PROCESS IMPROVEMENT PARKING AREA FOR VEHICLE EXPORT BUSINESS

By

CHATCHAWAN TRAkoonsitthisri

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

August 2016
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A Final of the Six-Credit Course SCM 7203 Graduate Project

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AUGUST 2016
Declaration of Authorship Form

I, Chatchawan Trakoonsitthisri, declare that this project and the work presented in it are my own and have been generated by me as the result of my own original research.

PROCESS IMPROVEMENT PARKING AREA FOR VEHICLE EXPORT BUSINESS

I confirm that:

1. This work was done wholly or mainly while in candidature for the M.Sc. degree at this University;

2. Where any part of this project has previously been submitted for a degree or any other qualification at this University or any other institution, this has been clearly stated;

3. Where I have consulted the published work of others, this is always clearly attributed;

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5. I have acknowledged all main sources of help;

6. Where the project is based on work done by myself jointly with others, I have made clear exactly what was done by others and what I have contributed myself;

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Signed ______________________

Date ______________________
Assumption University
Martin de Tours School of Management and Economics
Master of Science Program in Supply Chain Management

Student Name: Chatchawan Trakoonsitthisri
ID: 572-9416

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

Signed
(Dr. Srobol Smutkupt)

Date 16 Aug 16
ACKNOWLEDGEMENT

I would like to extend my special thanks to my advisor, Dr. Srobol Smutkupt, who always guided and supported me both inside and outside the classroom. Without her valuable guidance support and encouragement, this research could not be completed. Her knowledge and experience helped me to do the right way in order to complete this research.

There are many parties who contributed to this project. They gave me the valuable data and information. Hence I would like to thank all ABC Company employees, especially the Product Planning and Supply Chain Logistics Department. They gave me this opportunity to use my knowledge to improve the real operation. Also I would like to thank ABC Company partner, the transportation companies. They provided important information of their real operation and collaboration.

Finally, I would like to express my great appreciation to my colleagues and friends, SCM batch 20 for giving me the spirit and support.

Chatchawan Trakoonsitthisri
Assumption University
August 2016
ABSTRACT

This research was conducted to improve the operation of the parking area for vehicle export and reduce the cost of management fee via implementation of barcode system. Barcode is the one of automated identifications which is powerful technology and applied in various fields. Barcode system could help the organization improve the operation process, reduce manual process, human error and lead time. It can reduce cost of manpower in parking area. The operation will improve accuracy and efficiency.

In this paper, all relevant data such as the current ABC Company information and operation, historical data of cost, company volume and the problem in the operation were collected and analyzed for developing a new operation process to help improve the existing process. To implement the barcode system, ABC Company has to invest in the barcode equipment and software. Not only barcode investment but ABC Company modified the parking area by installing studs bar on the ground. The Net Present Value of the returns for this project shows that the investment is valuable to the organization.

After everything has finished and applied in the operation, the researcher has compared the current operation with the new operation about the process and cost. The results of implementation of the barcode system are not only to solve the existing issue, but also to improve the vehicle export operation process. This project eliminates non-value added activities and enhances the skill of manpower. The communication inside and outside company is easier, accurate and reliable. All concerned parties have responded quickly to deal with the urgent issues. Supply chain in organization is more efficient and effective than before executing this project. After the implementation of the barcode system, the company can reduce costs, gain competitive advantage and collaborate with its partners. These are all the benefits that are significant to the company after the implementation of the barcode system.
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Master of Science in Supply Chain Management

Form signed by Proofreader of the Project

I, A. Mary Bien Catalan, have proofread this project entitled

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and hereby certify that the verbiage, spelling and format are commensurate with the quality of internationally acceptable writing standards for a Master's degree in Supply Chain Management.

Signed

(A. Mary Bien Catalan)

Contact Number / Email address: yeyen_67@yahoo.com

Date: August 19, 2016
CHAPTER I

GENERALITIES OF THE STUDY

This chapter explains the detail and information of the case study in the automotive manufacturer located in Thailand. This chapter includes the background of the study, the current problem of the manufacturer, research objectives, scope of the research, importance of the research and limitation of the research.

1.1 Background of the Research

For the manufacturer side, there are many processes in the production line, raw materials and finished goods, sale and delivery to the customer. Most of the manufacturers have to face the problem inventories. Some businesses have a lot of inventories and small items that are very difficult to control manually. Therefore, barcode system is the alternative, and it is very popular in the business both enterprise and manufacturing. Barcode is a visual representation of data which is scanned and interpreted for the information. Barcode contains the code which works as a tracking technology products and is represented in a sequence of lines or other shapes. Using the barcode in the business inventory can help the business track where the merchandise is located and how many merchandise is available. The worker will know the update of inventory and the location in the warehouse by just keying the code in the system. It can save time in the operation, and inventory will be accurate and minimize the risk of error and human error. There are many advantages to the business but less expensive compared with other tools. That is the reason why barcode is a very popular tool to improve the supply chain for the organization’s efficiency and effectiveness.
1.2 Statement of the Problems

ABC Company is a vehicle manufacturer in Thailand. The headquarters is in Japan and there are many plants in Asia. For ABC Company, there are two plants in Thailand. The first plant is in Samrong, Samutprakran province. The second is in Gateway plant, Chachengsao province. There are two main products of ABC Company which are pickup vehicle and commercial vehicle (truck). ABC Company is a manufacturer, and all completed vehicles are sold to traders. ABC Company does not sell directly to other parties and does not have any dealers both in Thailand and abroad. The products are sold to two trader companies in Thailand. First, trader company takes care of sales and marketing of pickup vehicles and trucks in Thailand. Second, trader company takes care of sales and marketing of pickup vehicles abroad. For the production and assembly process, the business starts with sourcing from overseas and local suppliers in Thailand. For the imported parts, ABC Company trades with some countries through the trader company. Some are traded directly with customer. For the local parts, ABC Company trades directly with the suppliers. ABC Company has warehouse to stock the imported parts. For the local parts, ABC Company uses milk run concept to receive parts from suppliers. The production undergoes a process. Supply parts and materials to the production line, assemble, painting, install the option, quality control and testing until the vehicle is finished. After that, the quality of the vehicle is checked.

At Samrong plant, ABC Company produces only pickup vehicles to sell in domestic market and export to other countries. For domestic market, after the final quality department has confirmed the vehicle quality, it will be transferred to the trader company immediately. It means that ABC Company sells all vehicles to the trader company (Customer). After this, the responsibility is transferred to the customer. The customer's driver drives the vehicles to the car park and wait for the trailer. When the trailer arrives at the plant, the driver can load the vehicles on the trailer and move out from the plant anytime. In case of some defects in product quality, customer can request the quality control department to fix it. For ABC Company side, the process for domestic market is not complicated, less document, no need to stock the vehicle,
and the lead time to transfer the property from seller to buyer is very fast. Also, there is no need to do the customs process.

For export market, there are many steps and processes that are complicated and use long lead time. Long lead time is spent in operation as the vehicle is delivered to the customer at Laemchabang and sold it. Therefore, ABC Company has to hire transportation companies which provide the trailer. Vehicles for export are not sold at the factory, so ABC Company has to park the vehicles in the factory. Now, there are three transportation companies (Company A, Company S and Company C) in contract. Two companies (Company A and Company S) are the main operators and one (Company C) is the back up. Of the two main operators, one of them takes care of managing the operation by checking the vehicle quality, sending engine number, lot number and unit number to the office and drive to the parking area. ABC Company has two shifts (day and night) to deliver the vehicles to the customer at Laemchabang two times per day.

For the daily operation of the export business, after the final quality department has confirmed the vehicle quality, the staff of Company A (managing the operation) checks the quality and appearance of the vehicle, such as scratch, dent, pigment color etc. If the quality standard is acceptable, the staff puts a mark sheet into the vehicle’s console. “Mark Sheet” is used to identify the motor pool area destinations at Laemchabang, which are MPG, MPB, and MPJ. Moreover, the mark sheet is used to identify the sequence of vehicle to each location and the trailer staff will know which vehicles to deliver. After putting the mark sheet in the vehicle, the staff of Company A writes down the engine number (six digits), lot number (three digits) and unit number (three digits) into the paper format (all information is in the vehicle). Finally, the staff drives the vehicle to park at the area that has been set in the factory. In the parking area, the drivers have to park in the line with same destination location. In one line, the drivers have to park seven units of vehicle because one trailer can contain seven units. It is easy for the transportation company to manage the trailer and loading. For example, in one line of the vehicles, seven units will be delivered to
MPB. The driver cannot combine two or three locations in one line. When the time come, the staff of Company A sends the detail paper format to the office of "Production Planning and Supply Chain Logistics Department."
### Figure 1.1: AS-IS Vehicle Export Business Operation Flow

<table>
<thead>
<tr>
<th>PRODUCTION LINE</th>
<th>NIGHT SHIFT</th>
<th>8:00-12:00</th>
<th>12:00-17:00</th>
</tr>
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<tbody>
<tr>
<td>CBU L/Off</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
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<table>
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<th>EXCISE DEPARTMENT</th>
<th>SHIPPING BROKER</th>
<th>CUSTOMS DEPARTMENT</th>
<th>CAR-CARRIER (TRAILER)</th>
<th>CUSTOMER'S YARD MANAGEMENT AT LAEMCHABANG</th>
</tr>
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<tbody>
<tr>
<td>CBU Complete</td>
<td>DO, Issued</td>
<td>PS01-28 Ackn. No.</td>
<td>Send Invoice, XML, PS01-28</td>
<td>Customs Approval</td>
<td>CBU Inspection</td>
<td>DO, Received</td>
</tr>
<tr>
<td></td>
<td>Issue Invoice &amp; PS01-28</td>
<td></td>
<td>Export Entry 0309</td>
<td></td>
<td>CBU Marking</td>
<td>Update into system</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Move CBU to MP/SR</td>
<td>CBU Arrival</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Prepare Trailer</td>
<td>RC by Yard Management</td>
</tr>
</tbody>
</table>

Source: ABC Company

Abbreviation from AS-IS flow

**CBU**: Completely Build Up (Complete vehicle for export or imported from abroad)

**DO**: Delivery order (The order of vehicle sent to the transport company for loading)

**L/Off**: Vehicle completed from production line.

**PS01-28**: The application form for excise tax exemption
Figure 1.1 shows the responsibility of Production Planning and Supply Chain Logistics Department (PSL) to issue delivery order and shipping invoice document for custom clearance procedure. After receiving email from the staff of Company A, the staff of the Production Planning and Supply Chain Logistics Department shares the volume to the trailer transport company. Then, the staff prints out the detail and key the engine number, lot number and unit number in the system one by one to issue delivery order. The purpose is to cut out the vehicle stock and download the vehicles that are ready for delivery to the customer into the excel file format. When the staff downloads the raw data into excel the file, the data are rearranged into the standard format: insert header, do the table, delete some data and share the volume to the trailer transport company. The delivery order is sent via email to the transportation company, customer, and customer's yard management team. Later, the staff does the process in the system again. After finishing the process in the system, the staff downloads and prints out the shipping invoice document. When the shipping invoice and excise exemption are done, the staff scans and sends email to the customs broker for customs clearance process. Around 30 minutes, the customs broker sends the draft export entry back to Production Planning and Supply Chain logistics Department. Then, the staff checks and confirms the details and the privilege. When the export entry is ready, the staff sends the document to the transportation company. The transport staff prints out the export entry and prepares to the drivers. This time, the transportation company delivers the vehicles to Laemchabang. The time to deliver the vehicles from ABC Company to Laemchabang port is around two to three hours, depending on the traffic congestion.

There are two main problems in the vehicle export operation. The first is human error in the operation. Second is ABC Company cannot track the vehicle in the parking area that cause waste of time to find it.

For the human error in the operation, ABC Company has a system to control raw material, finished goods in and out and all process in the production line. But, for the export vehicle business, after the vehicle is checked completely at the final quality shop, there is no control system in the parking area. Transportation company has to
drive the vehicles to the parking area in an available space. No tracking system, everything at the parking area is manual. There are many processes for the manual both to office side and factory side (yard management at parking area). For the factory side, staff of Company A has to write down the detail of engine number, lot number and unit number. The situation which the staff writes down the wrong details always happens. For example

Table 1.1: Human Error

<table>
<thead>
<tr>
<th></th>
<th>ENGINE NO.</th>
<th>LOT NO.</th>
<th>UNIT NO.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right details in the system</td>
<td>HT1234</td>
<td>011</td>
<td>012</td>
</tr>
<tr>
<td>Human error</td>
<td>HT1243</td>
<td>011</td>
<td>012</td>
</tr>
</tbody>
</table>

Source: Author

Table 1.1 shows the human error from factory and office side. The office staff receives the wrong detail (Human error) that is Engine no. HT1243. Case 1; the office staff inputs this engine number in the system to issue the delivery order and shipping invoice document. If the system has this engine number (HT1243), the office staff chooses it because it is taken to be correct. The document does not match with the vehicle. Case 2; in the case of no exact engine number, the system does not show the pop up indicating whether the engine is available or not. But, the system will show other engine numbers which are nearby or adjacent. For example, the office staff inputs engine no. HT1243 the system will show engine no. HT1244 or HT1245. If the office staff does not notice, he or she will select the wrong one in the system. Case 3; if the office staff inputs the engine number in the system and notices that there is something wrong, the office staff calls the transportation staff and ask to check it. The only way to check is to go to the row where the vehicles are and see the details inside the vehicles. After getting the correct detail, he or she will inform office staff again. This matter takes time around 15-30 minutes. So, the process is delayed and the lead time to deliver the vehicles to the customer is delayed also. Sometimes, the factory side (managing the operation at parking area) provides the right information, but the
office side inputs the wrong data in the system. So, the office staff has to ask the transportation staff to check and that is waste of time. Documents are very important for export business because they are needed in the government, such as Excise Department, Customs Department, etc. Documents have to be declared to the government sectors and retroact audit around five years. It is a risk to ABC Company to its reputation, penalty fee and termination of the export license, if the details in document mismatch (intentionally or unintentionally), wrong data or fraud.

Second, operation cannot track the vehicle location in parking area. After the transportation staff checks the external appearance, he or she drives the vehicle to the parking area. The responsibility of transportation staff drives the vehicle to the available parking slot. If the office staff asks for checking, they have to find the vehicle in the yard by walking in the row. That is waste of time. Sometimes, office staff has to wait around 15-30 minutes for the detail.

This study aimed to answer the research question: "How can ABC Company eliminate human error in the operation and improve the overall process in the parking area?"

1.3 Research Objectives

ABC Company had to manage and eliminate waste from the process such as eliminating long lead time, human error and inefficient worker in the process. The ABC Company could develop, improve and create productivity of supply chain as follows:

1.3.1 To improve the process of issuing delivery order to transportation company by reducing lead time. Transportation Company can send the accurate detail of engine number, lot number and unit number. Office side can input the correct engine number in the system. ABC Company can deliver the right vehicle and match with the right document to the customer at Laemchabang port.
1.3.2 To eliminate the human error both from office and manufacturer sides by using the barcode scanning rather than the worker’s handwriting. All documents have to be accurate at 100 per cent.

1.3.3 To reduce the manpower fee in the parking area because there is no need to hire a worker at yard. Barcode system can track the vehicle’s location in the parking area. Both the office side and factory side can track the vehicle’s location real-time data. When the customer requests for an urgent vehicle order, it is easy to find the location and deliver to the customer on time.

1.3.4 To promote an accurate report to the Customs department of Thailand. To audit the yearly report print out from the system is trustworthy than the manual yearly report.

For all these problems, the barcode system is the alternative to eliminate and solve the problems in the process. ABC Company already has the system but there is no tool to control it; therefore, to invest in barcode system is cheaper than the other tools. Implementation of barcode system can eliminate long lead time when issuing the delivery order and invoice process, human error when preparing the document and save the cost of manpower because it can track the location in the parking area.

1.4 Scope of the Research

This project focused on improving the vehicle export business by using the barcoding system in the process at ABC Company parking area. ABC Company expected that the barcode system would help to track the vehicle location and reduce manual process. This study had major scope as follows:

1.4.1 Identify the major problem in the operation by collecting internal data, interview all concerned parties and survey.

1.4.2 Modify ABC Company’s main system to support the yard management software by providing barcode system and equipment support in the vehicle export business.

1.4.3 Reduce manpower in the operation.
1.5 Significances of the Research

This project emphasized on barcode system. Barcode is an automated identification technology. Automated identification is a powerful technology and is a device that captures, transfers, tracks and aggregates data. Xie and Sarathchandra (2015) stated that the automated identification is an inventory management. It helps the supply chain efficiently and reduces the situation intensive of labor. After applying the barcode in the operation, it reduces the manual operation and lead time, improves accuracy and makes the process more efficient. Barcode system helps the organization to manage inventory, reduce lead time when issuing the document and human errors in the operation. Hiring more staff cannot solve some problems in the organization. This research explained how to implement the barcode system in the organization.

1.6 Limitation of the Research

This project was based on the case study of ABC Company with emphasis on the parking area for vehicle export business. The research emphasized on the completion of the vehicle from the production line until its delivery to the customer at Laemchabang. The research did not cover all the causes of the problems in the organization. All data and information came from the real problem and situation. The implementation of the barcode system in ABC Company was the best solution at that time. However, the solution by using the barcode system may be not suitable for the other companies as each company has different process, condition, policy and industry.

1.7 Definition of Terms

**Barcode System**  
A powerful automatic identification technique by using the set of bar and space to represent the data and information (Lavery, 1990).

**Customs Clearance**  
The document permission to obtain that the National Customs Authority grants to imported goods so that
they can enter the country or to exported goods to be taken out of the country. It entails tedious border checks, irritating delays and complicated form filling (Appels & de Swielande, 1998).

**Free Zone**
The secure areas under the Customs Department. The import tax and duty is not required on foreign products. The domestic products enter to the free zone are considered as an export activity (Cornwell, 1989).

**Logistics Service Provider**
An organization that provides and sourcing the logistics activities in a wide variety to the customer. It is not only for transportation function but also for warehouse management (Selviaridis & Spring, 2007).
CHAPTER II
REVIEW OF RELATED LITERATURE

This chapter discusses about the theories to improve the vehicles parking area in the factory and delivery to the customer at Laemchabang Free Zone (Export Business). The main research focused on the automated identification which helps the operation in car parking area effectively and efficiently. The scope of this chapter is the literature including yard management, types of automated identification and steps to prepare and implement the barcode system.

2.1 Yard Management

Ford Motor Company’s Michigan Track Plant (MTP) is the first automotive company that has implemented the yard management system by using a system called WhereSoft Vehicle. The software system consists of many functions which are the location processor, wireless tag equipment and the antenna equipment. The software application provides the visibility to the manufacturer starting from the final assembly to the customs and finally, shipping to the customer. Thousands of vehicles are controlled in the vehicle’s location because of the available space as parking lots. Ford Motor is able to reduce the cost of management fee within this area because of the reduction of labor in the yard operation. The company is able to identify the vehicle in the yard and deliver the vehicle to the customer with shorter lead time. Therefore, it has increased the efficiency in the supply chain because of less hours spent to find the vehicle in the yard. The result is, Ford Motor is able to save million of dollars from this area business (Clara, 2000).

Kia, Shayan and Ghotb (2000) indicated that the case study on “port congestion in Australia” found that the current capacity to accommodate containers in port terminal operation in Australia is not enough for the customer demand by year 2006-2007. It should have expanded or the excess containers should have been taken away from the
port terminal. The main reason is that the container handling equipment is not enough to ship to shore within the port terminal, the volume of container in year / space area in the port terminal, the height of stacked container, the high ratio of import container compared with the export and the last one the ratio between empty and full container. The port terminal tried to solve this situation by using the electronic commerce (EC) to facilitate the data and/or information exchange transaction between the enterprise and individual customer. It makes the transaction flow faster and does not waste the time. The electronic commerce helps the port terminal increase its operating efficiency in the port terminal such as faster discharge and loading container, increase productivity and faster turnaround of containers, easy to control and monitor the container storage (space increasing), accurate information and high level of data and/or information to every party in this supply chain of transportation area.

Macklin (2002) stated that the case study conducted by the Associated Food Stores of Salt Lake City, Utah. The group has used the distribution system to control the yard inventory and equipment utilization. The system that used has made the organization’s supply chain efficient and the labor has been utilized. The 127 temporary workers have been eliminated from this area and only five persons have been designated as permanent workers. The real time technology is able to check the location of inventory immediately and has helped the Associated Food Stores reduce the temporary work from the yard and warehouse. The group has used the radio frequency identification and barcode as tools to know and identify every inventory in the yard, no need to walk into the yard and find the inventory one by one. Finally, the inventory report has one hundred percent accuracy of data and/or information.

McCrea (2010) indicated that yard information system helps the manufacturer or organization manage the real time information. It is not only visibility that the organization gets but also it is saves time and money in the operation. It helps to improve the supply process and save time in the operation.
2.2 Stockyard Layout Planning

Dawood and Marasini (2001) stated that the precast concrete product industry manage the stockyard layout planning that helps to ensure the time to supply the product to the customers. It helps the precast concrete product industry manage the stock layout and reduce the cost of delivery by 5-10 percent. This industry uses the concept of make-to-stock because the sales volume is high in the summer and low in the winter. The precast concrete product industry use the computerized system which helps to manage the stockyard layout such as computerized relative allocation of facilities (CRAFT) (Armour & Buffa, 1963), computerized relationship layout planning (CORELAP) (Lee & Moore, 1967) and automated layout design program (ALDEP) (Seehof & Evans, 1967). Moreover, the system helps to utilize the stockyard space, the number of order, the point of location and quantity of product. These things affect the stockyard layout.

2.3 Automated Identification

McFarlane and Sheffi (2003) indicated that automated identification (Auto ID) is an application that provides the data and/or information to the user. It identifies the physical items in the supply chain. The user tracks the real time in the real time data and/or information in each item. Automated identification is very useful in terms of supply chain operation because it tracks and traces the inventory, inventory management, implement the operation improvement. Automated identification is used to do the re-engineering of the supply chain manufacturer and/or organization by reducing the limitation and constraint in the supply chain. Automated identification technology can help organization to improve supply chain by using product identity code, radio frequency identification (RFID), tag and reader and barcode system.

Xie and Sarathchandra (2015) stated that many organizations still use the manual tracking to manage their inventory. The manual uses the long lead time which is time consuming because a lot of inventories and data that have to check. Finally, human error occurs. The automated inventory management helps the supply chain efficiently
and reduce the situation of “Labor-intensive”. There are many types of common automated identifications, such as barcode, radio frequency identification, biometrics, magnetic strips and optical character recognition. Shepard (2005) indicated that the famous automated identification technology is barcode. Barcode technology is not expensive, easy to use, and used worldwide.

Finch and Marsh (1997) indicated that automated identification is a low cost method for tracking the localized data and/or information. There are many reasons why many organizations use automated identification. The reasons are few inventory control management and ordering process, safety legislation, portable appliance testing legislation, steal, and identification of the location.

Karkkainen, Ala-Risku, Framling, Collin and Holmstrom (2010) stated that a pilot study was conducted on the implementation of the temporary storage location by using tracking system to control the company’s inventory. They concluded that tracking the location is effective by using the tools which are barcode and radio frequency identification technology. Thus, it reduces the labor in the operation and motivates data transfer between the organizations.

2.3.1 Barcode system
Lavery (1990) mentioned that barcode is a powerful automatic identification and popular in the business world. It can prevent error from the worker. The organization achieves effectiveness, flexibility and practicality. The data and information are more accurate than when done manually by the worker. The organization is able to track the information anytime. Even though the barcode technology is useful, this technology has to use the scan reader closer to the barcode label and the red light has to focus with the barcode label. The shape of package and product may be the obstacle for reading the barcode. If the parts or products are put on the shelves in the warehouse, their barcode labels are difficult to read. Hellstrom and Wiberg (2010) stated that barcode technology is not appropriate for the batch side or a lot of parts and materials. The limitation is that the worker wastes time in scanning the barcode. While worker scans the barcode reader, it may damage and scratch the product.
Harrington, Lambert and Vance (1990) indicated that in the case study conducted on Cincinnati Bell Telephone, the company’s problem about the inventory does not match with the customer’s need. Huge inventories make the company pay the additional cost for the management of the inventory, such as warehouse rental and worker’s salaries operating in the warehouse. The company uses the barcode technology to record the inventory transactions because company believes that if the inventory moves to another location, the transactions of data have to be updated also. The recording of the inventory transactions cannot be done manually by the worker. Company has solved the problem by using the barcode tool to manage the inventory, track the location and record the transaction.

Coyle-Camp (1994) mentioned that many organizations face the problem of not being able to control their asset and inventory. Some assets in the organization have to be insured to cover the risk. Sometimes they pay the insurance charges even though they are not sure whether the assets exist in the company or not. Finally, they have to pay for the insurance charges a lot per year. If the managers do not know how much available have and some have already expired, they cannot control the cost and also the company’s budget. For this case, barcode system can control and track the inventory in the organization, and it is the inexpensive solution.

2.3.2 Radio Frequency Identification
Barjis and Wamba (2010) indicated that Radio Frequency Identification is similar to barcode but RFID does not need to use the red line to see closely the product. RFID uses wireless electromagnetic field to transfer the data and/or information. It uses tag, reader and antennas. RFID is appropriate to the Fast Moving Consumer Goods industry, a retail and warehouse for equipment.

Yusof, Abel, Saman and Rahman (2015) mentioned that the modern library (S.Library) uses RFID application to help the user perform the library transactions, such as returning, borrowing and viewing the customer historical data.
Hellstrom and Wiberg (2010) indicated that Radio Frequency Identification (RFID) is a technology that provides accurate, time efficient and reliable data and/or information to the organization. It is further emphasized that RFID provides many benefits to the organization, such as inventory control, tracking the location, process control, production control and availability, securities, etc. The research has covered the pilot implementation by using RFID in the production line and assembly process in nine stations.

**Figure 2.1: Production and Assembly Processes**

Figure 2.1 shows the process flow in the production line by using RFID technology. Starting with the first station (Injection moulding), until station nine (Loading) and pass the RFID gate. The result from this pilot is, RFID makes the operation inventory control accurate, the error rate has reduced but reliable and the process has improved and efficient. The research also concluded that RFID is appropriate with the batch or lot side, and there is no need to scan the inventory one by one just pass through.

**2.4 Barcode is the best alternative.**

For ABC Company, there are many literatures reviews identified to support that Barcode technology is more appropriate than the other technologies as follows:

2.4.1. Inexpensive technology investment than radio frequency identification and other tools, user friendly and not complicated system (El-Omari & Moselhi, 2009).
2.4.2 ABC Company uses AS400 system as a main system to control. Interface between barcode system and the main computer is easy to operate. The system can stand alone or use multi-device systems (Lavery, 1990).

2.4.3 The weak point of barcode is, using the reader equipment closely with the barcode label, but it does not have an impact with the ABC Company. Every vehicle after its completion from production line has a document that identifies the engine number, lot number, unit number and barcode label. Every vehicle has to pass through receiving area one by one and check the internal and external. So, scanning the barcode in the document is not waste of time (Barjis & Wamba, 2010).

2.5 Preparation of Barcode System

Barcode system consists of hardware and software parts. Before implement this system, the organization has to prepare many things and processes. The organization has to announce the time line to the concerned departments and discuss together to find the solution and impact.

2.5.1 Planning of Barcode

For a successful organization, every department has to have the same goal. If some departments would like to implement the useful activity or project, other or concerned departments have to cooperate and help. Novack, Rinehart and Fawcett (1993) stated that cross function integration is important. All departments in the organization such as purchasing, marketing, production, business operation, etc. have to discuss and talk together. All departments have to think about the organization's benefit. For example, production department is concerned about capacity, but it has also to be concerned about how to move this capacity to the customer. Then, cross functional by brainstorming and summary to propose the project to the top management because the management has to judge and make the project smooth. It cannot avoid that implement the new project, some departments have a lot of job and some do nothing.
2.5.2 Main system

ABC Company uses AS400 as the main system, which stores, links and transfers data and/or information to its affiliated company. Partners of ABC Company can download the parts ordered from the ABC Company system. The customer can track the vehicle status that it has been completed from the production line or not. A lot of data and information are stored in the main system. The users have to know the background of the system. If they do not know, it is difficult to link the barcode software with the main system. Lavery (1990) indicated that the main company system can communicate with the computer, automated identification equipment and software. System network can store, pull and route data.

2.5.3 Yard Management Software

At present, there are many supply chain softwares, such as HULFT7, Oracle yard management, etc. These softwares help the organization manage the inventory or vehicles in the yard. The software which is appropriate to the organization depends on the main system, the function and option, high or low of cost of investment and service fee. Ford Motor Company's Michigan Truck Plant (MTP) uses yard management system called WhereSoft from WhereNet. The result, it reduces cost of manpower and make the supply chain smooth (Clara, 2000). Macklin and Gary (2002) also indicated that the Associated Food Store of Salt Lake City, Utah is using the distribution system from WhereNet to control and track the location of the vehicle in the warehouse and yard.

2.5.4 Application and Cost of the Implementation Barcode system

There are many applications of barcode system. Harrison (1987) mentioned that there are many components of the barcode system which are the label, label printers, menu-cards, barcode reader and data analysis programs. The label is important because it can transfer the information and/or data from the label to the computer system. There are many types of barcodes such as CODE11, CODE39, CODEBAR, UPC SYMBOL, Two of Five, Interleaved Two of Five, Nixdorf and Plessey.
Evans (1983) stated that EAN code is printed on the package of millions of products. The costing is £50 from a one-off master costing. He also indicated that in the future, barcode printing technology will be developed in the shape of inkjet and desktop and low cost laser technology. Barcode will be the cheapest technology, but it is improving its quality, density, volume and reliability.

2.5.5 Evaluation of Barcode System

A study by Huang and Gramopadhye (2016) indicated that health information technology was implemented to reduce the medication error and improve the healthcare quality in the rural hospital. In this study, they used the focus group method to the medical staff by reviewing and investigating the medical process.

i. Observation study setting and design; investigation of the workflow and administration of medication process were made after two months of implementing the system. The data collection was made.

ii. Focus group settings and design; the focus group was used to identify the mistake and failure in the work standard. Interview with the medical staff by asking the important question was conducted.

2.6 Implementation of Barcode System

Frusman and Wibisono (2013) mentioned about the case study on PT Latinusa Tbk. This company is in Indonesia. The business produces the tinplate material. Tinplate is the raw material of milk can, paint cans, batteries and the other package material. This company has faced the problem about how to manage the inventory in the warehouse. In the warehouse the staff does not know the inventory location. They take a long time to find it. The data are not accurate. Therefore, the company likes to use barcode system to make the process efficient and improve the company’s process. The research shows that barcode system has helped the organization save time in the operation in warehouse management, has taken quality data, has increased customer satisfaction and has improved the company image. PT Latinusa Tbk has set the steps to implement the barcode as follows:
2.6.1 Identify business solution alternatives: There are many alternatives to improve.

i. Set working instruction issues and request its workers to do the job according to working instructions.

ii. Human resource issues: recruit new employee or do the job rotation in the department or across department.

iii. Information technology issues: use barcode system in the operation to reduce human error and make the supply chain efficient.

2.6.2 Business solution analysis: select the best solution to improve the warehouse management by

i. Evaluating the worker’s job according to the working instructions.

ii. Providing the training to worker on how to control and monitor his or her division.

iii. Hiring new employee to replace the current worker that is more than 45 years old. Replace the new employee in the warehouse operation.

iv. Conducting a job rotation to challenge the worker.

v. Providing barcode system in the operation to reduce human error.

2.6.3 Business process design: The barcode implementation is divided into two main areas. First, improvement of storage management in the warehouse. Second, improvement of shipment activity.

2.6.4. System and technical design

i. Barcode format design: There are two type of barcode. First, 1 dimension which can only hold up to 20 numerical digits. Second, 2 dimension which can hold 7,089 numeric character and 1,817 Kanji characters of information.

ii. Barcode process design: Set the work flow on how the barcode can link with the data in the system

iii. Supporting component: The supporting components are the main system of the company, barcode label, barcode standard, barcode scanner and system operation.
2.7 Chapter Summary

There are many automated identifications at present. However, the barcode technology is not new and high technology compared with radio frequency identification (RFID) or GPS tracking by satellite. Every automated identification has the limitations and advantage and disadvantage. Higher technology comes with a high investment and it is difficult to understand the system. For ABC Company, both advantage and disadvantage of barcode system are appropriate and suitable with the organization as all the literature reviews stated. Therefore, the organizations have to know their background of the business and choose the tool that is suitable. If the organization uses the tool or system appropriately, it will make the business smooth, and it will flow efficiently and effectively.
CHAPTER III
RESEARCH METHODOLOGY

This chapter aims to identify the current problems that cause the inefficiency and ineffectiveness of the supply chain in the organization in the vehicle export business. The methodology for this research contains of four steps which are data collection, data analysis, proposed model, and evaluation. These four steps had helped the organization see the problem clearly, understand the weak points in the process, find the solution, develop better process, and improve the supply chain in the organization. The analysis was based on the data for twelve months from January - December 2015.

3.1 Data Collection

The researcher collected real data from ABC Company. In the company, there are many raw data and information. The data shown in the research are the necessary data for the methodology as follows:

3.1.1 Internal data

Monthly meeting, any records or reports about the problem, and emails from customers complaining about delivery mistake and delayed delivery from January 2015 – December 2015.

3.1.1.1 Export vehicle volume

The researcher collected the data of export volume from year 2010-2015. These are the important data to support why an automated identification is needed. In 2010, ABC has started the export business with a small volume. It means that ABC Company was able to control the process in the yard manually. Now, ABC Company is trying to promote the product to export market and is successful. Then, the vehicle export volume has strongly increased compared with the volume in the past five years. Now, the volume per day is almost four hundred units more which is almost
three times compared with that in the year 2010. So, ABC Company is facing the problem a full of parking area, which leads the production line to stop. Also it is difficult to prevent the human error in the process. Therefore, every step has to be faster, smoother and more accurate.

3.1.1.2 Transportation Manpower and Cost
Currently, there are three transportation companies (Company A, Company S and Company C) that ABC Company is using to deliver the vehicles to Laemchabang. There are two main transportation companies, A and S Companies taking care of the shipment while C Company is a back up. If the two main transportation companies cannot utilize their trailers, ABC Company contacts C Company to support in the delivery of the vehicle to the customer. The researcher checked the contract and quotation agreement of the two main transportation companies with ABC Company from January 2015 – December 2015 as follows:

i. Quotation submitted each company

ii. Number of workers agreed to work for ABC Company operation

iii. Responsibilities of worker in the operation

These details enabled the researcher to know whether the number of workers in the operation is more than necessary or not.

3.1.2 Interview
The researcher had to separate the interview into two sides. First, staff in the office and second, staff in the factory side. There are three persons in the office side. The researcher wanted to make sure about the current process and the problems that always happen. Moreover, the researcher wanted to know whether the current solution is better or not. In addition, the researcher wanted to know whether the operation would improve or not if the company provides a new solution such as automated identification. The interview with all the staff was conducted before and after the implementation of the new solution.
3.1.3 Observation

The researcher observed the operation in the factory. The researcher wanted to know the parking area worker respond and solve the problem when contacted by the office staff. Furthermore, the researcher wanted to know how long does it take for the worker to find the engine number when needed.

3.2 Data Analysis

In this stage, the researcher had to know first the current operation and process. In the past three years, the researcher used to work in this area, but now some process in this operation have been changed. After observing the overall current operation, the researcher found that the process starts from the production line completing the vehicle and ends in the loading of the vehicle on the trailer and deliver to the customer at Laemchabang by the transportation company.
Figure 3.1: As-Is Process Flow in Vehicle Export Business

Source: Author
Figure 3.1 shows the operation starting from the production line completing the vehicle until delivery to the customer. After interviewing the staff of both sides, the researcher found two weak points as follows:

**Point number 1**

*Cause from factory side (Transportation staff error)*

When the transport (Company A) checks the vehicle quality, it has to write down the engine number, lot number and unit number. It takes around three minutes to check the appearance and write down the details. If the transportation staff writes down the wrong detail and sends to the office, the office side eventually issues the wrong data which is waste of time. The office staff requests the transportation company to check the vehicle’s details again. It is waste of time because the transportation staff does not know the location of the vehicle in the yard. Staff has to walk in the roll and see the DD Sheet (identifying engine number, lot number and unit number) in the vehicle. This error happens every day. The office staff tries to be strict and requests the transportation staff to be careful in this process, but it always happens.

*Cause from office side*

After receiving the data from the transportation staff, the office staff has to input the engine, lot and unit number in the system. The office staff said in the interview that sometimes the details received from the transportation staff are correct but the office staff inputs the wrong information. In one day, there are 250-450 vehicles, so the chance to input the wrong vehicle details occur.

**Point number 2**

No matter whether error occurs from the office or factory side, the transportation staff has to check the vehicle in the parking area. The researcher identified this point as a weak point because the transportation staff has to find the vehicle in the parking area.
The factory side cannot identify the exact vehicle location. Staff in the parking area who is finding the exact location of the vehicle wastes so much time.

Table 3.1: Vehicle Export Volume in Year 2015

<table>
<thead>
<tr>
<th>Year 2015</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit</td>
<td>9,987</td>
<td>8,298</td>
<td>9,517</td>
<td>7,620</td>
<td>8,860</td>
<td>9,932</td>
<td>6,286</td>
<td>7,341</td>
<td>8,083</td>
<td>8,668</td>
<td>8,130</td>
<td>6,663</td>
<td>99,385</td>
</tr>
<tr>
<td>Working day</td>
<td>20</td>
<td>19</td>
<td>24</td>
<td>19</td>
<td>20</td>
<td>22</td>
<td>23</td>
<td>20</td>
<td>22</td>
<td>20</td>
<td>22</td>
<td>19</td>
<td>250</td>
</tr>
<tr>
<td>Unit/day</td>
<td>499</td>
<td>437</td>
<td>397</td>
<td>401</td>
<td>443</td>
<td>451</td>
<td>273</td>
<td>367</td>
<td>367</td>
<td>433</td>
<td>370</td>
<td>351</td>
<td></td>
</tr>
</tbody>
</table>

Source: Author

Table 3.1 shows that in the year 2015, the export volume has increased 17% compared with the year 2014. However, in the year 2014 the volume has increased 247% compared with the year 2010. Working day is 250 days per year. It means that the manual operation in the vehicle export business is difficult to control, especially in January and June 2015, when the volume of vehicle export is at the very peak. In this situation, both the office and factory side (transport company) face the problem as they cannot control the operation.

Table 3.2: Pareto Analysis

<table>
<thead>
<tr>
<th>Type of error</th>
<th>Jan’15 – Dec’15 (Case)</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Human error both office &amp; transport</td>
<td>271</td>
<td>96%</td>
</tr>
<tr>
<td>Delayed delivery</td>
<td>7</td>
<td>2%</td>
</tr>
<tr>
<td>Cannot find the vehicle</td>
<td>3</td>
<td>1%</td>
</tr>
<tr>
<td>Deliver wrong vehicle</td>
<td>2</td>
<td>1%</td>
</tr>
<tr>
<td>Total</td>
<td>283</td>
<td>100%</td>
</tr>
</tbody>
</table>

Source: Author

Table 3.2 shows the problems in the vehicle export business. In year 2015, there were 283 cases that occurred in the process. The majority of the problem which came from the human error both office and transportation company is 96 percent. Human error in this case means the error from writing down the wrong engine number and inputting
the wrong engine number in the system. It means that ABC Company had to focus and solve this problem.

Figure 3.2: Human Error Between Office and Transport Side Year 2015

![Human Error Between Office and Transport Side Year 2015](image)

Source: Author

Figure 3.2 shows that the error from the transport side is strongly higher than the error from the office side. After the research, the researcher found the majority of the problems by using Pareto analysis and deeply into the problem. The main reason was that the transportation staff had to write down the engine number, lot number and unit number. Transportation staff had to provide the first source of details to the office side. No chance to recheck the detail if the driver has driven the vehicle to the parking area. If there are a lot of completed vehicles, the error from the transport occurs. Recording the number digits and alphabet is a risk to error record. Working environment in the checking area is important, too. Checking area is not appropriate for the transportation staff to concentrate so much because there are many workers, no desk to write down, less time and stuffy from the sun light. From the office side, the error did not always occur. Office side can check whether the vehicle details in the system that the transportation staff provides are correct or not. The staff can
concentrate on their work and the working environment is suitable. The risk to error is low.

**Figure 3.3: Problems in Export Business Year 2015**

Source: Author.

Figure 3.3 shows the data from the office side showing the problem that is the error of writing the wrong vehicle details. It was the major problem in the vehicle export business in the year 2015. Checking the vehicle details in the parking area or revising the document has led ABC Company to delay its delivery to the customer at Laemchabang because of waste of time in checking and revising the document. Actually, there was no tracking location in parking area, but the case of “cannot find the vehicle” meant that the transportation staff was not able to find the vehicle in the yard and nobody knew the vehicle status. The office side had to request the Final Quality Control Department find the vehicle in the yard and around the parking area. Finally, they found it at the repair shop. The last case was the vehicle and the document did not match. The transport company delivered the vehicle to Laemchabang motor pool and unloaded the vehicle in the roll and waited for the customer’s outsource company to check the product quality. After checking they found that the document and vehicle mismatch. Therefore, ABC Company had to request the trailer to pick up this vehicle back to ABC Company and had to revise the document.
Figure 3.4: Human Errors in Current Operation

Source: Author
Figure 3.4 shows the errors in the current operation. For the current operation both office and factory sides cannot control the error. The flow shows that when the wrong data are sent from the transportation staff, it is possible that the office staff will use the wrong data to issue the delivery order and send the wrong data to the transportation company. For example, receive the engine number EN3456. When the office staff inputs this engine number in the system, the system will show the nearby engine number that is EN3457. If the office staff chooses it, the vehicle and delivery order will not match. There are many cases of errors from both side as follows:

### Table 3.3: The Cases of Error in Operation

<table>
<thead>
<tr>
<th>Case of error</th>
<th>Transportation Side at Receiving area</th>
<th>Office Side</th>
<th>Trailer at parking area</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sending the wrong vehicle details</td>
<td>Receiving without noticing and checking</td>
<td>Driver did not check document before loading</td>
<td>Error</td>
</tr>
<tr>
<td>2</td>
<td>Sending the wrong vehicle details</td>
<td>Receiving without noticing and checking</td>
<td>Driver checked document before loading</td>
<td>Waste of time</td>
</tr>
<tr>
<td>3</td>
<td>Sending the wrong vehicle details</td>
<td>Receiving by noticing and checking</td>
<td>Request staff to check at the parking area</td>
<td>Waste of time</td>
</tr>
<tr>
<td>4</td>
<td>Sending the correct vehicle details</td>
<td>Input wrong vehicle details in the system</td>
<td>Driver did not check document before loading</td>
<td>Error</td>
</tr>
<tr>
<td>5</td>
<td>Sending the correct vehicle details</td>
<td>Input wrong vehicle details in the system</td>
<td>Driver checked document before loading</td>
<td>Waste of time</td>
</tr>
</tbody>
</table>

Source: Author

Table 3.3 shows that the cases of errors in the vehicle export business always happen. Both parties are possible to make errors. It cannot assign only one party to control it. In the system, it shows every vehicle in ABC Company that is completed from the
production line no matter whether the drivers drive to the parking area or not. If the office side inputs the engine number in the system that has not been completed from the production line yet, the system will not show any messages to warn the user. But, the system will show the engine number nearby. If the office side does not notice or concentrate, the staff will choose the other or wrong engine number.

Due to this export business, ABC Company faced problems in cases one and four. ABC Company had to declare the export entry document before entry to the Laemchabang free zone. If the export entry and the vehicle do not match, ABC Company will write a letter and submit evidence to present its sincerity to the Customs Department. The Customs Department can punish the company by penalty or termination of the export license of the company. That is the big problem of the export business. For export business operation all process and documents have to be accurate with no error.

3.3 Proposed Model

After the researcher found the causes of vehicle export business operation, ABC Company should have the automated identification to reduce the error and lead time and improve the operation. Barcode system is the best alternative because it is easy to adopt in the ABC Company business. The cost of investment is inexpensive. For vehicle export business, there are many parties both internal and external that the company is concerned of. Only Product Planning and Supply Chain Logistics department cannot do this activity by themselves. Therefore, the researcher has to set the agenda of the barcode system and steps to implement the project as follows:

Step 1. Set a cross-functional meeting with Production, Final Quality Control, Business Planning, Finance, System and Production Planning and Supply Chain Logistics department. The agenda is the implementation of the barcode system in the vehicle export business. Every department should think about the company’s highest benefit. The topic should include the current problems, ideas to solve them and the
benefits that the company will get. Then, propose this project to GM Production Planning and Supply Chain Logistics.

Step 2. The researcher will search or investigate with the affiliate company or outside about how they control their inventory and the tool or system they use. On the other hand, ask ABC Company’s transportation providers about their other automotive customer’s operating and controlling the vehicle in their yard. Also to ask about software or system developer do they use and the investment cost.

Step 3. Preparation system and barcode equipment such as scanner, printer, etc. Set a meeting with the Final Quality Control department, Production Planning and Supply Chain Logistics department and transport company. The current operation will be changed. Some workers have to be eliminated from the operation.

Step 4. Trial the operation starting April 2016

3.4 Evaluation

After the ABC Company had implemented the barcode system in the vehicle export operation for around one month, the researcher conducted review and investigation. The researcher wanted to ensure that the error, lead time and process were improved by using the steps as follows:

Step 1. The researcher interview the office staff and the transport company (operator) to find out whether or not the barcode implementation has helped both parties in the following smooth process, lead time reduction, real time tracking, data accuracy and user friendly.

Step 2. The researcher interview the manager about the overall process in vehicle export business. The researcher wanted to find out whether or not barcode system has made the process smooth and has eliminated the human error.

Step 3. The researcher used the actual payment from January 2015 – December 2015 to compare with the barcode implementation.
Step 4. The researcher used the current interview data about the error made by both office side and factory side (transportation company) and other types of errors in the year 2015 compared with the new implementation of the barcode system.

3.5 Chapter Summary

This chapter provides an explanation, clarification of methodology and steps of the research methodology. This chapter presents the current process including analysis and finding the major problems in the operation. The researcher has to find the best solution to solve and improve the vehicle parking area. So, the researcher proposes the barcode system implementation in the operation. The expectations after the implementation of the barcode system are to eliminate the manual process, error and long lead time. Even though there is increase in the manpower in the process, it cannot solve the problem and it comes with the cost. Barcode system is expected to help the supply chain to have a smooth flow in the operation. Finally, ABC Company is expected to reduce the manpower and save the management fee. The details and comparison are examined in the next chapter.
CHAPTER IV

PRESENTATION AND CRITICAL DISCUSSION OF RESULTS

This chapter presents the result of the analysis that consists of comparison of the new process with the previous process. The barcode system helps to eliminate the human error, lead time issuing the delivery order, manual process and reduce the cost of manpower in the parking area for vehicle export business. All of these topics are explained clearly in this chapter.

4.1 Complete Process Flow

After implementing the barcode software and tool in the operation, the process and manpower are expected to change. ABC Company has to link the yard management software to the main system. Using the barcode system in the operation instead of the staff handwriting, there are many tools that ABC Company has to prepare, such as barcode scanning, printer, internet router, etc. Besides the barcode system, ABC Company divides the parking area into three zones based on the customer destinations in Laemchabang Freezone. In parking area, aluminium studs bar is punched with a barcode tag on the ground for each vehicle parking slot. The purpose of studs bar is to track the vehicle location in the parking area. Using the new process is expected to reduce the human error, manual process and lead time in the vehicle export business and makes the operation accurate, efficient and effective. The details are explained in the “To Be Process Flow.”
Figure 4.1: To Be Process Flow

Source: Author
Figure 4.1 shows the “To Be Process Flow” in the vehicle export business after implementing the barcode system. Some steps in the process are changed at the receiving and parking area. After the vehicle is lined off from the production line and checked completely by the Final Quality Department, the vehicle is passed to the transportation staff. Transportation staff has to check the external and internal appearance. If the transport staff accepts the vehicle standard, the barcode is scanned at DD sheet. After scanning the barcode at DD sheet, the staff has to scan his or her ID card barcode also. The purpose is to identify who is responsible for the vehicle into the parking area. This new process is important because it is expected to eliminate the human error using the manual process and reduce the lead time in the recording. The transport staff does not need to write down the vehicle details in the paper. Then, the drivers drive the vehicle to the parking area, the drivers have to park at the parking slot only. After the drivers park the vehicle at the parking slot, they have to scan the studs bar on the ground. Then the transporter prints the parking slip and puts it in the vehicle. (Details are shown in Appendix B) This is the new vehicle process in the parking area.

For the office side, the process of issuing the delivery order is to be changed also. In the morning, the office staff logs in the yard management system and sees the completed vehicles in the parking area that are ready to deliver to the customer at Laemchabang. In the system, the staff sees the details of engine number, lot number and unit number. There is no need to wait for the vehicle details from the transportation staff via email and input the vehicle details in the system. The system has function to see the location, parking slot and send the order to the trailer company. The office staff chooses and shares the volume to each company. The system sends through email the amount of trips and location in the parking area automatically to the transportation company and customer yard management at Laemchabang. The delivery order format is changed to a new style. (Details are shown in Appendix A) Before implementing barcode system, the delivery order had too many vehicle details which some were not be required or necessary. But, the new one provides the barcode tag and important information. When the transportation companies receive the delivery order, they prepare the trailer for ABC Company. Then, the trailers come to
ABC Company, then go to the location identified in the order and load the vehicles into the trailers. Before the transport staff of the three companies load the vehicles into the trailers, they have to return the delivery order to the transportation staff of Company A. After the staff of the Company A receives the delivery order, he or she will scan barcode of the delivery order. In this step, the yard management system shows that the vehicle is out from the factory (motor pool out). The office staff is able to see the operation in the parking area through the yard management system.

**Figure 4.2: Yard Management Software**

Figure 4.2 show the yard management software that is used to link between the main system and barcode system by using the chassis number as the important key to link. The manual process of writing down the vehicle details is eliminated. Using the barcode reader, the DD sheet is scanned and the vehicle details such as chassis number, engine number, lot number and unit number are sent to the yard management system. The scanned barcode on the studs bar at the yard helps the management to identify and track the location of the vehicle at the parking area. The office side can track the vehicle location in real time and knows about the status of the vehicle available in the parking area. The staff can check the availability of the parking slot in
the parking area. The process of issuing the deliver order by inputting the vehicle details in the system is eliminated. Transportation company can prepare the trailers for ABC Company and there is no need to wait for the delivery order from the office staff. After loading the vehicle to the trailer, the transportation staff has to scan the barcode on the studs bar on the ground again. It means that the vehicle is ready for delivery to the customer at Laemchabang. The office staff can check the stock balance in real time because the system shows the real time result. When the customer requests for the vehicle urgently, the office staff can key the details of the vehicle. Finally the location is shown where it is. Especially in the rainy season, barcode can help to smoothen the process and flow because there is no need to wait for the rain to stop to check the vehicle details.

Figure 4.3: To Be Parking Area

![Parking Area Diagram]

Source: ABC Company

Figure 4.3 shows the new layout of the parking area after implementing the barcode system. Besides barcode system, ABC Company adopts a new layout suitable for the new operation. There are two main parking areas in the factory which are separated to five groups according to the customer destination areas. For customer side, there are three locations at Laemchabang freezone. Those areas are G, J and B. Each area is
owned by the different freezone industries. Area B is special. It is separated into three sub-locations (area B, F and A) because the export volume is high and the customer tries to find a new area to support higher volume. In the previous layout, drivers drive the vehicle into the parking area and park at empty slot. So, the vehicles are all mixed in all locations in the parking area. The new layout separates the areas clearly and are grouped by customer destination. The benefit to separate the location to match with the customer destination is easy to manage and notice. The drivers have to park at the location identified in DD sheet. If the identified area is not available, the driver can park at the spare area at the preload number two. In a row, there are seven units of vehicles because one trip of the trailer can deliver seven units of vehicles. It is easy for transportation company to check and load the vehicle to the trailer.

Figure 4.4: Studs Bar with Barcode Tag

![Studs Bar with Barcode Tag](image)

Source: ABC Company

Figure 4.4 shows the studs bar in the parking area. There are studs bar in every parking slot. After the drivers park the vehicle in the parking area, they have to scan the barcode tag on the ground. Every time that they move the vehicles out from the parking area, they have to scan the barcode tag also. Studs bar with barcode tag demonstrates the vehicle location in the parking area. The office side can track the real time of the vehicle location easily through this technology. (Details are shown in Appendix C).
4.2 Trial Implementation

After setting the cross functional meeting, all concerned departments have to do their assignment. During this period, the system department operates the main system and the yard management software. Production Planning and Supply Chain Logistics department and transportation companies prepare the new operation for the vehicle export business. The factory side prepares the process in the parking area by punching the studs bar on the ground and separating the parking area. The trial period starts from July 2016 – August 2016, a total of two months. ABC Company has to retain all transportation staff in the vehicle export operation in this trial period.

4.2.1 Eliminate the waste in the operation

Compare as-is model with to-be model, the researcher set the meeting to follow up the result of the three main concerned parties, the factory, office and customer. The result is, manual operation has been eliminated from the operation. As for the factory side at the receiving area, the operation is smooth compared with the previous operation. The transportation staff does not need to write down the vehicle details into the paper and concentrate on the number and alphabet in DD sheet. They use only the barcode reader to scan the barcode at DD sheet. Lead time has reduce and flexible for the staff when working at the receiving area. Transportation staff can stand around the receiving area and scan the barcode. The human error is eliminated because the barcode technology is very accurate. There is no need the recheck the vehicle details. (Details are shown in Appendix D)

As for the office side, the staff is not able input the engine number one by one into the system. Barcode system can eliminate this manual process from the operation. Actually, the office staff does the delivery order process for around two hours. But, the barcode system helps to improve the process and reduce the lead time in the operation. In the trial period, there has been no error in writing the engine number. The office staff has not called the transportation staff to check the vehicle detail in the parking area. In the morning, the office staff is able to access to the yard management system and able to choose the vehicle row and reserve the trailer to transportation
company. After that, the system has sent the delivery order to all concerned parties. They have used the lead time in not more than twenty minutes to finish the delivery order to all concerned parties. Trailers have come to the factory faster and have more time to load the vehicles into the trailer. Transport companies appreciate the barcode system because the lead time of delivery order is shorter and very accurate. They can utilize their trailer better than before. (Details are shown in Appendix D)

Table 4.1: Reduced Lead Time to issue Delivery Order

<table>
<thead>
<tr>
<th>No</th>
<th>Job Detail</th>
<th>Previous Operation</th>
<th>New Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Manual Process</td>
<td>Barcode System</td>
</tr>
<tr>
<td>1</td>
<td>Received email from transporter</td>
<td>Yes</td>
<td>No need</td>
</tr>
<tr>
<td>2</td>
<td>Print shipping marks from email and group the order.</td>
<td>Yes</td>
<td>No need</td>
</tr>
<tr>
<td>3</td>
<td>Type vehicle details such as engine number to the system.</td>
<td>60 minutes</td>
<td>No need</td>
</tr>
<tr>
<td>4</td>
<td>Loading the vehicle details to excel file and modify the format.</td>
<td>60 minutes</td>
<td>No need</td>
</tr>
<tr>
<td>5</td>
<td>Typing email to all transporters and customer and customer outsource.</td>
<td>15 minutes</td>
<td>No need</td>
</tr>
<tr>
<td>6</td>
<td>In case transporter writes down the wrong vehicle details. The office staff</td>
<td>Yes and often</td>
<td>No need</td>
</tr>
<tr>
<td></td>
<td>has to check and wait for the confirmation</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: ABC Company

Table 4.1 shows the lead time of previous and new operation barcode system. The lead time to issue delivery order was around two hours and fifteen minutes in the previous operation. This lead time did not include the waiting time because of the wrong vehicle detail received from the transporter. Whenever the office staff finds something wrong, he or she had to request transporter at the parking area to check.
The time for checking was about fifteen to thirty minutes per time. But the new operation using the barcode system, the office staff is able to finish all the process of issuing delivery order for about twenty minutes with no human error. The data that the staff received and sent to the transporter was been more accurate and faster compared with the previous operation. Therefore, the new operation can reduce the lead time for issuing delivery order around two hours.

**Figure 4.5: Parking Location Status Visible**

![Parking Location Status Visible](image)

Source: ABC Company

Figure 4.5 shows the real time parking location status at ABC Company. After the office staff logs in the password, he or she sees the parking location status and all the vehicle details in the yard. If the parking area is almost full, the staff sends the special delivery order to the transportation company immediately. The parking location web page shows many status, such as available space, suggestion for parking, confirmed delivery, received order, waiting for repair and block area.

As for the customers side, they receive the delivery order and vehicle faster. Then, they can prepare for the operation early, such as preparation of the document, staff inspection of the vehicles and the area for parking. When the customer likes to check the status of the urgent vehicle or to request for urgent vehicle, the office staff
informs the customer immediately. In the trial period, the problem of mismatch between document and vehicle did not happen. ABC Company has delivered the vehicle on time. (Details are shown in Appendix D)

4.2.2 Issues Occurred During Implementation of Barcode System

During the implementation of the barcode system, there have been problems that the transport companies have to be careful. When drivers drive the vehicles to the parking area, they have to scan the barcode on the studs bar every time. If the transport staff does not scan the barcode, the system will show that the parking slot is empty. Therefore, the office staff cannot find the vehicle in the parking area. Next problem is about the transport staff loading the vehicles into the trailer. There are three transport companies operating in ABC Company. Company A takes care of receiving area and yard management. Company S is the transport company in the contract and Company C is the back up. Company A takes care of the receiving area and trailer transport. Company S and Company A take care of only the trailer transport. After these two companies load the vehicles into the trailer, they have to send the delivery sheet to Company A. Company A staff scans the vehicle barcode to cut the vehicle details in the system. If they do not submit the delivery sheet and scan the barcode, the office side will see this vehicle in the parking location even though it has been moved to customer. The trailer's drivers are asked by staff to submit the delivery order when they go out from the parking area.

4.2.3 Condition During Implementation of Barcode System

The period of the implement of the trial barcode system is two months. ABC Company starts to install and implement the barcode system, barcode equipment and adjust the location in the parking area. But only the manpower in the parking area has remained the same. ABC Company has to cancel the manpower of the transport company thirty days in advance before termination. But it is the intention of ABC Company. If the problems occur, ABC Company has the manpower to operate in the process. Cutting the manpower immediately is a risk for ABC Company. After the trial implementation for two months, ABC Company has amended the contract on
manpower. The reduction of transportation staff from the operation is explained in detail in the next topic.

4.3 Cost Analysis

For the implementation of the barcode system in the operation, ABC Company has to invest in software, tools and development fee. Besides the continuous improvement, it can reduce the long term cost such as cost of manpower in the operation.

4.3.1 Benefit of the Implementation of the Barcode System

In vehicle export business, there are many steps that use manual process in the operation. As literature review mentioned in chapter two, manual process needs more manpower to execute. It means that the company has higher cost than necessary and it does not create value. Barcode system is a technology that helps the enterprise to manage the inventory, reduce lead time and manpower. The benefit of ABC Company is the reduction of management fee.

Table 4.2: Company A Management Fee

<table>
<thead>
<tr>
<th>Position</th>
<th>D</th>
<th>N</th>
<th>Total</th>
<th>Salary (Baht)</th>
<th>Per month (Baht)</th>
<th>Reduce Person (Baht)</th>
<th>Monthly saving (Baht)</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Foreman</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>36,450</td>
<td>72,900</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operator</td>
<td>3</td>
<td>3</td>
<td>6</td>
<td>32,700</td>
<td>196,200</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Administration</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>32,700</td>
<td>130,800</td>
<td>2</td>
<td>65,400</td>
</tr>
<tr>
<td>Driver</td>
<td>3</td>
<td>3</td>
<td>6</td>
<td>26,350</td>
<td>158,100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Staff at yard</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>26,350</td>
<td>105,400</td>
<td>2</td>
<td>52,700</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>22</strong></td>
<td></td>
<td><strong>153,850</strong></td>
<td><strong>663,400</strong></td>
<td></td>
<td><strong>4</strong></td>
<td><strong>118,100</strong></td>
</tr>
</tbody>
</table>

Source: ABC Company

Table 4.2 shows the staff of the Company A that takes care of the operation at receiving area and transportation from ABC Company to customer at Laemchabang.
There are twenty-two persons (Day shift eleven persons and night shift eleven persons). After implementing the barcode system, Production Planning and Supply Chain Logistics has found that the operation can reduce the manpower into four persons. So, ABC Company can reduce the position in the administration into two persons (Day shift one person and night shift one person) and staff at yard into two persons (Day shift one person and night shift one person). So ABC Company can reduce the cost of management fee from Company A around 118,000 baht per month and 1,417,200 baht per year. After the trial implementation, Company A has eighteen staff in the operation.

Table 4.3: Company S Management Fee

<table>
<thead>
<tr>
<th>Position</th>
<th>D</th>
<th>N</th>
<th>Total</th>
<th>Salary</th>
<th>Per month (Baht)</th>
<th>Reduce person (Baht)</th>
<th>Monthly saving (Baht)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant advisor</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>25,000</td>
<td>25,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Co-ordinator</td>
<td>2</td>
<td>-</td>
<td>2</td>
<td>23,052</td>
<td>46,104</td>
<td>1</td>
<td>23,052</td>
</tr>
<tr>
<td>Staff at yard</td>
<td>4</td>
<td>-</td>
<td>4</td>
<td>23,052</td>
<td>92,208</td>
<td>2</td>
<td>46,104</td>
</tr>
<tr>
<td>Total</td>
<td>7</td>
<td>-</td>
<td>7</td>
<td>71,104</td>
<td>163,312</td>
<td>3</td>
<td>69,156</td>
</tr>
</tbody>
</table>

Source: ABC Company

Table 4.3 shows the staff of Company S that takes care of only the transportation from ABC Company to customer at Laemchabang. There are seven persons working only on a day shift. So, ABC Company can reduce cost of management fee from Company S around 69,156 baht per month and 829,872 baht per year. After the trial implementation, Company S has four staff in the operation.
Table 4.4: Compare Previous and New Operation in Term of Investment

<table>
<thead>
<tr>
<th>Year</th>
<th>No Barcode System</th>
<th>Implement Barcode System</th>
<th>Difference (Baht)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Manpower fee</td>
<td>Manpower fee</td>
<td>System Service Fee</td>
</tr>
<tr>
<td>1</td>
<td>9,920,544 Baht</td>
<td>7,673,472 Baht</td>
<td>5,231,960 Baht</td>
</tr>
<tr>
<td>2</td>
<td>9,920,544 Baht</td>
<td>7,673,472 Baht</td>
<td>1,103,700 Baht</td>
</tr>
<tr>
<td>3</td>
<td>9,920,544 Baht</td>
<td>7,673,472 Baht</td>
<td>1,103,700 Baht</td>
</tr>
<tr>
<td>4</td>
<td>9,920,544 Baht</td>
<td>7,673,472 Baht</td>
<td>1,103,700 Baht</td>
</tr>
<tr>
<td>5</td>
<td>9,920,544 Baht</td>
<td>7,673,472 Baht</td>
<td>1,103,700 Baht</td>
</tr>
<tr>
<td>Total</td>
<td>49,602,720 Baht</td>
<td>38,367,360 Baht</td>
<td>9,646,760 Baht</td>
</tr>
</tbody>
</table>

Source: ABC Company

Table 4.4 shows the comparison between the previous operation without barcode system and the new operation with the barcode system in terms of investment cost. In the first year, ABC Company had to pay more than the previous operation amounting to 2,984,888 baht. Starting from year two, implementing the barcode system has saved the cost amounting to 1,143,372 baht. Therefore, in the long-run, ABC Company has benefited from cost saving and has improved the overall process in the operation.

Finally, ABC Company has reduced the manpower in the vehicle export business from twenty-nine to twenty-two persons. Manpower fee has reduced from 9,920,544 baht to 7,673,472 baht. The amount of money that ABC Company is able to save is 2,247,072 baht per year. Cost reduction is around twenty two percent.

Besides saving manpower fee in the operation, the company can reduce other cost. That is soft saving cost, such as paper, telephone call, email, etc. The researcher did not calculate and show the amount of the soft saving cost.

4.3.2 Cost of Investment and Monthly Expense

In the implementation of the barcode system, there are many things that have to be prepared such as hardware, software, studs bar in yard, consultant fee, maintenance
fee and other expenses. Some expenses are paid only one time, but some have to be paid monthly such as maintenance fee. So in implementing the barcode system, ABC Company Account Department has to control both investment cost and expense cost. There are steps in preparing the barcode system. First, ABC Company has to pay the cost of system modification. Next, the consultant team has to design and develop the software with the System Department. When the system is finished, the consultant team educates the staff about the overview of the barcode system and how to use it. After implementing the system, the team will provide the service and maintenance to the customer. If the problems occur about the software, the customer can inform the problems to them. This is the cost of maintenance fee that ABC Company has to pay every month until the termination of the contract. About the hardware such as printer, barcode reader and electronic equipment, these things need to be used at least five years. If the hardware is damage or cannot be repaired, ABC Company will changed depending on the situation.

Table 4.5: Investment of Barcode System

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Cost (Baht)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Yard road studs &amp; location barcode</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Aluminium road studs</td>
<td>63,000</td>
</tr>
<tr>
<td>3</td>
<td>Installation of road studs</td>
<td>25,200</td>
</tr>
<tr>
<td>4</td>
<td>Barcode Tags</td>
<td>25,200</td>
</tr>
<tr>
<td>5</td>
<td>Software and license</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Software design (System analysis)</td>
<td>1,980,000</td>
</tr>
<tr>
<td>7</td>
<td>Development and programing team</td>
<td>1,080,000</td>
</tr>
<tr>
<td>8</td>
<td>All software to interface with AS400</td>
<td>248,940</td>
</tr>
<tr>
<td>9</td>
<td>Barcode equipment</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Dashboard screen and other</td>
<td>53,400</td>
</tr>
<tr>
<td>11</td>
<td>Printer 2 sets</td>
<td>23,520</td>
</tr>
<tr>
<td>12</td>
<td>Handheld 5 sets</td>
<td>399,000</td>
</tr>
<tr>
<td>13</td>
<td>Safety training and safety equipment</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>4,128,260</td>
</tr>
</tbody>
</table>

Source: ABC Company
Table 4.5 shows the investment cost that ABC Company has to pay. It is paid only one time to operate the barcode system. All things have useful life of at least five years. For barcode handheld, the warranty is covered for three years. If there are problems, the transport company has to claim the insurance first. In the case of damage from the accident, the staff of the transport company has to be responsible for the cost of the repair.

Table 4.6: Company’s Annual Cost of Implementation

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Cost (Baht)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Internet charge</td>
<td>130,800</td>
</tr>
<tr>
<td>2</td>
<td>Software maintenance and service</td>
<td>972,900</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>1,103,700</strong></td>
</tr>
</tbody>
</table>

Source: ABC Company

Table 4.6 shows the annual expense cost that ABC Company has to pay every year. Software maintenance and service include software development and customer services. Development yard management software is the responsibility of the transport company. The software should be accurate, up-to-date and easy to use. If there are the problems in the system, they will provide a technician to solve and advise.

4.3.3 Calculation

Even though the barcode system implementation can reduce manpower cost in the process, ABC Company has to invest first. Investment is important an issue in the organization. ABC Company can eliminate the manual process and lead time in the operation but investment of around four million and monthly payment have to be accepted. Therefore, the researcher would like to show the calculation that the investment can generate the value to the company by using Net Present Value (NPV). NPV is an indicator that can explain of how much value an investment adds to the organization. The result of NPV can show three situations. (1) NPV is positive, means that the investment can generate the value to the organization. (2) NPV is negative, means that the investment is a subtract value from the organization. (3) NPV is zero,
means that the investment would neither gain nor loss value of the organization. ABC Company Accounting department has decided to use five years and ten percent for interest rate to analyze the Net Present Value.

\[
NPV = \sum \frac{Nt}{(1+i)^t}
\]

Abbreviation from NPV formula as follows:

\(N = \text{Net profit (Cash inflow - Cash outflow)}\), \(i = \text{Discount rate}\), \(t = \text{Time}\)

Table 4.7: Net Present Value Calculation

<table>
<thead>
<tr>
<th>Year</th>
<th>Cash Inflow (Baht)</th>
<th>Cash Outflow (Baht)</th>
<th>Net Profit (loss) (Baht)</th>
<th>PV (10%) (Baht)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2,247,072</td>
<td>5,231,960</td>
<td>-2,984,888</td>
<td>-2,713,535</td>
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<tr>
<td>2</td>
<td>2,247,072</td>
<td>1,103,700</td>
<td>1,143,372</td>
<td>944,936</td>
</tr>
<tr>
<td>3</td>
<td>2,247,072</td>
<td>1,103,700</td>
<td>1,143,372</td>
<td>859,032</td>
</tr>
<tr>
<td>4</td>
<td>2,247,072</td>
<td>1,103,700</td>
<td>1,143,372</td>
<td>780,938</td>
</tr>
<tr>
<td>5</td>
<td>2,247,072</td>
<td>1,103,700</td>
<td>1,143,372</td>
<td>709,944</td>
</tr>
</tbody>
</table>

NPV: 581,316

Source: ABC Company

Table 4.7 shows the result of NPV which is a positive value. It means that the investment can add or generate value to ABC Company. The researcher will use this calculation to be presented to the Production Planning and Supply Chain Logistics Department management. The result can make sure that barcode system can improve the process in the vehicle export business. Investment will be lost but it will generate value to ABC Company.
4.4 Chapter Summary

After the implementation of the barcode system, ABC Company is able to gain benefits by using barcode system. There are direct and indirect benefits effecting to ABC Company. Direct benefits are, the company can reach its objective, can reduce the manual process, lead time and cost of manpower in the vehicle export business. Indirect benefits are, the company can do the continuous improvement in the process, increasing the customer satisfaction, encourage the staff to do other things that have value, gain the competitive advantage than other competitors and offering better supply chain management in and outside organization.
This research is focused on the improvement for the parking area of the vehicle export business by using barcode system in the process. Barcode identification technology can help to improve the operation. Therefore in this chapter, the researcher provides the summary findings, conclusion, theoretical implications, managerial implications, limitations and recommendations for the future research.

5.1 Summary of the Findings

According to the research question mentioned in chapter one "How can ABC Company eliminate human error in the operation and improve the overall process in the parking area?" The implementation of the barcode system can help the ABC Company to solve the problems on manual processes such as tracking the location and also reduce manpower in the operation. Manual process leads the company to hire more staff to support in the operation. No tracking location, the company has to hire more staff to manage the vehicles in the parking area. The excessive demand in manpower and cost to support in the operation had increased. Therefore, the implementation of the barcode system can reduce the manual processes not only in the office but also at the factory side. Barcode system can remove the process of writing and typing the vehicle details. The error is eliminated by the barcode system. Transportation at receiving area is the first source of data. The barcode reader scans the barcode on the studs bar. Handwriting is a risk to human error and is not clear. The operation can track the vehicle location. It can reduce the time in finding the vehicle. The company can check the vehicles real time location and status anytime. The office staff can check the status of the vehicle even though they are not in the office. Lead time in the vehicle export operation is reduced because
the manual process is eliminated. Vehicle data from the receiving area are transferred to the ABC Company main system. The office staff does not need to key the data into the system anymore. Seven staff who work in vehicle export operation will be reduced. The barcode system helps to reduce the manual process. The cost that ABC Company can save is 2,230,272 baht per year.

ABC Company decided to choose barcode technology rather than RFID because this technology is appropriate to its operation. The vehicles quality has to be checked one by one, both internal and external. Therefore, scanning the barcode is not waste of time. Barcode technology is inexpensive compared to RFID. Barcode technology is easy to adapt and link with ABC Company main system. Therefore, barcode technology is the most suitable for ABC Company at present.

5.2 Conclusions

The purpose of this research is to reduce human errors, lead time, manual processes and cost of manpower in the parking area of the vehicle export business. Improving the current process situation of ABC Company, the researcher recommends the automated identification technology that is barcode system. There are much data and information, such as the current operation, advantage and disadvantage of barcode and expense in the vehicle export operation that have to be studied. The barcode system was developed in order to solve the major problem and improve the company’s performance.

Besides that the barcode system can eliminate the problems in the operation, It can reduce the cost of management and the process is efficient and effective. According to the objectives of this research, the results can solve the ABC Company problem and improve the vehicle export operation process. Barcode system can help the company eliminate non-value added activities and reduce the cost of manpower. ABC Company gains the competitive advantage than other competitors. Supply chain in organization is improved and customer satisfaction increases.
After manual process was eliminated, the office staff did not waste their time to conduct some manual operations in the system. The department has assigned a staff to monitor and control the whole process rather than to key in the vehicle details in the system. The purpose is to motivate the staff and make them ensure their career path in the future.

5.3 Theoretical Implications

This research is the real case of ABC Company. The researcher has collected data and interviewed all the concerned parties. After collecting all data, the researcher used the Pareto Analysis concept to find the majority problem in the company. The problems were the manual process and the human error in the process. Increasing the manpower in the operation did not work and made the company to pay higher cost of management fee.

Automated identification is one alternative that helps to reduce manual process in the operation. Lavery (1990) mentioned that barcode is a powerful automatic identification and popular in business world. It can prevent error from the worker. The organization cost is effectiveness, flexibility and practicality. The data and information are more accurate than done manually by the worker. After applying the barcode system in the operation, the outcome is the accurate data and information but shorter lead time and reduce manpower. The yard management software links between ABC Company main system and barcode system. Staff can easily track the vehicle location at real time. Data can be transferred from receiving area to the main system. Therefore, barcode system can make the process in the parking area efficient and effective.

5.4 Managerial Implications

This research can be a guideline for the implementation of the barcode system to manage and control the vehicle parking area of ABC Company. This research is appropriate to the organization wanting to eliminate the manual process, human error
and lead time and track the product location by using barcode technology. Barcode is cheaper technology than other automated identification but powerful tool. There are many benefits for the enterprise to control huge inventory. Therefore, barcode system is the best alternative for the company which does not want to invest much. It depends on the business background and condition also.

5.5 Limitations and Recommendations for Future Research

This research was conducted to improve the parking vehicle process in automotive industry. The company chose the barcode system technology to solve the major problem. So, the automated identification and condition may not correspond to the other business processes due to different industries, conditions and timeframes.

Due to limitations of this research, this research has mainly focused on the vehicle export automotive industry. There are many automated identification technologies, but the researcher proposed to use the barcode system. Barcode system has disadvantages compared with other technologies, but it is suitable for ABC Company’s vehicle parking area. The investment of barcode is not expensive and easy to install with main system. Vehicle export business needs very accurate data because it concerns with the Customs department.

There are recommendations for the future research. The company should improve and develop the system more efficiently. After sending the delivery order to all transportation company, the office staff can issue the shipping invoice and print it out immediately. Office staff does not need to download the vehicle details to excel shipping format again. If the system can be developed to issue shipping invoice, the department will reduce few staff and rotate them to improve another function.


Frusman, P., & Wibisono, D. (2013). Design and implementation of Warehouse management improvement strategy using barcode systems approach at PL LATINUSA TBK.


APPENDICES
APPENDIX A

New Delivery Order Format
<table>
<thead>
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<th></th>
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</tr>
</tbody>
</table>
APPENDIX B

Parking Slip
Parking slip

Driver No.: sompob
Driver First Name: ทวีศักดิ์
Driver Last Name: ปัทม์
VIN No.: MP1TFR86JEG016241
Model Code: TFR86JEMH4
Color Code: 034
Lot: 034
Unit: 5
Support Location: LA0105

Print Date: 03-Apr-2014 16:48:12
APPENDIX C

Studs Bar in Parking Area
APPENDIX D

Interview Questions
Company Name: Production Planning and Supply Chain Logistics (Office staff)

Question: Due to the new implementation barcode system in vehicle export business. As you work directly in this operation. In your opinion, do you think barcode technology can reduce human error and improve the overall process or not?

Answer: In the trial period July – August 2016, the operation flow and smooth. No need to key the vehicle detail such as engine number into the system. We waste the time to key the vehicle detail a lot. Sometime we cannot read the hand writing from transporter. We complaint to them many time but they cannot changed. Many time that we have to wait them to check the vehicle detail. Barcode system can help a lot. We just log in to yard management system. We just drag and choose the row of vehicle everything transfer to all concerns parties automatically. No error in trial period. We did not call to transporter the check and find the vehicle. We can check the vehicle status even though we are home.
Company Name: Transportation Company (Staff Company A)

Question: Due to the new implementation barcode system in vehicle export business. As you work directly in this operation. In your opinion, do you think barcode technology can reduce human error and improve the overall process or not?

Answer: Barcode system helps the process smooth and flow. We received compliant from the customer about the error of vehicle detail many time. We try to solve this problem but when the time pass the problem will occur again. At receiving area, the environment is not support our staffs to write down the detail like this. They have to write down the numeric and English alphabet. No desk for sit. After ABC Company implement the barcode system. It can help the staff at receiving area too much. They use the barcode reader to scan the barcode at DD sheet. It is very flexible and comfortable. No error in trial period because staffs did not write down the vehicle detail anymore. We can move the staffs to another working area.
Company Name: Customer

Question: Due to the new implementation barcode system in vehicle export business. As you work directly in this operation. In your opinion, do you think barcode technology can reduce human error and improve the overall process or not?

Answer: For the previous process, we have to wait ABC Company to find the vehicle that we request urgent. ABC Company staff cannot answer immediately because ABC Company has no system to track the vehicle in parking area. Sometime they cannot find the vehicle that we ask for deliver urgent. Sometime ABC Company staff uses long lead time to check the status of the vehicle.

Now ABC Company invests in the barcode system. In our opinion, it looks good. When we ask for the urgent vehicle, the staff can answer me immediately because they can search in the yard management system.