiveness to changing customer and market demands, and allows businesses to adopt a demand-driven business model rather than supply-driven. Shortens lead time for product enhancements and new product delivery is found. It helps to enter to new territories and markets. EDI provides a common business language that facilitates business partner on boarding anywhere in the world. EDI promotes corporate social responsibility and sustainability by replacing paper-based process with electronic alternatives. This will save money and reduce CO2 the environment.

4.4.2 Negative Effects of Implementation of the New Systems

Implementation EDI needs lots of capital investment. It will impact company's cash flow and turnover. It is not suitable for small enterprises and single firms since EDI systems should cooperate with trading partners to show its effects. When the firms implement EDI system should combine existing systems and EDI to make EDI fit company's processes and bring more benefits, **but** it is difficult to design a new

process mapping. More time on research is spent and, discussion with the related partner increase. Using EDI make it necessary set up standard format of transaction information. It needs to include all trading partner's format and get a unique standard to transmit information to each other. Since each trading partner has their own format, the system has no complete format to match each member. EDI and Barcode systems are automatic that means manual handling will be replaced, and a lot of manpower will lose their jobs.

CHAPTER V

SUMMARY FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

This Chapter describes the conclusions and recommendations of future research. Firstly, the summary of the findings shows results of this research. Secondly, the conclusion represents an overview of the research. Thirdly, give the managerial implications of firm and recommendations. Finally, the recommendations for future researches are suggestion.

5.1 Summary of the Findings

This research found that implementation EDI and Barcode systems could help the ABC Company solve the problem of excessive demand in labor costs increase. Through implementation of new systems ABC Company can save a total of 19 staffs' salary and enhance effectiveness of company production process which makes transaction time reduce and improve. Moreover, a new proposed production process is developed, and results analyzed by using Excel worksheets. The summary of key improvements in this research is as follows:

1. Currently, 19 staff who work on sorting will be replaced by the new production process because use of EDI and Barcode systems have automatic operations. Therefore some of these 19 staffs' costs will be saved by implementation of the new systems. This 19 staff do manual sorting only and no impact on any other person or operational activities. Since their labor salary is 11,000 baht per month, 19 labors will save 209,000 baht per month and 2,508,000 baht each year. This cost is a real saving for current situation because this 19 manpower are used to do current sorting.
2. Implementation of EDI needs to focus on some critical factors such as top management support. It is the most important factor to success of implement EDI. Management decides this program is to proceed because investing on EDI. The

project teams, it should prepare to conduct it by their design planning In the whole implementation process is usually divide into two parts which are preparing and management. During the preparation stage business applications are enable to use **EDI,** translating transactions into EDI standard messages, forming a network connection to trading partners via value-added networks or directly, providing consistent management and auditing between applications by trading links, performing service validation tests are prepared. The management stage, requires to initial drawing up of trading partner profiles, checking the system is working, regular archiving of transactions, inspecting error logs and changing passwords, on-demand updating of trading profiles, restoring transactions, stopping/starting EDI link to VAN or partners.

3. Excel calculations are use to check this investment is valuable by real data collection from ABC Company real practice to calculate net present value, internal return rate and payback period of the investment. The financial results are given below:

Table 5.1 Financial Index Result

NPV	56,215 Baht
IRR	12.4715 %
Payback Period	3.38 years

After calculating NPV, IRR and Payback Period, the results indicated implementation of the new systems is valuable for operation of the firm. It will be accepted. While the figure looks small, but in the long run, the new system not just help the company improve its processes and reduce manpower cost but also brings more indirect benefits for the company in the future, such as get more competitive advantage to keep competitive station, more opportunity to developing their business process and creating good environment for supply chain. This benefit is many times that of invested costs.

4. After implementation of the new systems there is improve information accuracy and reduce of trading cycle time. All data can be transmitted to trading partners

and feedback is useful to review and adjust the. process. Improve national efficiency; Economic: reduce costs to industry, government, and nation; Improve competitive position; Closer relationship with trading partners; Development: ability to broaden trading horizons. These benefits could help the company enhance management and information tracking and bring more opportunities in the future development.

5.2 Conclusions

In 2011, Shenzhen ABC Company Technology Co. Ltd. faced a problem which because of flooding in Thailand. Customers requested and suppliers had to deal with a crisis. Demand increased, and sorting HDDs become a big problem to company. After comparison of four alternatives, the firm decided to implementation EDI and Barcode systems to solve this problem.

In this paper, existing process mapping will be analyzed in order to improve the company production process and designed for new process mapping. All relevant data such as benefits, expenses, HDD information, logistics information needs to be collected and analyzed for new production process design. The new production process was developed in order to solve a crisis problem and improve company performance.

During this research, two methods: strategy growth model and EDI implementation framework are use as a guidance for ABC Company is current situation for design new business process help solve problem and improve production process.

The results of the existing process mapping were compared to results of new proposed process mapping for clarifying the improvement, especially to indicate the valuable of the implementation of the new systems. According to objectives of this research, the results can solve company's problem and improve production process of ABC Company. New system could help the company save massage processing cost since EDI is a paperless trading transaction. Saving manpower costs because of automatic

trading instead of manually trading is useful. Saving inventory costs and space, could help save time by quick responses. Except these direct benefits still could gain more indirect benefit like improve national efficiency, reducing costs to industry, government and nation, and improving competitive position, closer relationship with trading partners and ability to broaden trading horizons can be gained. The indirect benefits are significance compares to the current direct benefit. Implementation new of system's practical is significance is not only reduces current 19 manpower costs, it is could bring more development opportunities for the company in order to improve performance in the future.

5.3 Managerial Implications and Recommendations for the Firm

The research was done in order to solve the company's current problem by implementation EDI and barcode system. This research needs re-organization and changing processes for business across regions. According to two models from the previous study it needs to combine with current company's situation. It selected only relevant information of issues such as HDD information, logistics information, finished goods information and shipping information. Demand and crisis are uncertainly and variance, EDI and Barcode systems can be use for dealing with massage processes, reducing costs and improving effectiveness. However, the finding of this study varies from the previous study mentioned in the literature in the following ways:

1. Process of strategy formulation and business strategy of implementation of EDI. The stage of growth model explains that successful implementation of strategic information system is based on the process of strategic formulation, which is embedded into a business strategy that includes socio-elements. It include acquisition of hardware and software, IT audit find out and meet the user needs, environment scanning and opportunity seeking and maintaining comparative strategic advantage monitor future interactive planning.
2. Before implementation of EDI systems the barrier and perceived benefits have some points that are different from after implementation of EDI. Successful implementation of the EDI needs construct a framework to adoption EDI.

From the managerial standpoint, finds of this study could benefit various parties like the whole supply chain. Implementation steps and all related details could apply to the results as the company supports ideas on could be achieved when EDI is what implement in the business process integration. The company could be aware of the important business processes aspects and support these factors through their ways in order to achieve a better performance. At the same times, the company should focus on the whole trading process and each trading partner's profile to design and modify the new model.

Implementation of EDI systems is costly. It present, the company only uses EDI systems combined with the existing systems to reduce manual errors, improve working efficiency, reduce labor and cycle time and using paperless trading, but if want to produce the best possible results of EDI, it should be from the internal optimization to applied EDI system, and utilized in production, service, sales and others parts. Make tight relationship with each trading partner to create seamless business to offer the best environment for supply chain management. Focus on the entire supply chain, and every member of trading business.

Enable real-time visibility into transaction status. This in turn, will enable faster decision making and improve responsiveness to changing customer and market demands, and allows business to adopt a demand-driven business model rather than supply-driven. Shorten lead time for product enhancement and new product delivery. Streamlines individual be ability to enter into new territories and markets. EDI provides a common business language that facilitates business partners on boarding anywhere in the world. Promote corporate social responsibility and sustainability by replacing paper-based process with electronic alternatives. This both will both save money and reduce CO2 to environment.

5.4 Recommendation for Future Research

In research supports all steps of how to implementation EDI and Barcode systems, it can use for future research and reference. But it focuses on ABC Company process mapping. Future research should connect with their real practice to implement EDI. The factors affecting success or failure of EDI and Barcode system implementation depend on each company status including their internal process management and their trading partners. Further study may discover more appropriate plans that are suitable to changing business environment and improving company performance.

This research aimed to improve the production process by implementation of EDI and barcode systems. In the future, could study other systems or strategies to solve more problems and improve process performance. This research was developed and analyzed based on Excel worksheet in which it is required manually to type in data and information. Other software or programs may be adopted more appropriate to business.

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