



Logistics Information System of Electrical
Equipment Trading Business

by

Ms. Sirilak Janthraphisit

A Final Report of the Three-Credit Course
CS 6998 System Development Project

Submitted in Partial Fulfillment
of the Requirements for the Degree of
Master of Science
in Computer Information Systems
Assumption University

November, 2001

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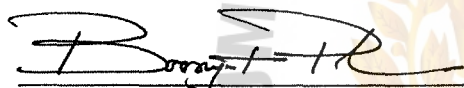
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Academic Year	November 18, 2001

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Approval Committee:



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Advisor



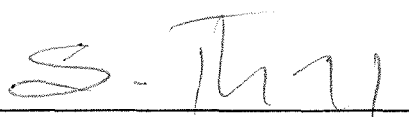
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ABSTRACT

Currently, the most important factor in doing business is not product, person, but information. It is the valuable treasure of a company. The right information must be available to the right person at the right time. However, there are a lot of problems caused by manual systems which often lead to inaccurate information and subsequently wrong decision making by the management.

Computerized system is adopted to provide a satisfactory solution. The project presents a method and a procedure for applying the information technology to gain the business advantages. Logistics Information System of J.C. Trading Company is the theme of this project. The company is an importer and a distributor of several product lines. The company currently operates its business manually. The project proposes a new computerized system that will enhance and maximize the strength of the current system. System analysis and design methodology is used to design and implement the new system.

Several tools and techniques are used to provide the best solution for the company. Friendly user interface is presented for convenient use. Concise and effective reports are proposed to support decision making. The proposed system uses Microsoft Access to implement the program that provides ease of use and efficiency to users.

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I. INTRODUCTION

1.1 Background of the Project

Nowadays is the time of business competency. A lot of companies plan many strategies to handle this situation. One of the strategies is the service-oriented strategy. This plan persuades companies not only to concentrate on producing and marketing, but also on servicing. Most companies, therefore, emphasize more on services especially in logistics.

Since the good logistics system is required for company growth and development. It is aimed to get the right goods to the right place, at the right times and in the desired condition, while making the greatest contribution to the company.

Most logistics operations procedures are currently done manually. Latent works always happen and they cause some losses to many transactions. A computerized system is definitely required to assist the traditional system. It can improve and develop the existing business procedures to be more productive and more efficient to face the current competitive market.

1.2 Objectives of the Project

The objectives of this project are as follows:

- (1) To analyze the existing system and all requirements.
- (2) To design the computer-based information system in order to serve the logistics information system.
- (3) To develop and to test the new software package for the logistics information system.
- (4) To evaluate the capability of new logistics information system.

- (5) To automate manual procedures to improve them in some way such as reducing errors, and increasing speed or accuracy.
- (6) To reduce the cost of the system output by streamlining and eliminating duplicate or unnecessary reports.
- (7) To shorten data-processing time.
- (8) To upgrade customer services to gain a competitive edge.

1.3 Scope of the Project

Major scopes of this proposed project are focused on:

- (1) Order Processing
 - (a) Sales Order-Inventory Procedures
 - (b) Order Information Transmittal
- (2) Inventory Management
 - (a) Stock Layout
 - (b) Documentation
- (3) Transportation
 - (a) Mode and Transport Service Selection
 - (b) Carrier Routing
 - (c) Vehicle Scheduling

1.4 Deliverables

The logistics information system of J.C. Trading Company covers the followings:

- (1) Project Implementation
 - (a) Background of the Project
 - (b) Objectives
 - (c) Scope

- (2) The Existing System
 - (a) Background of the organization
 - (b) Existing business function
 - (c) Current problems and areas for improvement
- (3) The Proposed System
 - (a) User Requirements
 - (b) System Design
 - (1) Candidate Systems Matrix
 - (2) Feasibility Analysis
 - (c) Hardware and Software Requirements
 - (d) Security and Control
 - (e) Cost / Benefit Analysis
- (4) Project Implementation
- (5) Conclusions and Recommendations

1.5 Project Plan

The project plan of Electrical Equipment Trading Business regarding the logistics system is shown in Figure 1.1.

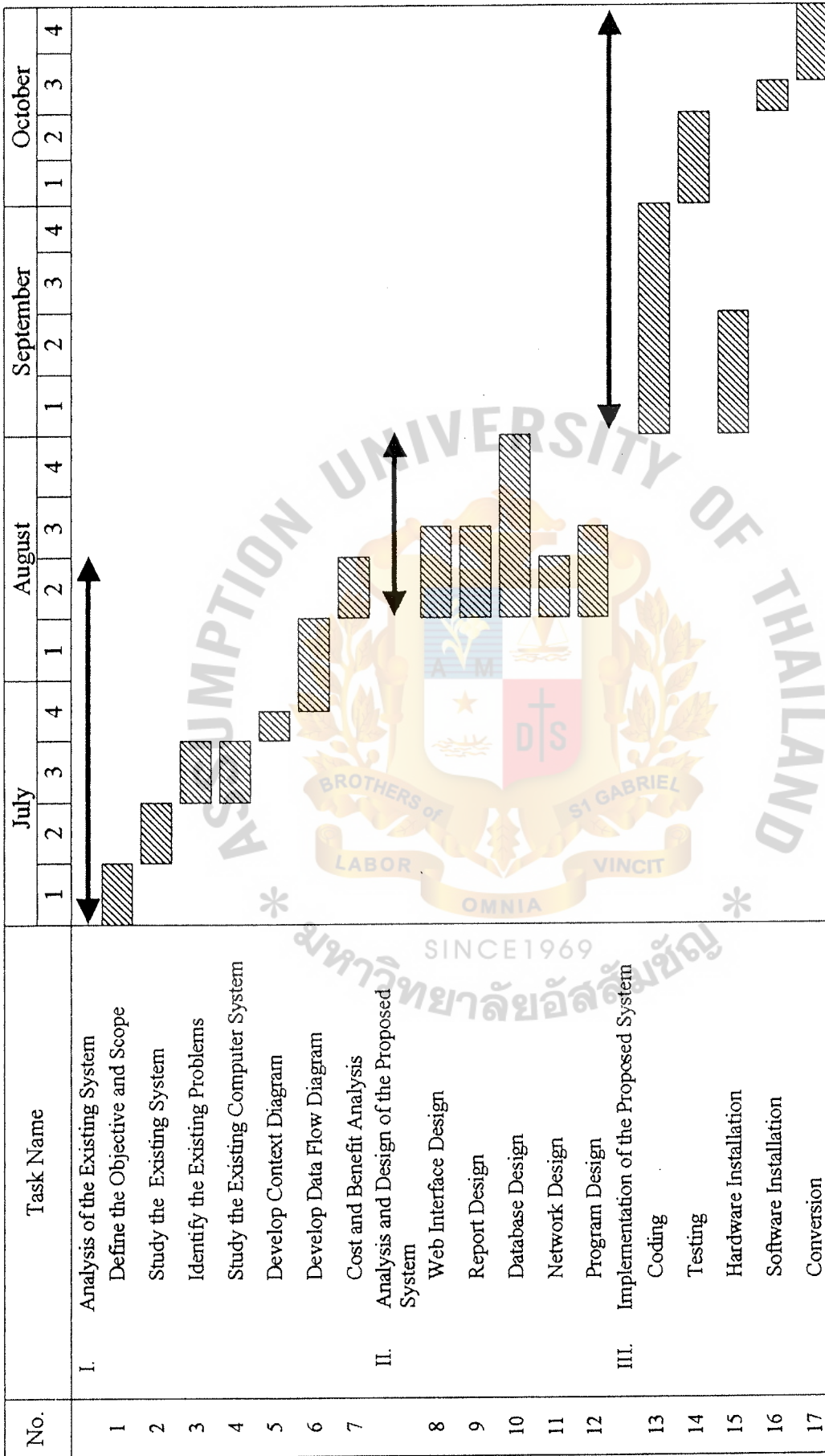


Figure 1.1. Project Plan of Electrical Equipment Trading Business.

II. THE EXISTING SYSTEM

2.1 Background of the Organization

JC Trading Company has been established in Thailand since 1975. The company has traded in the fields of the electrical equipment and materials. Most products are imported from international sources and some are supplied from the local manufacturers. These products are distributed to manufacturers, distributors, and retailers, which cover almost the whole country.

Nowadays, JC Trading Company has expanded to the other related product lines. Subsequently the number of business transactions increases rapidly. However, because of the manual operating system, the company is facing with many problems. The computer-based system, therefore, is required instead of the paper-based system. This system will be able to eliminate the confronted problems. Moreover, it is the opportunity of the company to improve the operating system to be potential in current economic crisis.

2.2 Existing Business Functions

The company is organized into four sections as follows:

(1) Sales & Marketing Department

This section is responsible for selling the goods and taking care to the customers and the market to enhance the market shares. Besides, the above preparing customer invoice is another vital work of this section.

(2) Finance & Accounting Department

This section deals with the works of finance and accounting like cash receipts and disbursements, payroll payment, and general accounting transactions.

(3) Purchase Department

This section concerns goods purchasing and other related information both local and foreign sources.

(4) Warehouse Department

This section refers to the logistics part that is the critical part of this project. It is separated to Inventory and Transport parts.

The investigation does not concentrate only on logistics part. The other operations are also considered. Nevertheless, the key business function concerns mostly logistics, which is the very essence of trading. Also, the most problems are found in the range of business logistics like order processing, inventory management, and physical distribution.

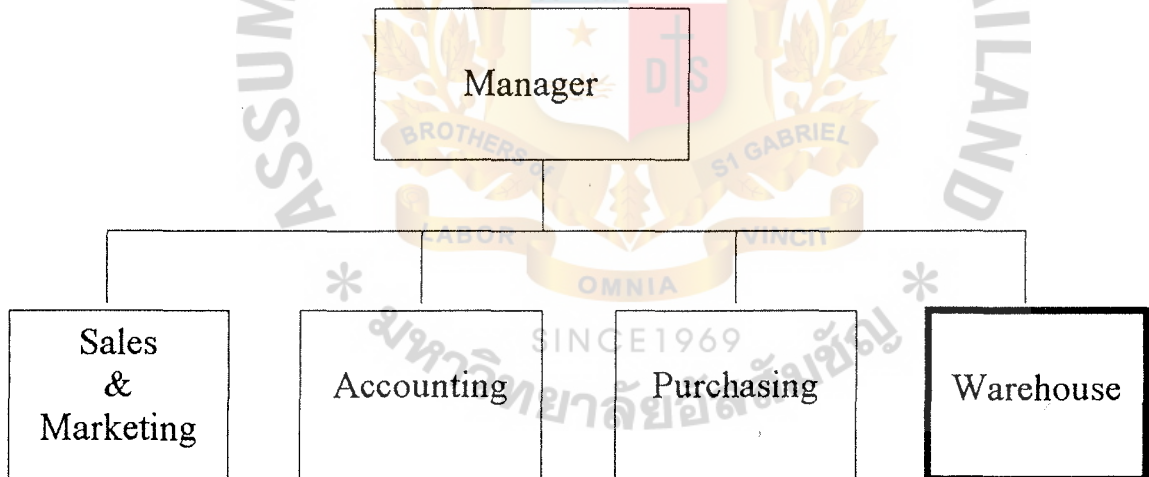


Figure 2.1. Organization Chart of Electrical Equipment Trading Business.

Additionally, the current processes of logistics information system of Electrical Equipment Trading Business covers the followings:

(1) Receive Order Process

A logistics staff gets an order from a sales officer. The order is sent either by paper or phone. A staff will check the availability of order via stock file. Unless the required order is available, the sales officer will be informed of the product status. On the contrary, the valid order is provided, simultaneously the documents are sent from the sales department as the product attachment.

(2) Delivery Process

After product arrangement, the destination place is checked via the customer record. A transaction will be considered for the suitable delivery. If it is delivered through the owned transport, the customer will receive the product directly. Oppositely, a transport agent will be responsible for delivery.

(3) Modification Process

Stock record is deducted after providing for customer, and is added after receiving new product from supplier. Moreover, stock checking is performed every quarter, and this process always takes a lot of time because of several product lines.

(4) Documentation Process

All Acknowledged (ACK) documents are collected in one section. Then they are classified to stock file and shipment file. These files are recorded in paper, and kept for report procedure.

(5) Generate Report Process

All files are concluded in quarterly for stock and shipment parts.

Subsequently the reports are generated for manager. It covers the topic like quarterly stock status, quarterly shipment status, and quarterly logistics status.

2.3 Current Problems and Areas of Improvement

Customer service is the most critical factor in current business. It is defined as the time elapsed during order receipt time and goods receipt. As the logistics prospective, it is also the result of all logistics activities. Good service could increase the customer satisfaction and ultimately create and maintain the customer loyalty.

J.C. Trading Company currently manages the business operations manually. There are four key areas around which current problems always take place and decrease the service quality of the company.

(1) Order Processing

There is no ordering condition standard. Sometimes inaccurate orders are received, causing some mistakes and damages to both customers and company.

(2) Location

This refers to the network configuration problem. Network, hereby, means the inner working areas. Various operational parts are always located on inappropriate places, and work without the assembly line standard. This causes the inconvenient, ineffective, and inefficient operations.

(3) Inventory

The inventory data file does not get updated often enough. Also, there are a lot of redundant records. So the shortage of goods and excess of goods in inventory part always happen.

(4) Transportation

Wrong transportation mode selection always causes the latent delivery; and sometimes lost or damaged products. Besides, the redundant shipment route always costs a lot of unnecessary expenses.

Furthermore, there is no integrated storage file. It displays that each department has its own information, which leads to difficulty in operation and management.



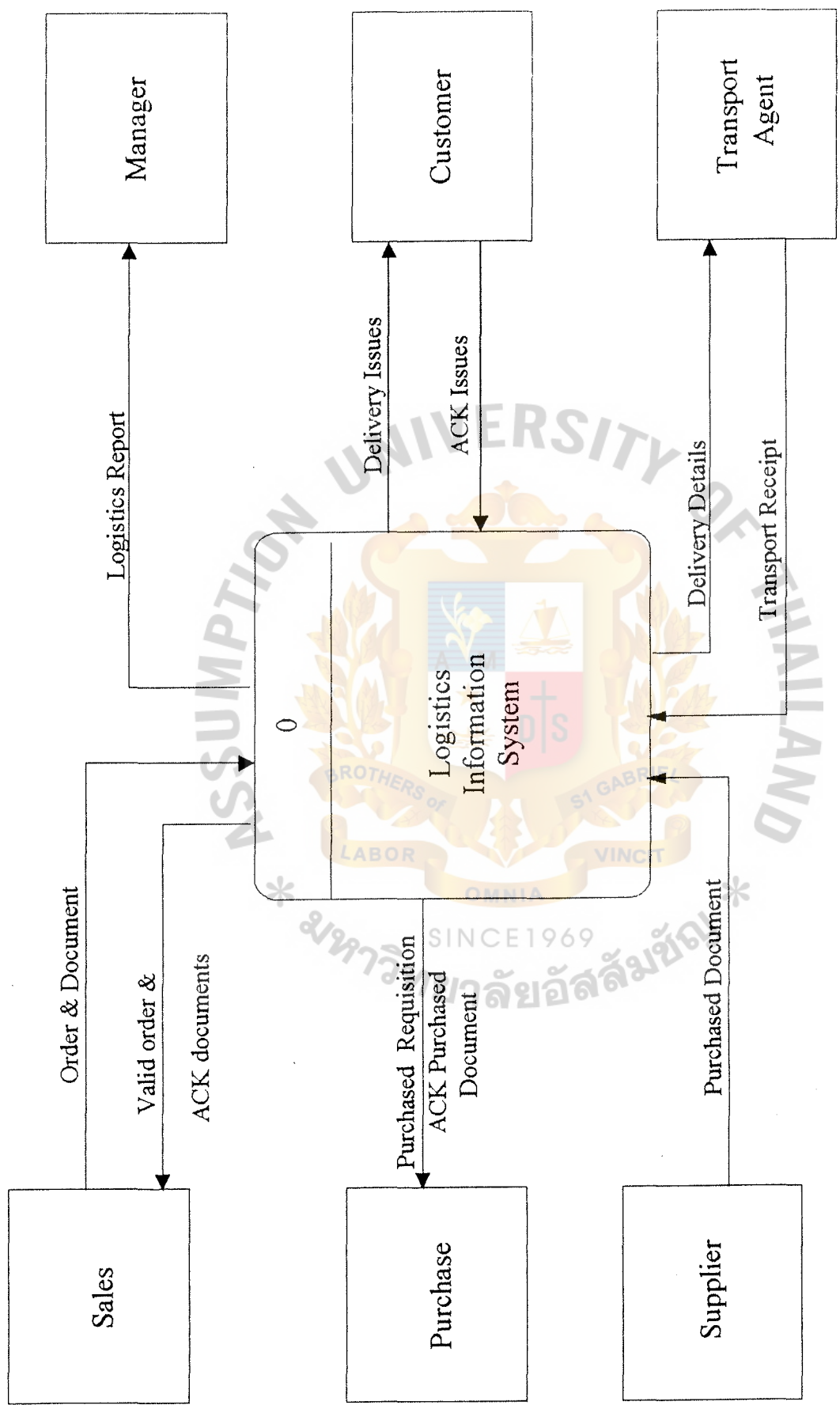


Figure 2.2. Context Level Data Flow Diagram of the Existing Information System.

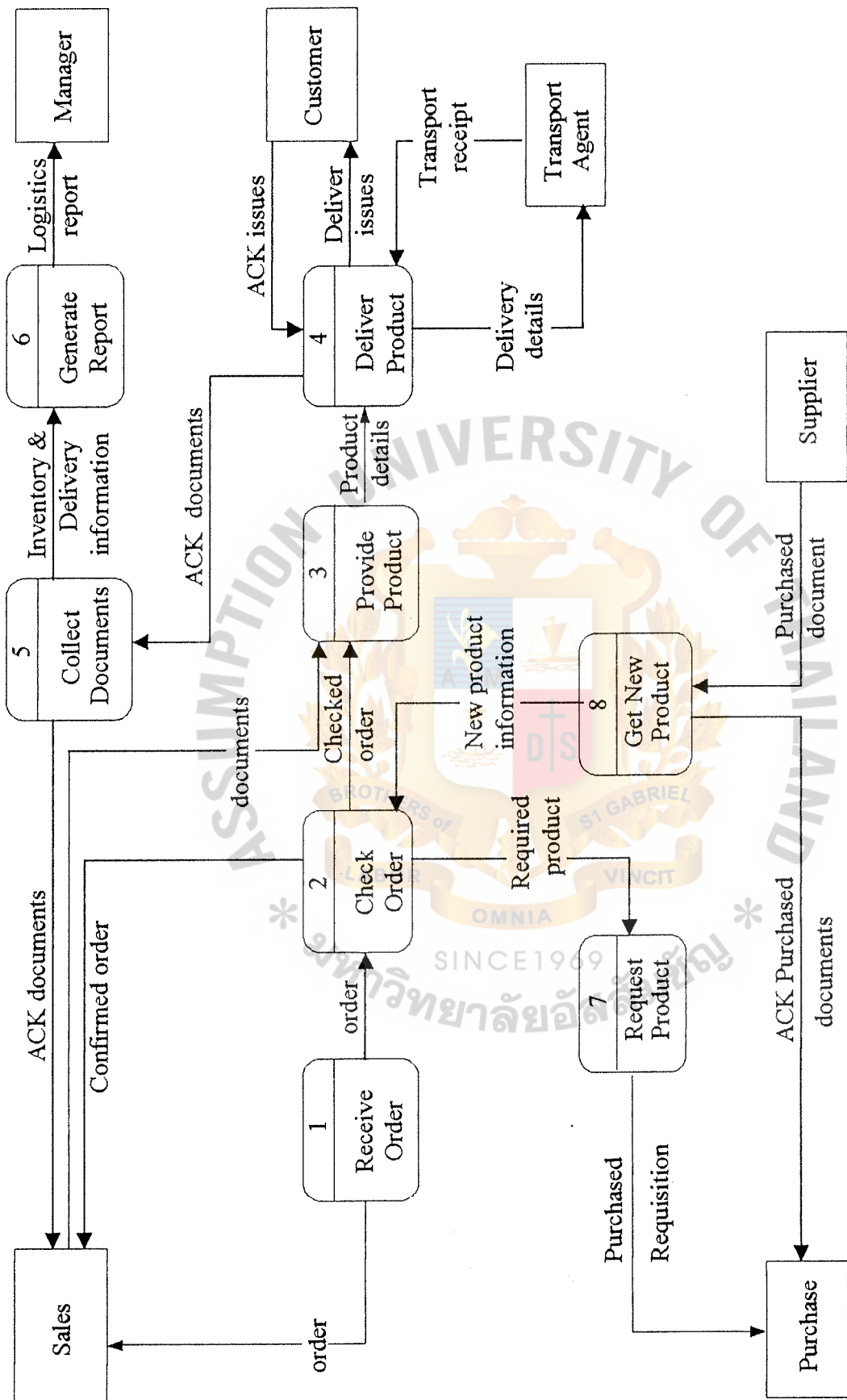


Figure 2.3. Level 0 Data Flow Diagram of the Existing Information.

III. THE PROPOSED SYSTEM

3.1 User Requirements

The proposed system is designed to solve the existing problems and fulfill the user requirements, which bases on not only the warehouse department but also the whole company. These requirements are very essential for developing the system successfully. This system development emphasizes on the suitable budget, timeliness, convenient operations, and system maintenance.

The user requirements are defined as:

- (1) To improve the logistics management, both inventory and shipment parts.
- (2) To provide accurate and up-to-date information to the Warehouse, Sales, and Purchase departments.
- (3) To provide efficient reports and information to support the management in decision making.
- (4) To be able to check errors occurred during operations.
- (5) To control the accuracy of work.
- (6) To provide friendly user interface with ease of use.
- (7) Reliability and fault to tolerance.

3.2 System Design

The proposed system is designed to provide the best solution for the existing logistics system, fulfill the requirements, and be friendly to end users. Also, the clear and complete specifications of computer-based technique are presented in this new system.

According to the requirements, three candidate solutions are proposed to respond

to those demands. First of all, the characteristics of three candidates are considered. The alternative candidates are defined with various features such as portion of system computerized, hardware, software, input / output, data processing, and storage. All these features are presented in Table 3.1. and Table 3.2. as follows:

Table 3.1. Candidate Systems Matrix.

Characteristics	Candidate1	Candidate2	Candidate3
Portion of System Computerized	Inventory Management and shipment operations in relation to logistics and surroundings.	Inventory and Shipment operations as software package can customize to satisfy the logistics system.	Same as Candidate1
Benefits	Fully supports user required business processes for logistics information system. Also, more efficient interaction in the whole company.	This solution can be implemented quickly because it is a purchased solution.	Same as Candidate1
Servers and Workstations	Technical architecture dictates Pentium III, Microsoft Windows Network Class servers and Pentium, Microsoft Windows 2000 professional	Same as Candidate1	Same as Candidate1
Software Tools Needed	Microsoft Visual Basic 6.0 Microsoft Access 2000	Genius Inventory Software Package would be purchased. Lotus Approach 97 for customization of package to provide report writing and integration.	Microsoft Visual C++ Microsoft Access 2000
Application Software	Custom Solution	Package Solution	Same as Candidate1

Table 3.1. Candidate Systems Matrix (Continued).

Characteristics	Candidate1	Candidate2	Candidate3
Method of Data Processing	Client / Server	Same as Candidate1	Same as Candidate1
Output Devices	(1) HP laser jet 1100 (4) Epson LQ 2180i	(1) HP Desk Jet 690C (2) Epson LQ 2180i	Same as Candidate2
Input Devices	Keyboard and Mouse	Same as Candidate1	Same as Candidate1
DBMS and Storage Devices	Microsoft SQL Server DATABASES with 30GB. Arranged capability	Same as Candidate1	Same as Candidate1

Furthermore, all alternative candidates are analyzed for feasibility by evaluating against four sets of criteria: Technical part, Operational part, Economic part, and Schedule part. The whole details are contained in Table 3.3. and Table 3.4.

(1) Technical Feasibility

There are two aspects to be measured in this part. Technology is an assessment of the maturity, availability (or ability to acquire), and desirability of the computer technology needed to support this candidate. Another one is Expertise, it is an assessment of the technical expertise needed to develop, operate, and maintain the candidate system.

(2) Operational Feasibility

There are two aspects to be considered here. Functionality is a description of to what degree the candidate would benefit the organization and how well the system would work. Political Feasibility, next, is a description of how well received this solution would be from user management, user, and organization perspective.

(3) Economical Feasibility

This refers to the evaluation of Cost to develop, Payback period, Return on investment, and Net present value.

(4) Schedule Feasibility

This feasibility refers to an assessment of how long the solution will take to design and implement.

Table 3.2. Feasibility Analysis Matrix.

Feasibility Criteria	Weight	Candidate1	Candidate2	Candidate3
Operational Feasibility -Functionality -Political	30%	Completely supports current user required functionality Score: 90	Only supports Inventory requirements and current logistics processes would have to be modified to take advantage of software functionality Score: 80	Same as Candidate1 Score: 90
Technical Feasibility -Technology -Expertise	30%	All hardware is available in the market and reliable. Required to hire or to train the computer expertise to perform modification for integration requirements. Score: 85	All hardware is powerful and reliable. The custom solution requires the expertise in Lotus Approach that is widely used and reliable. The training for the technical user is also required. Score: 85	All hardware is available in the market. The computer expertise is required. The training for technical users' also required. Score: 75

Table 3.2. Feasibility Analysis Matrix (Continued).

Feasibility Criteria	Weight	Candidate1	Candidate2	Candidate3
Economic Feasibility Cost to develop: Payback period (discounted): Return On Investment (ROD): Net Present Value (NPV): (Calculation details in Appendix A)	30%	Approximately 990,000.00 Approximately 3 years Approximately 16.79% Approximately 1,642.954.00 Score: 90	Approximately 1,200,000.00 Approximately 4 years Approximately 7% Approximately 692,044.00 Score: 65	Approximately 850,000.00 Approximately 3 years Approximately 11.50% Approximately 817,268.40 Score: 75
Schedule Feasibility	10%	Not exceed 4 months Score: 80	Not exceed 3 months Score: 85	Not exceed 4 months Score: 80
Ranking	100%	87.50	77.50	80.00

According to the above Feasibility Analysis Matrix, the Candidate1, which is a custom solution is selected. The company can design the suitable system for company' s requirements as well as its environment.

Attention to the system design of the Candidate1, it firstly focuses on Geography, Data, Processes and Interface Architecture.

(1) Geography or Network Technology

The proposed logistics information system will apply Distributed Data or Two-tiered client/server for network architecture. It places the information system's stored data on a server and the business logic and user interfaces on the clients.

A Local Area Network or LAN is the most appropriate technique of this system. It is a set of client computers connected to the server via cable relatively short distances. Moreover, file servers will adopt to store the database although the client computers must execute all database instructions.

The clients in the Distributed Database typically run the business logic of the information system application. This logic is written in Microsoft Visual Basic.

Separating data and business logic of Distributed Data Architecture enhances to isolate each from changes to the other, make the data more available to users, and retain the data integrity of centralized computing through centrally managed servers.

Increasingly, the proposed system will apply Star Topology technique for the computer connection. This topology links multiple computer systems through a central computer, which does not have to be a mainframe or minicomputer. It could be an application server that manages the transmission of data and messages between the other clients.

Network Configuration of the proposed logistics information system is shown in Figure 3.1.

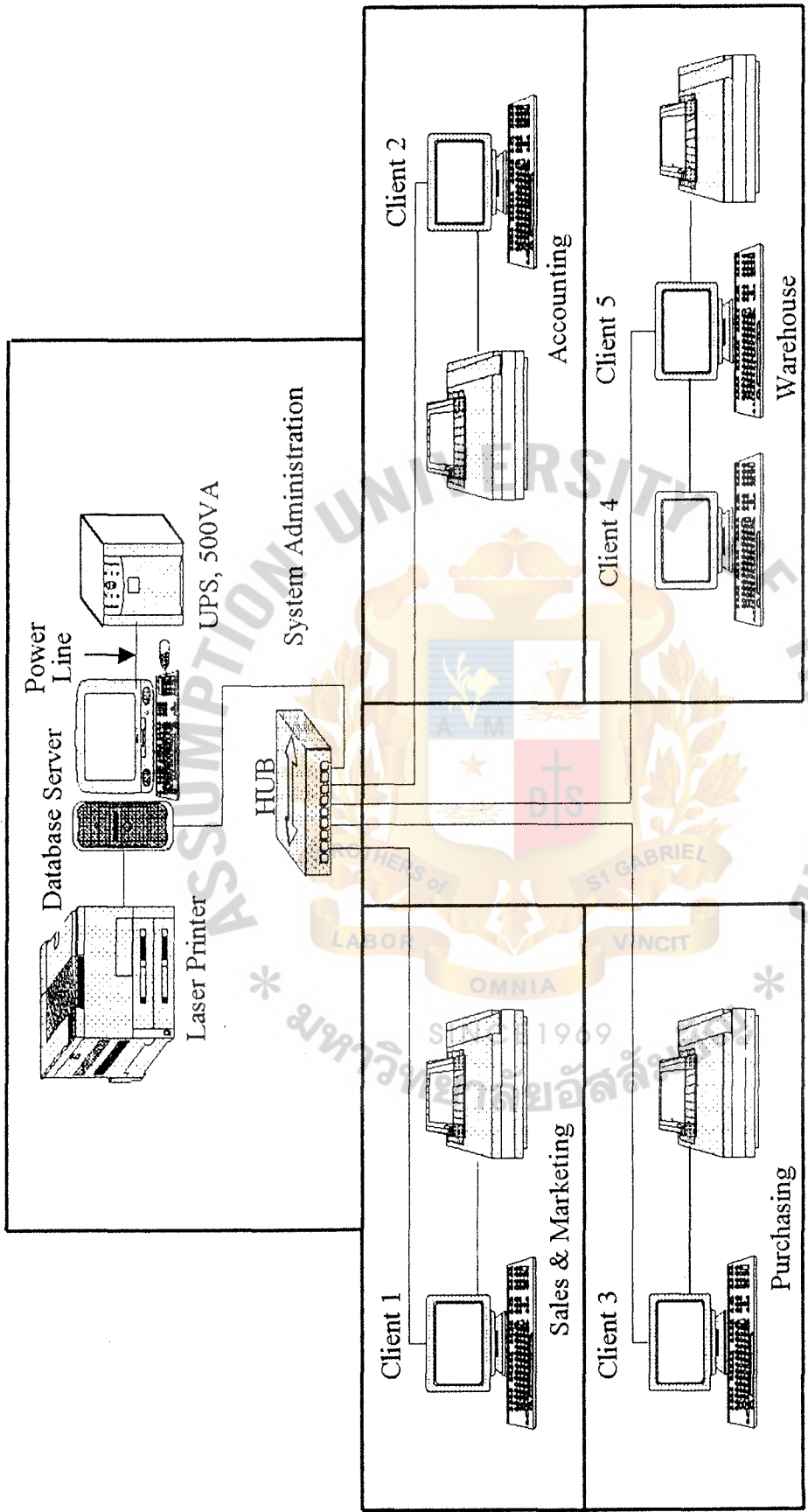


Figure 3.1. Network Configuration of the Proposed Logistics Information System.

(2) Data Architectures

Distributed Relational Database of the proposed system store data in a tabular form. Each file is implemented as a table and related records between tables are implemented by intentionally duplicating columns among tables.

The software required to implement Distributed Relational Database is called Distributed Relational Database Management System or Distributed RDBMS. It is a software program that controls access to and maintenance of the stored data. It also provides for backup, recovery, and security.

(3) Process Architectures

Software development environment is defined to use for developing the business logic and application programs. It is a language and toolkit for constructing information system applications.

As the proposed system, the typical software development environment for two-tiered client/server applications consists of client-based programming language with built-in Microsoft Visual Basic connectivity to the server database engines.

(4) Interface Architectures

Batch Input/ Output Processing is adapted in the proposed system. The transactions are accumulated into batches for periodic processing. The batch inputs are processed against master files. Transaction files may also be created or updated by the transactions. Most outputs tend to be generated to paper on a scheduled basis. Others might be produced on demand or within a specified time period.

Before the computer files and databases are designed for the target system, some additional analysis and address distribution issues of the data should be reconsidered, including:

(1) Data Flow Diagram

The diagram is structured analysis and design tools that allow the analyst to comprehend the system and subsystems as a set of interrelated data flows. It is useful for simply understanding the logical movement of data throughout a business. Data Flow Diagram of the Proposed Logistics Information System is shown in Appendix B.

(2) Database Design

This design is the process of translating logical data models into physical database schemas. Database Design of the proposed project is presented in form of Entity Relationship Diagram as illustrated in Appendix E.

(3) User Interface Design

The user interface is the specification of a communication between the system user and computer. It could provide a friendly means by which the user can interact with the application to process inputs and obtain outputs. Therefore, the design should be emphasized on the user requirement and acceptance. The proposed user interface design figures in Appendix G.

(4) Output Design

Output is the useful information or data delivered by the decision support system to the user. Therefore, output design should serve the intended purpose, fit the user, deliver the right quantity of output, deliver to

the right place, provide output on time, and select the right output method.

The output design is shown in Appendix H.

3.3 Hardware and Software Requirements

Client/Server model is selected for the developed system in Candidate1. The client will run business logic of the delivery information system application. Program will execute on client, which improves application efficiency. As while all information will be stored in server. The hardware and software specifications for the Proposed Logistics Information System are illustrated as follows:

Table 3.3. The Hardware Specifications for the Server.

Hardware	Specification
CPU	Pentium III 750 MHz
Cache	256 KB
Memory	64 MB
Hard Disk	20 GB
CD-ROM Drive	52X
Floppy Drive	1.44 MB
Network Adapter	LAN Adapter
Display Adapter	SVGA card
Display	14" SVGA color monitor
UPS	500 VA
Printer	Laser Printer

Table 3.4. The Software Specifications for the Server.

Software	Specification
Operating System	Microsoft Windows NT Server 4.0
Database Server	Microsoft Access

Table 3.5. The Hardware Specifications for the Clients.

Hardware	Specification
CPU	Pentium III 450 MHz
Cache	256 KB
Memory	64 MB
Hard Disk	10 GB
CD-ROM Drive	52X
Floppy Drive	1.44 MB
Network Adapter	LAN Adapter
Display Adapter	SVGA card
Display	14" SVGA monitor
Printer	Inkjet Printer

Table 3.6. The Software Specifications for the Clients.

Software	Specification
Operating System	Microsoft Windows 2000
Application Software	Microsoft Office 2000

3.4 Security and Controls

Since the information is one of key organizational resources, security is recognized to be necessary in company. Security is classified to three portions.

(1) Physical Security

Securing the computer facility, its equipment and software through physical means.

- (a) Discretionary Security Protection System or Discretionary Access Control.
- (b) Human Sign: In/Out System.
- (c) Backup data frequently.

(2) Logical Security

This refers to logical controls within software itself.

(a) System Security

Users should enter the login name and correct password before using the system.

(b) Application Security

It is able to being used for protection data from unauthorized or non-privileged users.

(3) Backup and Recovery Process

Backup of data and operations are necessary so that they can be recovered in case of emergency. System administration will maintain back up all system configurations file once a week.

(4) Virus Protection

All client/server machines are installed virus protection programs.

Anyway, system administration has to often update program version and data file.

3.5 System Cost Analysis

Cost and benefit analysis has been used to evaluate the feasibility of the proposed system. The costs of both the traditional and the proposed system are compared during the limited time. Also, Payback Period and Break-even Point Analysis, Return On Investment, and Net Present Value are chosen in this feasibility analysis.

(1) Cost Estimation

Evaluating the resources that will be required to develop and operate a system derives the cost. The cost can be divided into two costs. Development Cost, firstly, are the resources that deal with the initial cost. It is composed as following;

- (a) Salaries for analyst, designer, and programmer.
- (b) Computer Hardware and Software
- (c) Supplies
- (d) Site Preparation
- (e) User training and documentation

Another one is operating costs that occur on a daily basis transaction, including:

- (a) Salaries for data processing staff
- (b) Hardware and Software Maintenance
- (c) Supplies
- (d) Utilities and Miscellaneous Costs

(2) Benefit Estimation

Most benefits can be measured as either an increase in revenues or decrease in expenses. Benefit can be categorized to Tangible Benefit and Intangible Benefit. Tangibles Benefits are those that can be assigned money value that are tied directly to the installation on the new system. The tangible benefits include:

- (a) More efficient use of data processing.
- (b) Supply costs deduction.
- (c) Provision of services like reports, trendy analysis, and query.
- (d) Ability to improve the operating efficiency with a smaller inventory on hand.

Intangible benefits are difficult to measure in physical values. It is the positive effective to the company that cannot be touched directly. Followings are some intangible benefits of the company.

- (a) Increase more productivity to encourage customer satisfaction.
- (b) Reduce volume of paper to be operated.
- (c) Reduce Human Error.
- (d) Reduce redundancy process.
- (e) Provide fast access information
- (f) Improve management control
- (g) Etc.

(3) Breakeven Analysis

This analysis is a potential technique for the cost comparison between the proposed system (Candidate1) and the existing system. The point at Breakeven Analysis identifies the equilibrium point of both systems. It

determines the break-even capacity of the proposed information system. Break-even Analysis is shown in Table 3.9. and Figure 3.2.

(4) Payback Period Analysis

This technique accesses whether a business should invest in a proposed information system. It determines the number of years of operation that the information system needs to pay back the cost of investing in it. The technique is shown in Appendix A.

Candidate Solution 1: Payback period is approximately 3.8 years

Candidate Solution 2: Payback period is approximately 4 years

Candidate Solution 3: Payback period is approximately 3.5 years

Since the fastest return investment is the best solution for this technique, the candidate solution 3 is the best one here. However, the result of candidate solution 1 is also closely to the result of the best one. Therefore, it is also acceptable for the candidate solution 1.

(5) Return On Investment (ROI)

ROI compares the lifetime profitability of alternative solutions. It presents in percentage rate that measures the relationship between the amount the company gets back from the investment and the amount invested. The ROI calculation is displayed in Appendix A.

Candidate Solution 1: Return On Investment is 16.79 %

Candidate Solution 2: Return On Investment is 7%

Candidate Solution 3: Return On Investment is 11.5%

Since the most percentage ROI is the best alternative, the candidate 1 is selected in this technique. Its percentage value is acceptable for the investment in this logistics information system.

(6) Net Present Value (NPV)

This is the preferred cost-benefit technique by many managers. It determines the adjustment of all costs and benefits back to present values. The investment is good if the net present value is positive. An alternative candidate solution, which has the highest positive net present value, is the best investment. The NPV is calculated in Appendix A.

Candidate solution 1: Net Present Value is 1,642,954.00.

Candidate solution 2: Net Present Value is 692,044.00.

Candidate solution 3: Net Present Value is 817,268.40.

As the positive Net Present Value refers to a good investment, all candidate solutions above are acceptable for the investment. Nevertheless, the candidate solution 1 has got the most value. This candidate solution, therefore, is considered to be the most potential investment.

Table 3.7. The Cost Comparison of the Computerized System and the Manual System, Baht.

Cost Items	Years				
	1	2	3	4	5
<u>Manual System:</u>					
Fixed Cost:					
Equipment	17,850.00	-	-	-	-
Annual Operating Cost:					
Salary Expenses (Increased by 10%)	2,520,000.00	3,564,000.00	3,920,400.00	4,312,440.00	4,743,684.00
Office Supplies (Increased by 5%)	258,000.00	270,900.00	284,445.00	298,667.25	318,600.00
Miscellaneous Cost (Increased by 5%)	24,000.00	25,200.00	26,460.00	27,783.00	29,172.15
Utilities Cost (Increased by 5%)	48,000.00	50,400.00	52,920.00	55,566.00	58,344.30
Total Manual System Cost	2,867,850.00	3,910,500.00	4,284,225.00	4,694,456.25	5,149,800.45
Cumulative Manual System Cost	2,867,850.00	6,778,350.00	11,062,575.00	15,757,031.25	20,906,831.70
<u>Computerized System:</u>					
Development Cost:					
Server and Storage Devices	450,000.00	450,000.00	450,000.00	450,000.00	450,000.00
Workstations 5 units @ 40000	200,000.00	200,000.00	200,000.00	200,000.00	200,000.00
Software Tool	80,000.00	80,000.00	80,000.00	80,000.00	80,000.00
Application Software	200,000.00	200,000.00	200,000.00	200,000.00	200,000.00
Training Cost	40,000.00	-	-	-	-
Setup Cost	20,000.00	-	-	-	-
Annual Operating Cost:					
Salary Expenses (Increased by 10%)	1,800,000.00	1,980,000.00	2,178,000.00	2,395,800.00	2,635,380.00
Office Supplies (Increased by 5%)	168,000.00	176,400.00	185,220.00	194,490.00	205,216.00
Miscellaneous & Utilities Costs	96,000.00	100,800.00	105,840.00	111,140.00	118,700.00
Maintenance Costs	-	-	-	20,000.00	18,000.00
Total Computerized System	3,054,000.00	3,187,200.00	3,399,060.00	3,651,430.00	3,907,296.00
Cumulative Computerized cost	3,054,000.00	6,241,200.00	9,640,260.00	13,291,690.00	17,198,986.00
Cumulative Difference	-186,150.00	537,150.00	1,422,315.00	2,465,341.25	3,707,845.70

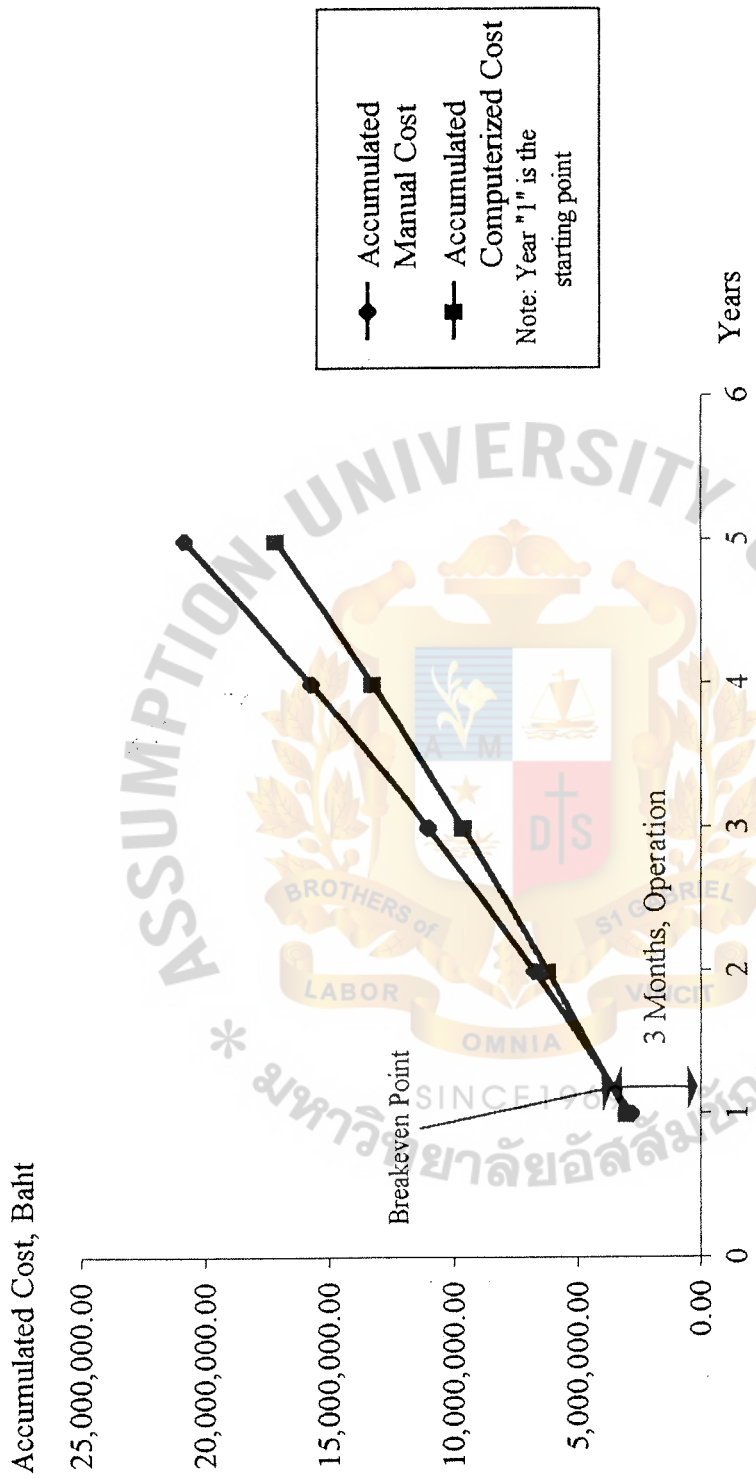


Figure 3.2. Breakeven Point Analysis.

According to Figure 3.2. where year 1 is the starting point, the cumulative cost of manual system and the cumulative cost of computerized system are presented. An intersect-point represents the Breakeven Point.

As the time increases, the costs of the manual system rise at the increasing rate. The computerized system would cost a substantial sum up front, but the incremental costs for higher volume would be rather small. This identifies that the computerized system estimates to gain the cost-effective before the second year. The proposed computerized system, therefore, is acceptable for the logistics information system of Electrical Equipment Trading Business.



IV. SYSTEM IMPLEMENTATION

4.1 Overview of Project Implementation

System Implementation is the process of putting the design specifications for the new information system in actual operation. Beginning with Construction Phase, it is aimed to build and test a functional system that fulfills business and design requirements and to implement the interfaces between the proposed system and the traditional system.

Deliver Phase, the following phase of System Implementation, is operated for transferring the proposed system to execution. To achieve this phase, the following objectives must be accomplished.

- (1) Conducting a system test to ensure that the new system works properly.
- (2) Preparing a conversion plan to provide a smooth transition to the new system.
- (3) Installing databases to be used by the new system.
- (4) Providing training and documentation for individuals, who will be using the new system.
- (5) Converting from the old system to the new system and evaluating the project and final system.
- (6) Recruiting the computer professional staff in order to handle and control the system.

4.2 Test Plan

Testing of the proposed system is done for checking the accuracy of the new system. It is divided into three portions: program testing, system testing, and process testing.

First of all, program testing, the phase will create valid and invalid test data, including software, input, output, program and databases. Also, it will test all possible cases and it is done until all subsystems function properly.

System performance is considered secondly, this test will verify that the application programs work properly when they are integrated into the total system.

Lastly, process testing will examine the rule for the transaction, the workload, and the method for processing multiple tasks. It means that the system must be able to process the tasks simultaneously.

4.3 Conversion Plan

Parallel Conversion is selected for conversion strategy of Implementation Phase. This refers to running the old system and the new system simultaneously, in parallel. Both systems are run at the same time for a specified period of time, and the reliability of results is examined. When the same results can be gained over time, the new system is put into use, and the old is stopped.

Gradually, running both systems in parallel gains the possibility of checking new data against old data in order to catch any errors in processing in the new system. Also, parallel processing offers a feeling of security to users, who are forced to make an abrupt change to the new system.

4.4 Training

End users are introduced to the functionality of new system via a one-on-one and / or group lecture program. Additionally, in order to support a smooth transition to the new system, training program covers the following topics.

- (1) Purpose and objectives of the system.
- (2) Difference between the existing and the proposed system.
- (3) Overview of the system operation and procedures.
- (4) Duties and responsibilities of end users.
- (5) Demonstration of the system.
- (6) Familiarization to use the system with test data.



V. CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

J.C. Trading Company has expanded rapidly, and more product lines have been added in the system. The existing manual cannot respond to the growing demands of business functions system. A lot of problems are confronted in the traditional system; including increasing workloads, outdated information, inaccuracy and redundancy information, inefficient work, time-consuming customer services, inability to communicate among several departments, customer dissatisfaction and lack of efficient report for planning and decision making. Computerized system, consequently, is required to assist the existing system. Moreover, the new computerized system will improve and develop the business operation to be effective and efficient in the competitive edges.

The existing problems, opportunities and objectives are initially considered in the proposed project. The information requirements are determined next for the particular users involved. Interviewing, observing and investigating hard data are the tools used to define the user requirements. Defining the alternative candidate solutions is the next step. Three candidates are proposed and they are evaluated by using System Matrix Analysis and Feasibility Matrix Analysis. Candidate1 is chosen to be the candidate solution with the percentage result 87.50.

What the analysis system needs is the next consideration. The data flow diagram is one of the alternative tools for charting the input, processes, and output of the business's functions into a structured graphical form. A data dictionary and process specifications are also developed in order to list all of the data items used in the system.

At this point, the feasibility analysis is performed to measure how beneficial or practical development of proposed information system will be to the company. Cost/Benefit Analysis is applied at this stage and found that the cost of the manual system is less than the computerized system only in the first year. The comparison of both systems' costs are shown on the Break-Even Point illustration, and Payback Period Analysis estimates that the proposed system will get return within 4 years.

Increasingly, the logical design of the information system is accomplished by applying the information collected earlier. At first, the database design selected Microsoft Access to be the application program since it is simply used and has a very user friendly interface. Also, the accurate data-entry procedures like User Interface and Input / Output procedures are designed for providing the effective input to the information system.

Before the new computerized system can be used, it must be tested. A series of tests to particular problems are run first with sample data and eventually with actual data from the existing system.

The information system, finally, is implemented by training users to handle the system. Additionally, Conversion Plan is required to plan to smoothly convert the old system to the new system.

Table 5.1 shows the time spent on each process of the Proposed System compared with the Existing System. It identifies that each process of the Proposed System spends less time than the Existing System one. This can describe that the Proposed System is more effective and efficient than the Existing System.

Table 5.1 Comparison of Degree of Achievement between the Proposed System and the Existing System.

Process	Existing System	Proposed System
Receive Order Process	25 minutes	10 minutes
Delivery Process	30 minutes	15 minutes
Modification Process	1 hour 30 minutes	30 minutes
Documentation Process	20 minutes	5 minutes
Generate Report Process	30 minutes	10 minutes
Total	3 hours 15 minutes	1 hour 10 minutes

According to Table 5.1. the proposed system can save around two hours and five minutes in the operating process. In the proposed system, receiving order process, delivering order process, and modification process spend less time than the existing system because the efficiency of database system. For the documentation process, all required information is provided in the electronic form, it is more convenient and can save more time than the existing system. Increasingly, the proposed system can generate report that is more precise and timely than the existing one since the electronic service report template assists the process.

5.2 Recommendations

After the proposed information system is installed, some maintenance should be considered. The computer program must be modified and kept up-to-date in order to correct software errors and enhance the software's capabilities in response to changing company requirements.

Moreover, there are some recommendations that make the proposed system more beneficial in the future.

- (1) Data-Entry technology like barcode system will be instructed next in order to improve the time consumed and be more productive.
- (2) In order to be more potential, high-end database software like Oracle and Microsoft SQL Server will be processed.
- (3) Database Servers tend to be designed instead of file servers. It is able to generate much less network traffic since it is unnecessary to execute all database instructions like in file servers.
- (4) Remote Batch will apply in future Interface Architecture. It is the combination of batch and on-line I/O. This technology will encourage the system to update the record on real time basis.
- (5) The company intends to expand into the E-Commerce System in the future. Since the Internet is convenient, fast, and costly for business communication, the company should begin to learn and train the staff to use the Internet. The company will also have its own websites in which the interesting information of the company is presented.



APPENDIX A
FEASIBILITY ANALYSIS

Table A.1. The Cost of Candidate1, Baht.

Cost Items	Cost Amounts
Development Costs:	
Server and Storage Devices	450,000.00
Workstations 5 units @ 40000	200,000.00
Software Tool	80,000.00
Application Software	200,000.00
Set Up Cost	20,000.00
Training Cost	40,000.00
Total Development Costs	990,000.00
Operating Costs:	
Salary Expenses	1,800,000.00
Office Supplies	168,000.00
Miscellaneous & Utilities Costs	96,000.00
Maintenance Costs	-
Total Computerized Costs	2,064,000.00

Remarks:

Salary Expenses will increase approximately 10% a year.

Miscellaneous & Utilities Costs will increase approximately 5% a year

Maintenance Costs of Hardware and Software will be 20,000.00 and 18,000.00 in the fourth and the fifth year respectively.

Table A.2. Payback Period Analysis of Candidate1, Unit in Thousand, Baht.

Cost Items	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
evelopment costs	-990.000	-	-	-	-	-
Operating costs	-	-2,064.000	-2,257.200	-2,469.060	-2,701.430	-2,959.296
Discount factor for 12%	1	0.893	0.797	0.712	0.636	0.567
Time-adjusted costs	-990.000	-1,843.152	-1,798.988	-1,757.970	-1,718.110	-1,677.921
Cumulative time-adjusted costs over lifetime	-990.000	-2,833.152	-4,632.140	-6,390.110	-8,108.220	-9,786.141
Benefits derived from operating of new system	-	2,100.000	2,415.000	2,950.000	3,950.000	5,320.000
Discount factor for 12%	1	0.893	0.797	0.712	0.636	0.567
Time-adjusted benefits	-	1,875.300	1,924.755	2,100.400	2,512.200	3,016.440
Cumulative time-adjusted benefits over lifetime	-	1,875.300	3,800.055	5,900.455	8,412.655	11,429.095
Cumulative lifetime-adjusted costs + benefit	-990.000	-957.852	-832.085	-489.655	304.435	1,642.954

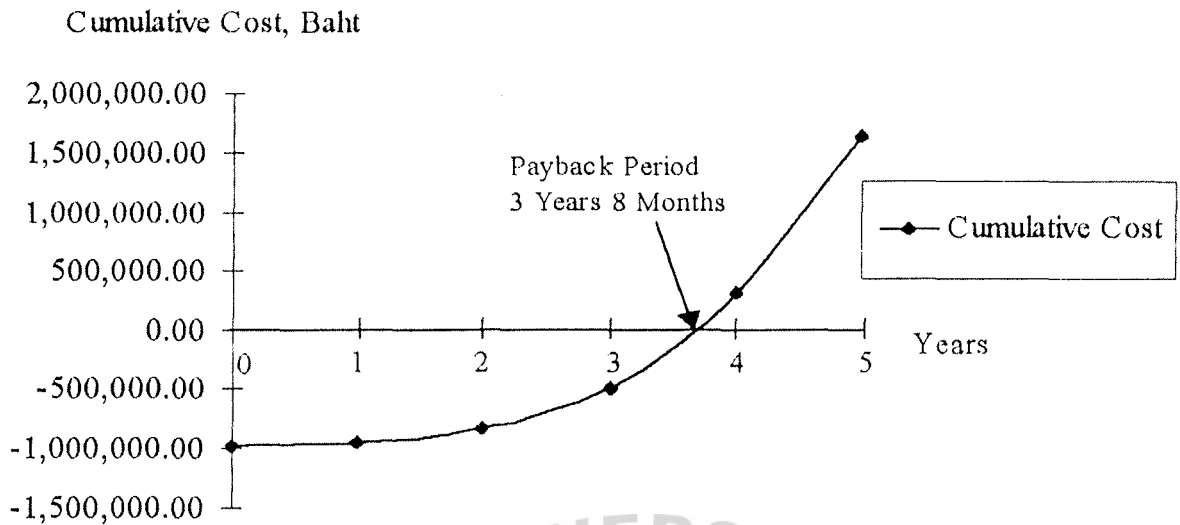


Figure A.1. Payback Analysis Chart of Candidate 1.

From the figure above, it illustrates a system of candidate 1 with a payback period of 3.8 years. That identifies the company will get the return from this within four years.

Return On Investment = (Estimated lifetime benefits – Estimated lifetime costs) /

Estimated lifetime costs

$$= (11,429,095 - 9,786,141) / 9,786,141$$

$$= 0.1679 \times 100$$

$$= 16.79\%$$

Net Present Value = Estimated lifetime benefits – Estimated lifetime costs

$$= 11,429,095 - 9,786,141$$

$$= 1,642,954$$

Table A.3. The Cost of Candidate2, Baht.

Cost Items	Cost Amounts
Development Costs:	
Server and Storage Devices	470,000.00
Workstations 5 units @ 40000	270,000.00
Software Tool	80,000.00
Application Software	280,000.00
Set Up Cost	40,000.00
Training Cost	60,000.00
Total Development Costs	1,200,000.00
Operating Costs:	
Salary Expenses	1,900,000.00
Office Supplies	168,000.00
Miscellaneous & Utilities Costs	132,000.00
Maintenance Costs	
Total Computerized Costs	2,200,000.00

Remarks:

Salary Expenses will increase approximately 10% a year.

Miscellaneous & Utilities Costs will increase approximately 5% a year.

Maintenance Costs of Hardware and Software will increase approximately 10% a year.

Table A.4. Payback Period Analysis of Candidate2, Unit in Thousand, Baht.

Cost Items	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Development costs	-1,200.000	-	-	-	-	-
Operating costs	-	-2,200.000	-2,420.000	-2,565.200	-2,873.024	-3,160.320
Discount factor for 12%	1	0.893	0.797	0.712	0.636	0.567
Time-adjusted costs	-1,200.000	-1,964.60	-1,928.740	-1,826.422	-1,827.244	-1,791.900
Cumulative time-adjusted costs over lifetime	-1,200.000	-3,164.600	-5,093.34	-6,919.762	-8,747.006	-10,538.906
Benefits derived from operating of new system	-	2,150.000	2,600.000	2,950.000	3,800.000	4,800.000
Discount factor for 12%	1	0.893	0.797	0.712	0.636	0.567
Time-adjusted benefits	-	1,919.950	2,072.20	2,100.400	2,416.800	2,721.600
Cumulative time-adjusted benefits over lifetime	-	1,919.950	3,992.15	6,092.550	8,509.350	11,230.95
Cumulative lifetime-adjusted costs + benefit	-1,200.000	-1,244.650	-1,101.19	-827.212	-237.656	692.044

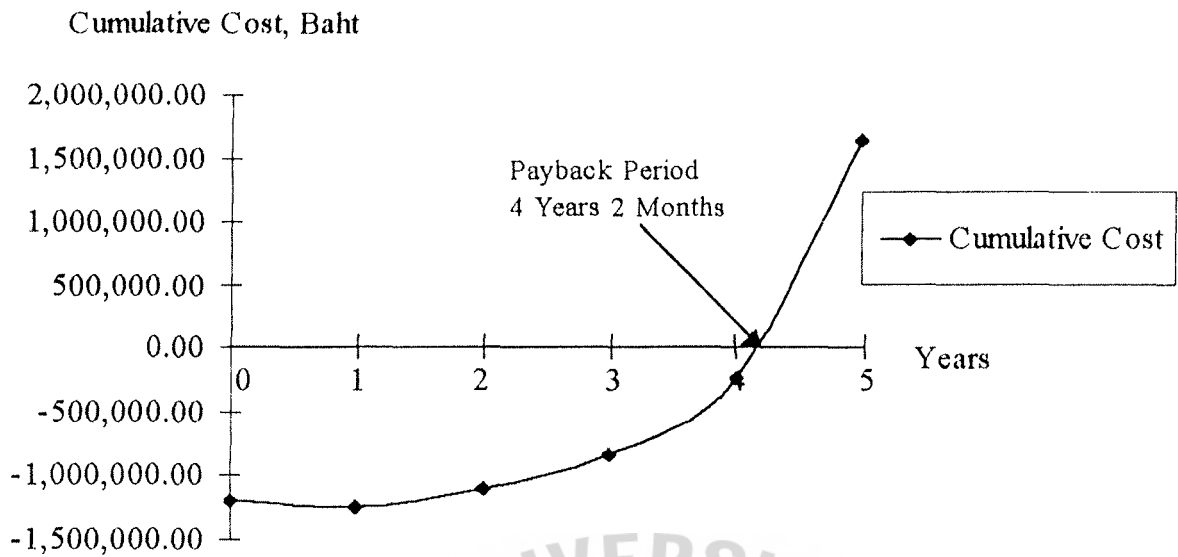


Figure A.2. Payback Analysis Chart of Candidate 2.

From the above, the cost value is positive after the fourth year, which identifies that within four years an investment of candidate 2 will get the return to itself.

$$\text{Return On Investment} = \frac{(\text{Estimated lifetime benefits} - \text{Estimated lifetime costs})}{\text{Estimated lifetime costs}}$$

$$\begin{aligned}
 &= \frac{(11,230,950 - 10,538,906)}{10,538,906} \\
 &= 0.07 \times 100 \\
 &= 7\%
 \end{aligned}$$

$$\text{Net Present Value} = \text{Estimated lifetime benefits} - \text{Estimated lifetime costs}$$

$$= 11,230,950 - 10,538,906$$

$$= 692,044$$

Table A.5. The Cost of Candidate3, Baht.

Cost Items	Cost Amounts
Development Costs:	
Server and Storage Devices	410,000.00
Workstations 5 units @ 40000	150,000.00
Software Tool	80,000.00
Application Software	150,000.00
Set Up Cost	20,000.00
Training Cost	40,000.00
Total Development Costs	850,000.00
Operating Costs:	
Salary Expenses	1,200,000.00
Office Supplies	170,000.00
Miscellaneous & Utilities Costs	80,000.00
Maintenance Costs	-
Total Computerized Costs	1,450,000.00

Remarks:

Salary Expenses will increase approximately 10% a year.

Miscellaneous & Utilities Costs will increase approximately 5% a year

Maintenance Costs of Hardware and Software will be 20,000.00 and 22,000.00 in the fourth and the fifth year respectively.

Table A.6. Payback Period Analysis of Candidate3, Unit in Thousand, Baht.

Cost Items	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Development costs	-850.000	-	-	-	-	-
Operating costs	-	-1,450.000	-1,595.000	-1,738.550	-1,947.176	-2,141.895
Discount factor for 12%	1	0.893	0.797	0.712	0.636	0.567
Time-adjusted costs	-850.000	-1,294.850	-1,271,215	-1,237.8476	-1,238.404	-1,214.455
Cumulative time-adjusted costs over lifetime	-850.000	-2,144.85	-3,416.065	-4,653.9126	-5,892.3166	-7,106.7716
Benefits derived from operating of new system	-	1,600.000	1,850.000	2,150.000	2,590.000	3,250.000
Discount factor for 12%	1	0.893	0.797	0.712	0.636	0.567
Time-adjusted benefits	-	1,428.800	1,474.75	1,530.800	1,647.240	1,842.750
Cumulative time-adjusted benefits over lifetime	-	1,428.800	2,903.25	4,434.050	6,081.290	7,924.04
Cumulative lifetime-adjusted costs + benefit	-850.000	-716.05	-512.815	-219.8626	188.9734	817.2684

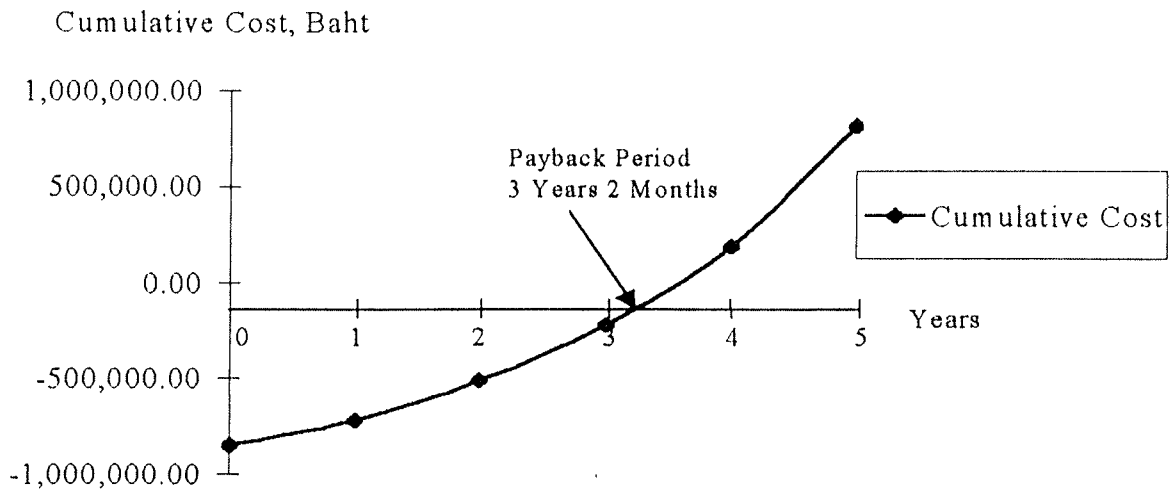


Figure A.3. Payback Analysis Chart of Candidate 3.

According to above figure, it shows that the graph cut the horizontal line on 3.2 point. The graph identifies that the company will get the payback from this investment during the first three years.

$$\begin{aligned}
 \text{Return On Investment} &= (\text{Estimated lifetime benefits} - \text{Estimated lifetime costs}) / \\
 &\quad \text{Estimated lifetime costs} \\
 &= (7,924,040 - 7,106,771.60) / 7,106,771.60 \\
 &= 0.115 \times 100 \\
 &= 11.5\%
 \end{aligned}$$

$$\begin{aligned}
 \text{Net Present Value} &= \text{Estimated lifetime benefits} - \text{Estimated lifetime costs} \\
 &= 7,924,040 - 7,106,771.60 \\
 &= 817,268.40
 \end{aligned}$$



APPENDIX B
DATA FLOW DIAGRAMS

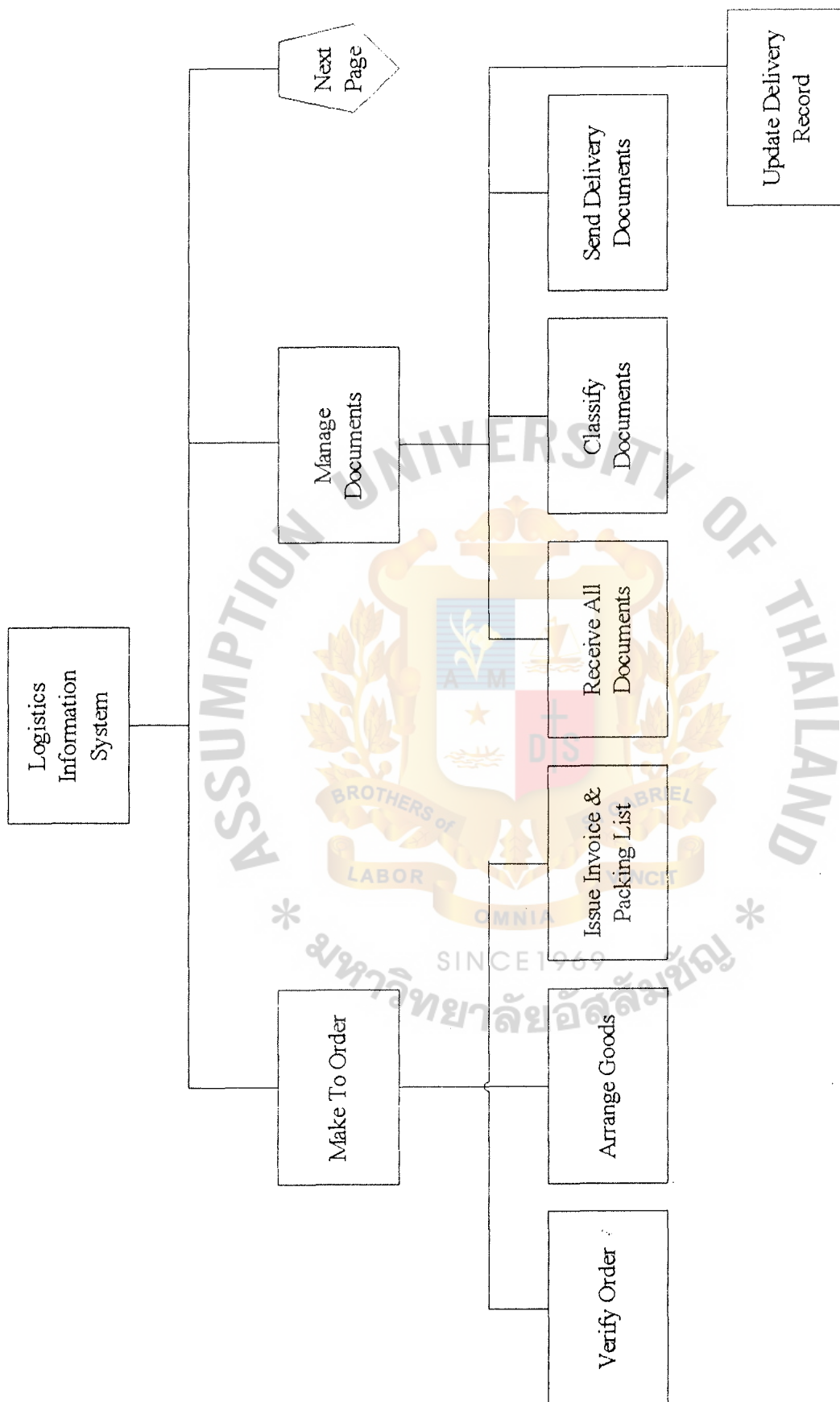


Figure B.1. Functional Decomposition Diagram of Logistics Information System (1).

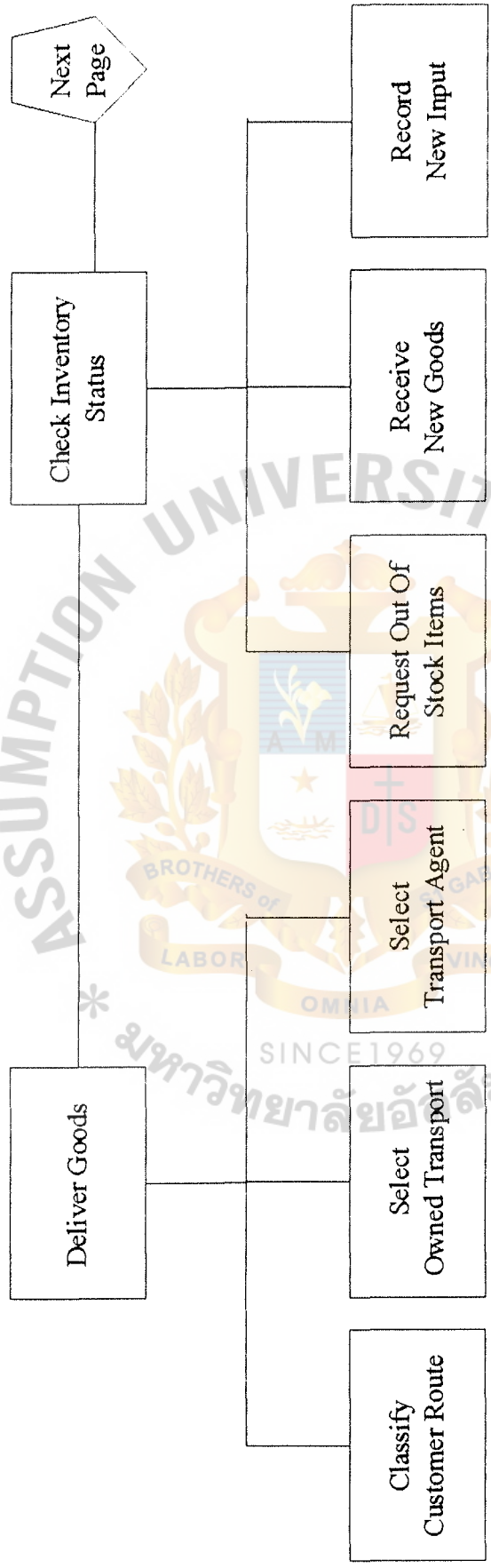


Figure B.2. Functional Decomposition Diagram of Logistics Information System (2).

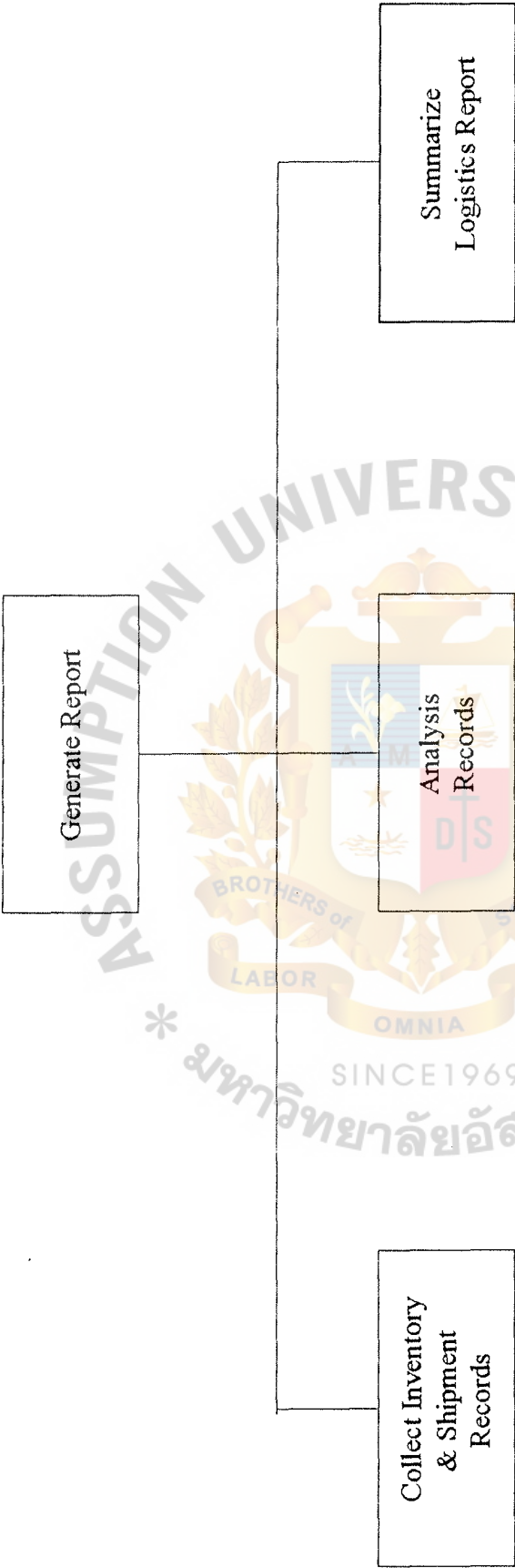


Figure B.3. Functional Decomposition Diagram of Logistics Information System (3).

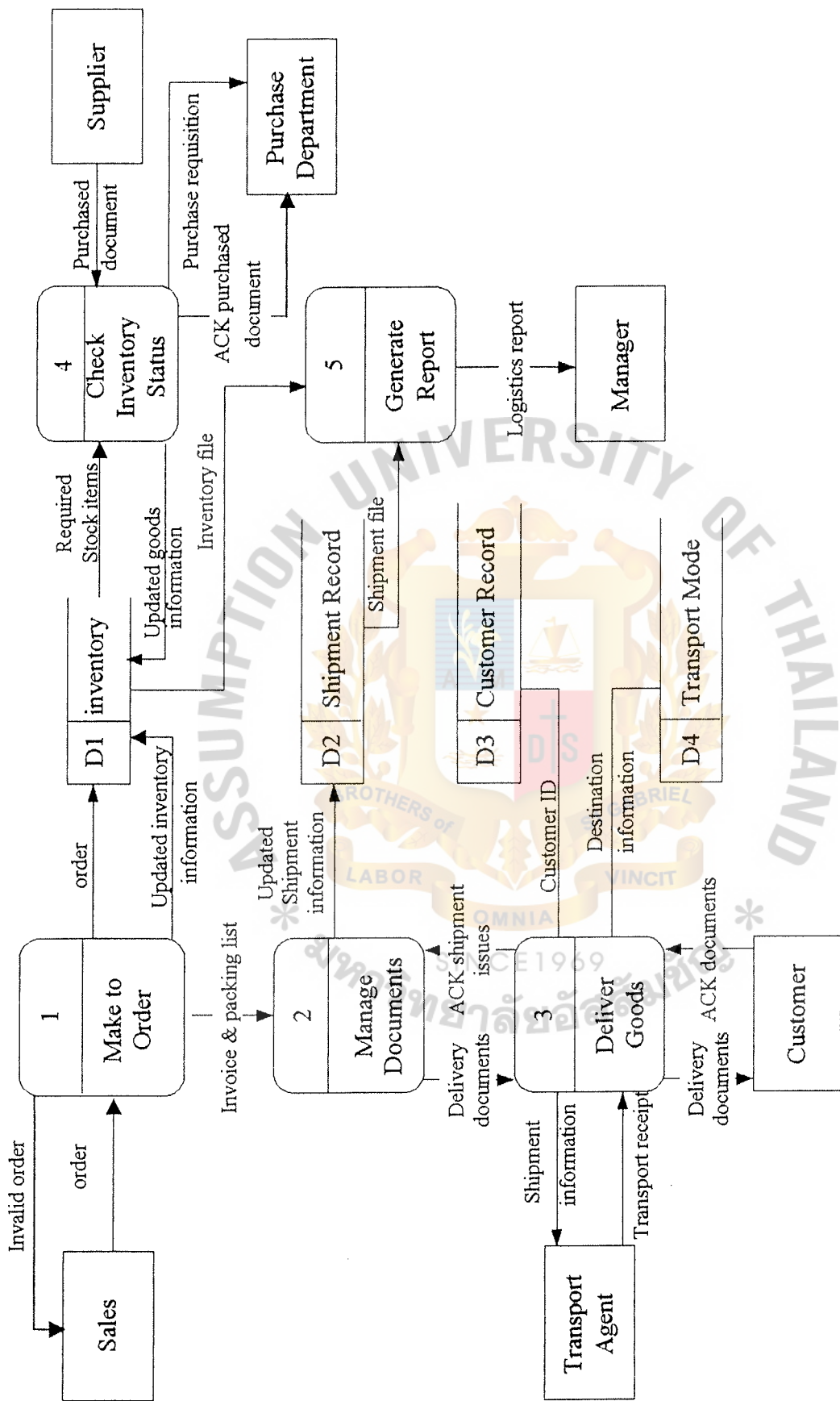


Figure B.4. Data Flow Diagram Level 0: Proposed Logistics Information System of J.C. Trading Company.

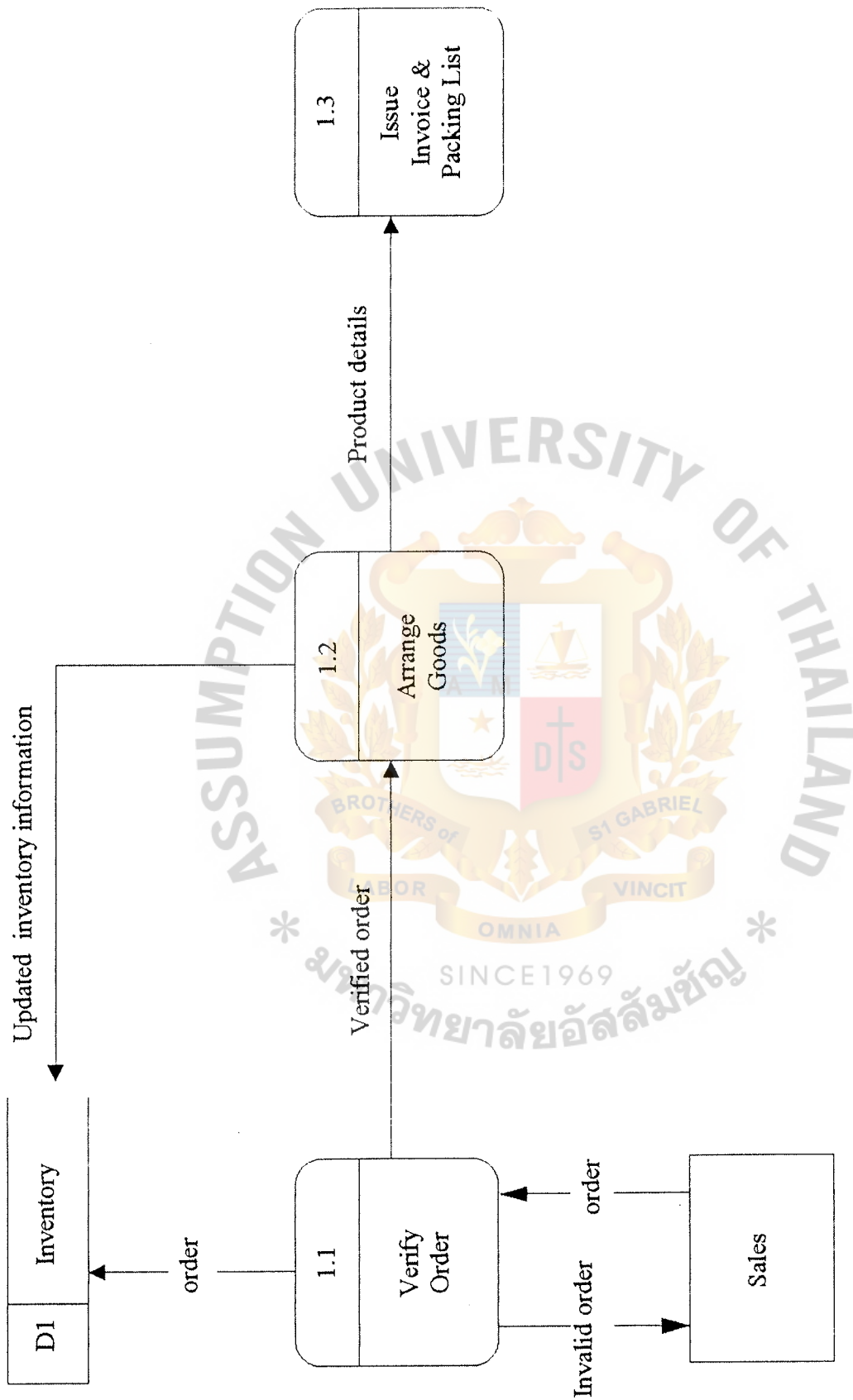


Figure B.5. Data Flow Diagram Level 1, Process 1: Make To Order.

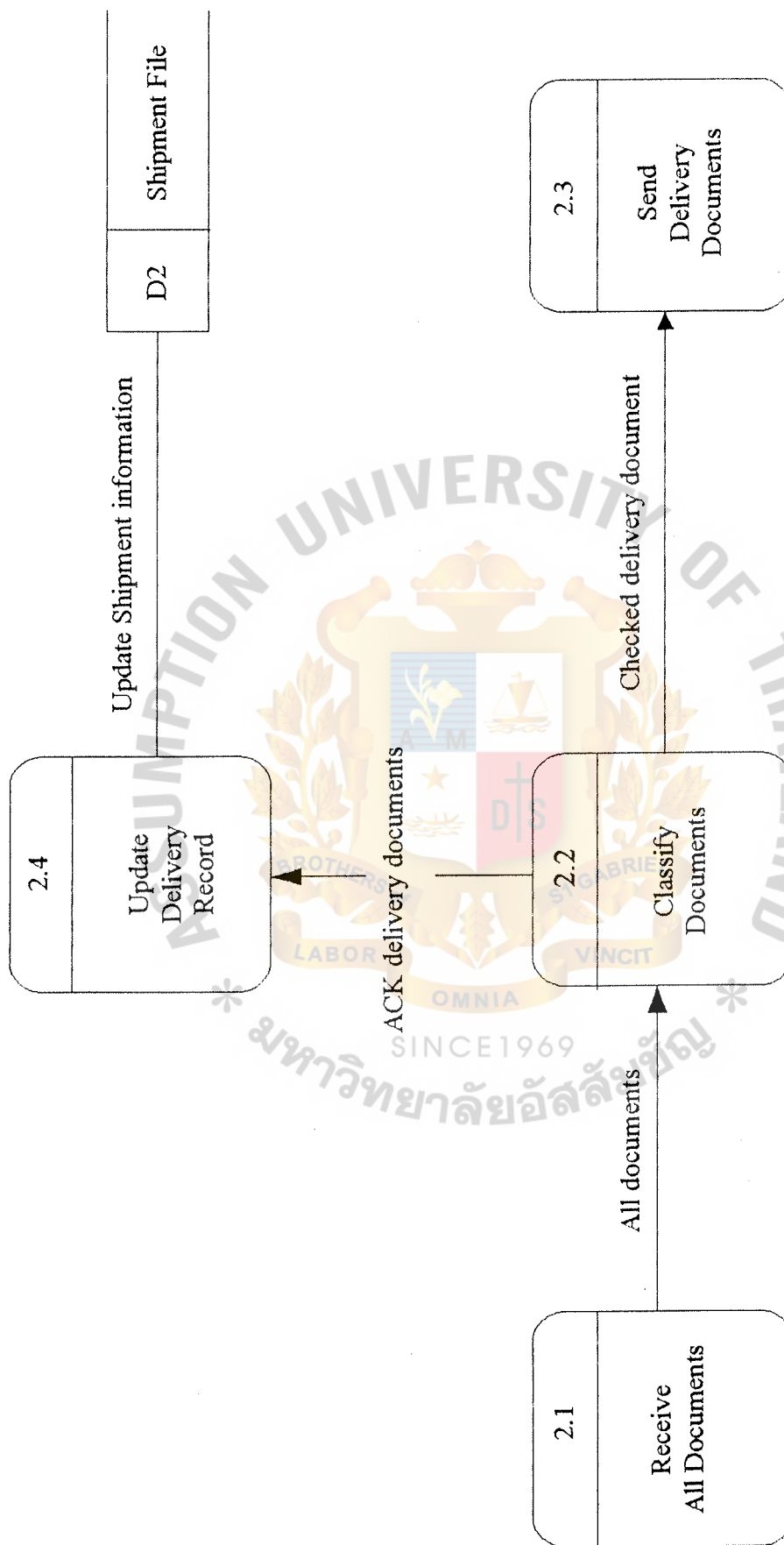


Figure B.6. Data Flow Diagram Level 1, Process 2: Manage Documents.

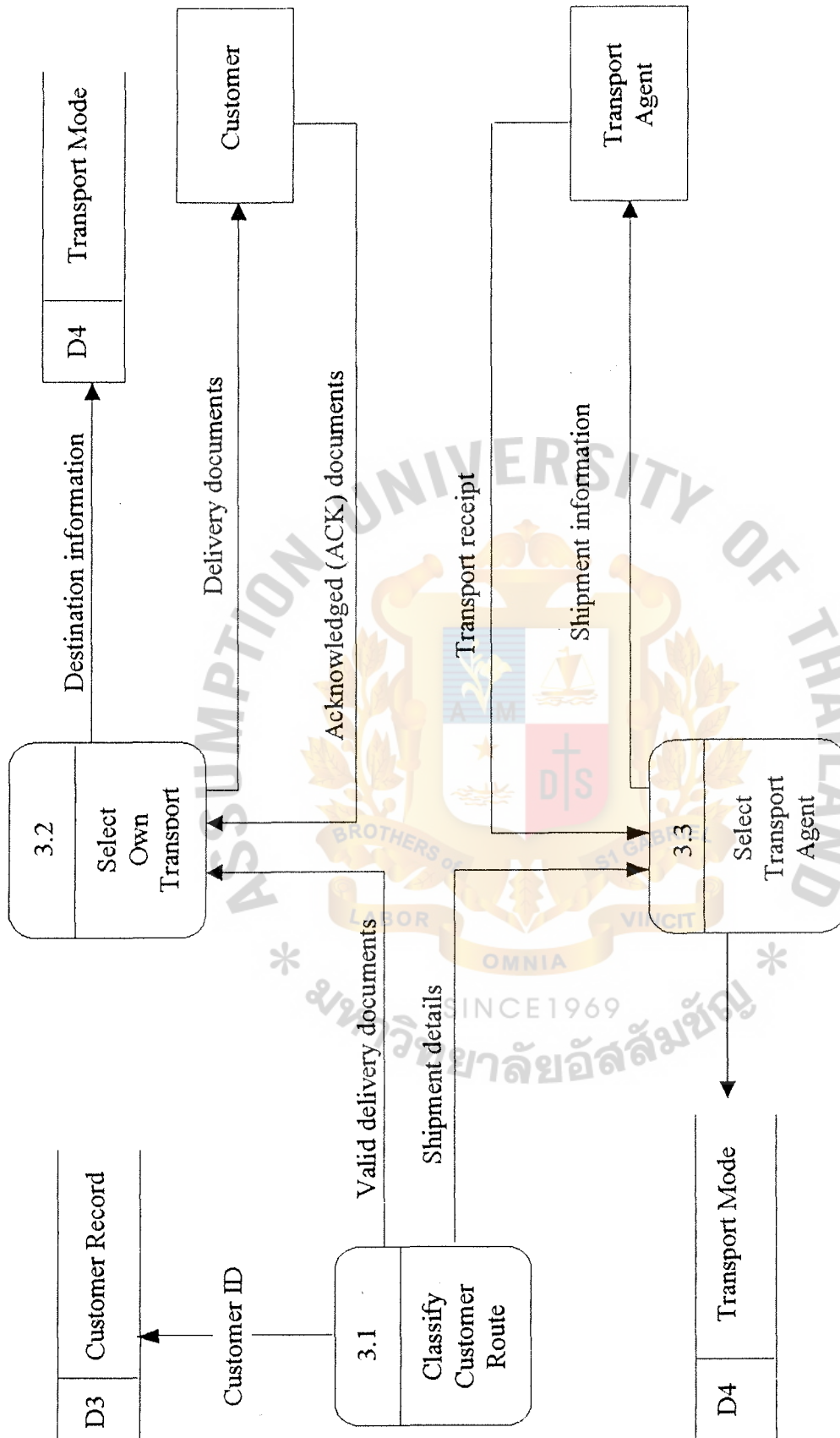


Figure B.7. Data Flow Diagram Level 1, Process 3: Deliver Goods.

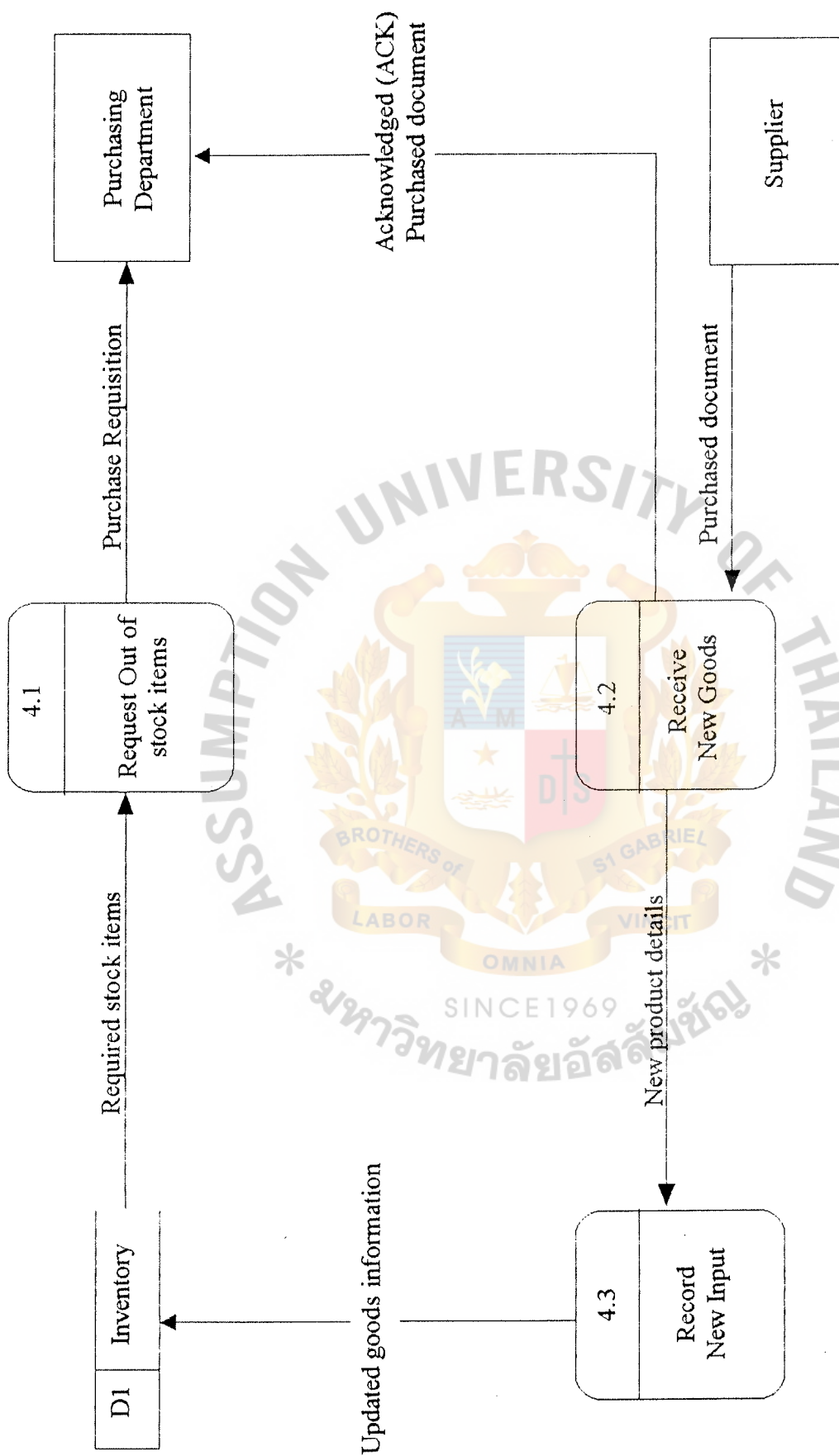


Figure B.8. Data Flow Diagram Level 1, Process 4: Check Inventory Status.

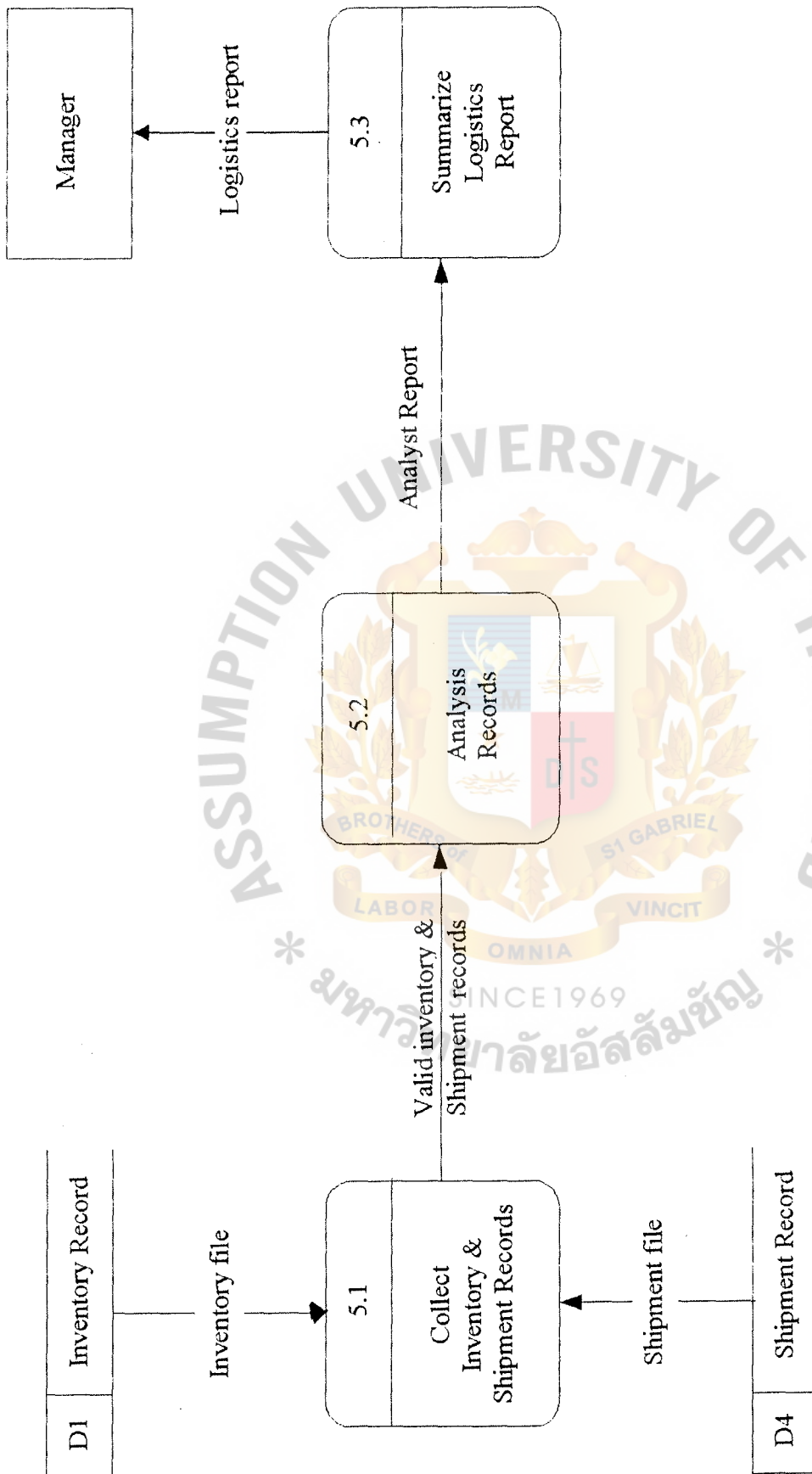


Figure B.9. Data Flow Diagram Level 1, Process 5: Generate Reports.



APPENDIX C
DATA DICTIONARY

DATA DICTIONARY

Table C.1. Data Dictionary of Logistics Information System.

Item	Description	Data Type
Acknowledged (ACK) delivery documents	All delivery documents both Invoice and Transport Receipt that are acknowledged after delivering.	Data Flow
ACK documents	Referring to document like Invoice, which is signed by customer after receiving goods.	Data Flow
ACK issues	Same as “ ACK document ”	Data Flow
ACK purchased documents	Documents like Purchase Invoice that has a signature of authorizer after acquiring new goods from Supplier	Data Flow
ACK shipping issues	Same as “ ACK document ”	Data Flow
All documents	Integration of non-delivered issues like Invoice and Packing List, and delivered issues like ACK Invoice and Transport Receipt.	Data Flow
Analyst Report	Both inventory and shipment records are analyzed and combined to be one issue.	Data Flow
Checked delivery documents	Delivery documents that are checked for complete issues.	Data Flow
Customer ID	Individual customer number.	Data Flow
Delivery documents	Referring to Invoice and Packing List, which are verified before shipment.	Data Flow
Destination Information	Details about place of delivery destination.	Data Flow
Invalid Order	Required order has some errors like unavailable order, incomplete detail.	Data Flow
Inventory file	Weekly record of inventory information	Data Flow
Invoice	Delivery Order and Receipt in one issue	Data Flow
Logistics report	Report that indicates about all details in warehouse department both inventory and shipment.	Data Flow
New product detail	Data of new input product from supplier.	Data Flow

Table C.1. Data Dictionary of Logistics Information System (Continued).

Item	Description	Data Type
Order	Non-checked order from sales.	Data Flow
Packing list	One document that stipulates details of goods such as quantity.	Data Flow
Product details	Data of arranged goods for preparing documents.	Data Flow
Purchased document	Input document from Supplier.	Data Flow
Purchased requisition	Requested goods purchased issue.	Data Flow
Required stock items	Referring to goods in stock which is less than its minimum level.	Data Flow
Shipment details	All information of goods delivery.	Data Flow
Shipment file	Weekly record of shipment information.	Data Flow
Shipment information	Same as "shipment details".	Data Flow
Transport receipt	Receipt of Transport agency, acts like ACK document.	Data Flow
Updated goods info	Up-to-date information of new product.	Data Flow
Updated inventory info	Up-to-date information of inventory transaction.	Data Flow
Updated shipment information	Up-to-date data of delivery	Data Flow
Valid inventory shipment files	Inventory & Shipment records that is verified before analysis.	Data Flow
Valid delivery documents	Delivery documents that are classified for the destination routine.	Data Flow
Verified order	Approved sales order	Data Flow
Customer	Details about customer number, name, address, phone, term and shipment.	External Entity
Manager	Represents manager or owner who executes and controls all company operations.	External Entity
Purchase Department	One of four departments in the company. The responsibility is to procure the required product.	External Entity

Table C.1. Data Dictionary of Logistics Information System (Continued).

Item	Description	Data Type
Sales Department	Sales & Marketing Department is its actual name. It is divided into two product sections: Electrical Equipment and Cable & related product.	External Entity
Supplier	Provides the new product to the storage, however, most information does not involve here.	External Entity
Transport Agent	Concerns with the shipment of product via the transport service companies.	External Entity





APPENDIX D
PROCESS SPECIFICATIONS

PROCESS SPECIFICATIONS

Table D.1. Process Specifications of Verify Order.

Items	Description
Process Name	Verify Order
Data In	Order
Data Out	Verified order, Invalid order
Description	To validate a customer order whether it is in the stock or not.
Process	<ol style="list-style-type: none"> 1. Get order from Sales Department. 2. Validate order in stock. 3. Unless order is valid, return to Sales Else sending for goods arrangement portion.
Attachment	Sales Department, Inventory File

Table D.2. Process Specifications of Arrange Goods.

Items	Description
Process Name	Arrange Goods
Data In	Verified order
Data Out	Product details, Updated inventory information
Description	To provide goods according to the order, then also pack it.
Process	<ol style="list-style-type: none"> 1. Get verified order. 2. Provide goods as order. 3. Pack goods. 4. Generate all goods details.
Attachment	Inventory File

Table D.3. Process Specifications of Issue Invoice and Packing List.

Items	Description
Process Name	Issue Invoice and Packing List
Data In	Product details
Data Out	Invoice and Packing List
Description	To issue Invoice and Packing List stipulate all related details like goods description, quantities, and price.
Process	<ol style="list-style-type: none"> 1. Receive all goods details. 2. Issue Invoice and Packing list. 3. Recheck goods with documents. 4. Send to check the correctness.
Attachment	-

Table D.4. Process Specifications of Receive All Documents.

Items	Description
Process Name	Receive all documents
Data In	Invoice & Packing List, ACK shipment issues
Data Out	All documents
Description	To check, classify and manage all documents.
Process	<ol style="list-style-type: none"> 1. Receive Non- delivered Documents from inventory part. 2. Receive ACK Invoice and Transport Receipt from shipment part. 3. Verify all documents. 4. If there are some errors, send back to adjust. 5. All verified documents are combined and sent to classified portion.
Attachment	-

Table D.5. Process Specifications of Classify Documents.

Items	Description
Process Name	Classify Documents
Data In	All documents
Data Out	- Checked delivery documents - ACK delivery documents
Description	To categorize all documents.
Process	1. Receive all essential documents. 2. Separate documents to each category. 3. Non-delivered documents are kept for delivery. 4. ACK documents are sent for updating record.
Attachment	-

Table D.6. Process Specifications of Send Delivery Documents.

Items	Description
Process Name	Send delivery documents
Data In	Checked delivery documents
Data Out	Delivery documents
Description	To prepare delivery document for ready sending.
Process	1. Get delivery documents. 2. Check the information accuracy again. 3. Send these documents to transport part.
Attachment	-

Table D.7. Process Specifications of Update Delivery Record.

Items	Description
Process Name	Update delivery record
Data In	ACK delivery documents
Data Out	Updated shipment information
Description	To edit or update delivery information in shipment database.
Process	1. Get ACK documents. 2. Validate the information status according to shipment. 3. If it is new record, edit. Else update the existing record.
Attachment	Shipment File

Table D.8. Process Specifications of Classify Customer Route.

Items	Description
Process Name	Classify Customer Route
Data In	Delivery documents
Data Out	Validated delivery documents
Description	To classify customer route suitable delivery type.
Process	1. Rechecked Delivery Documents. 2. Verify customer route from customer Database. 3. Verify kind of delivery in suitable. 4. Send documents to chosen delivery type.
Attachment	Customer Record

Table D.9. Process Specifications of Select Owned Transport (1).

Items	Description
Process Name	Select Owned Transport
Data In	Validated delivery documents
Data Out	Delivery Document
Description	To choose the suitable transport mode.
Process	<ol style="list-style-type: none"> 1. Receive Delivery Document from routine checking. 2. Check the appropriated mode of delivery. 3. Deliver to customer.
Attachment	Customer, Transport Mode Databases

Table D.10. Process Specifications of Select Owned Transport (2).

Items	Description
Process Name	Select Owned Transport
Data In	ACK documents
Data Out	ACK issues
Description	To manage the acknowledge documents back to Documents Part.
Process	<ol style="list-style-type: none"> 1. Get document with customer signature. 2. Confirm ACK document condition. 3. Return ACK document to document Part.
Attachment	Customer

Table D.11. Process Specifications of Select Transport Agency (1).

Items	Description
Process Name	Select Transport Agency
Data In	Shipment details
Data Out	Shipment information
Description	To select suitable agency and deliver.
Process	<ol style="list-style-type: none"> 1. Get Delivery Document from Routine Checking. 2. Select the suitable agency. 3. Deliver via transport agency.
Attachment	Transport Agency, Transport Mode Databases

Table D.12. Process Specifications of Select Transport Agency (2).

Items	Description
Process Name	Select Transport Agency
Data In	Transport Receipt
Data Out	Checked Transport Receipt
Description	To manage Transport Receipt to document portion.
Process	<ol style="list-style-type: none"> 1. Receive Delivery Invoice from Transport Agency. 2. Confirm Invoice correctness. 3. Send Transport Agency back to data portion.
Attachment	Transport Agency

Table D.13. Process Specifications of Request Out of Stock Items.

Items	Description
Process Name	Request out of stock items
Data In	Required stock items
Data Out	Purchase Requisition
Description	To check and order non-existed stock.
Process	<ol style="list-style-type: none"> 1. Get record of non-existed items. 2. List the out of stock items. 3. Make Purchase Requisition. 4. Send Purchase Requisition to Purchasing Department.
Attachment	Inventory File, Purchase Department

Table D.14. Process Specifications of Receive New Goods.

Items	Description
Process Name	Receive New Goods
Data In	Purchase Document
Data Out	ACK Purchase Document, New product details
Description	To get new goods and proof them.
Process	<ol style="list-style-type: none"> 1. Receive new goods from supplier. 2. Verify the purchase document. 3. Send Purchase Document to Purchase Department and send new goods information to inventory part.
Attachment	Supplier

Table D.15. Process Specifications of Record New Input.

Items	Description
Process Name	Record New Input
Data In	New product details
Data Out	Updated goods information
Description	New goods information is inputted in Invoice Record.
Process	1. Receive new goods information. 2. Update or Edit the new goods information. 3. Deliver updated information to inventory storage.
Attachment	Inventory File

Table D.16. Process Specifications of Collect Inventory and Shipment Records.

Items	Description
Process Name	Collect Inventory and Shipment Records
Data In	Inventory File, Shipment File
Data Out	Valid Inventory and Shipment Records
Description	To retrieve the information files from Inventory and Shipment.
Process	1. Get weekly inventory file and weekly shipment file. 2. Sort both records in properly. 3. Validate the accuracy of both records.
Attachment	Inventory File, Shipment File

Table D.17. Process Specifications of Analysis Records.

Items	Description
Process Name	Analysis Records
Data In	Valid Inventory and Shipment Records
Data Out	Analyst Report
Description	Delivery and Inventory records are integrated for analyze.
Process	1. Get Delivery Record and Inventory Record. 2. Analyze Delivery Record and Inventory Record in month.
Attachment	-

Table D.18. Process Specifications of Summarize Logistics Report.

Items	Description
Process Name	Summarize Logistics Report
Data In	Analyst Report
Data Out	Logistics Report
Description	To conclude all activities in Warehouse by monthly.
Process	1. Receive the analyst reports of inventory and delivery. 2. Summarize and integrate all details. 3. Launch Logistics Report for presenting manager.
Attachment	Manager



APPENDIX E
DATABASE DESIGN

DATABASE DESIGN

Table E.1. Structure of Customer Table.

No.	Field Name	Field Type	Key Type
1.	Customer Number	Long Integer	Primary Key
2.	Customer Name	Text	Attribute
3.	Customer Address	Text	Attribute
4.	Customer Phone	Text	Attribute
5.	Customer Type	Text	Attribute
6.	Shipment	Text	Attribute

Table E.2. Structure of Invoice Table.

No.	Field Name	Field Type	Key Type
1.	Invoice Number	Long Integer	Primary Key
2.	Order Number	Long Integer	Foreign Key
3.	Transport Agent Number	Long Integer	Foreign Key
4.	Invoice Date	Date	Attribute
5.	Amount	Long Integer	Attribute

Table E.3. Structure of Packing List Table.

No.	Field Name	Field Type	Key Type
1.	Packing List Number	Long Integer	Primary Key
2.	Order Number	Long Integer	Foreign Key
3.	Packing List Date	Date	Attribute
4.	Quantity	Long Integer	Attribute

Table E.4. Structure of Product Table.

No.	Field Name	Field Type	Key Type
1.	Product Number	Long Integer	Primary Key
2.	Product Name	Text	Attribute
3.	Product Cost	Long Integer	Attribute
4.	Stock Quantity	Long Integer	Attribute
5.	Minimum Quantity	Long Integer	Attribute
6.	Last Date Received	Date	Attribute

Table E.5. Structure of Purchase Request Table.

No.	Field Name	Field Type	Key Type
1.	Purchase Request Number	Long Integer	Primary Key
2.	Product Number	Long Integer	Foreign Key
3.	Requested Quantity	Long Integer	Attribute
4.	Required Date	Date	Attribute

Table E.6. Structure of Sales Order Table.

No.	Field Name	Field Type	Key Type
1.	Order Number	Long Integer	Primary Key
2.	Customer Number	Long Integer	Foreign Key
3.	Product Number	Long Integer	Foreign Key
4.	Quantity	Long Integer	Attribute
5.	Price	Long Integer	Attribute

Table E.7. Structure of Transport Table.

No.	Field Name	Field Type	Key Type
1.	Transport Agency Number	Long Integer	Primary Key
2.	Transport Agency Name	Text	Attribute
3.	Transport Agency Address	Text	Attribute
4.	Transport Phone	Long Integer	Attribute
5.	Service Destination	Text	Attribute

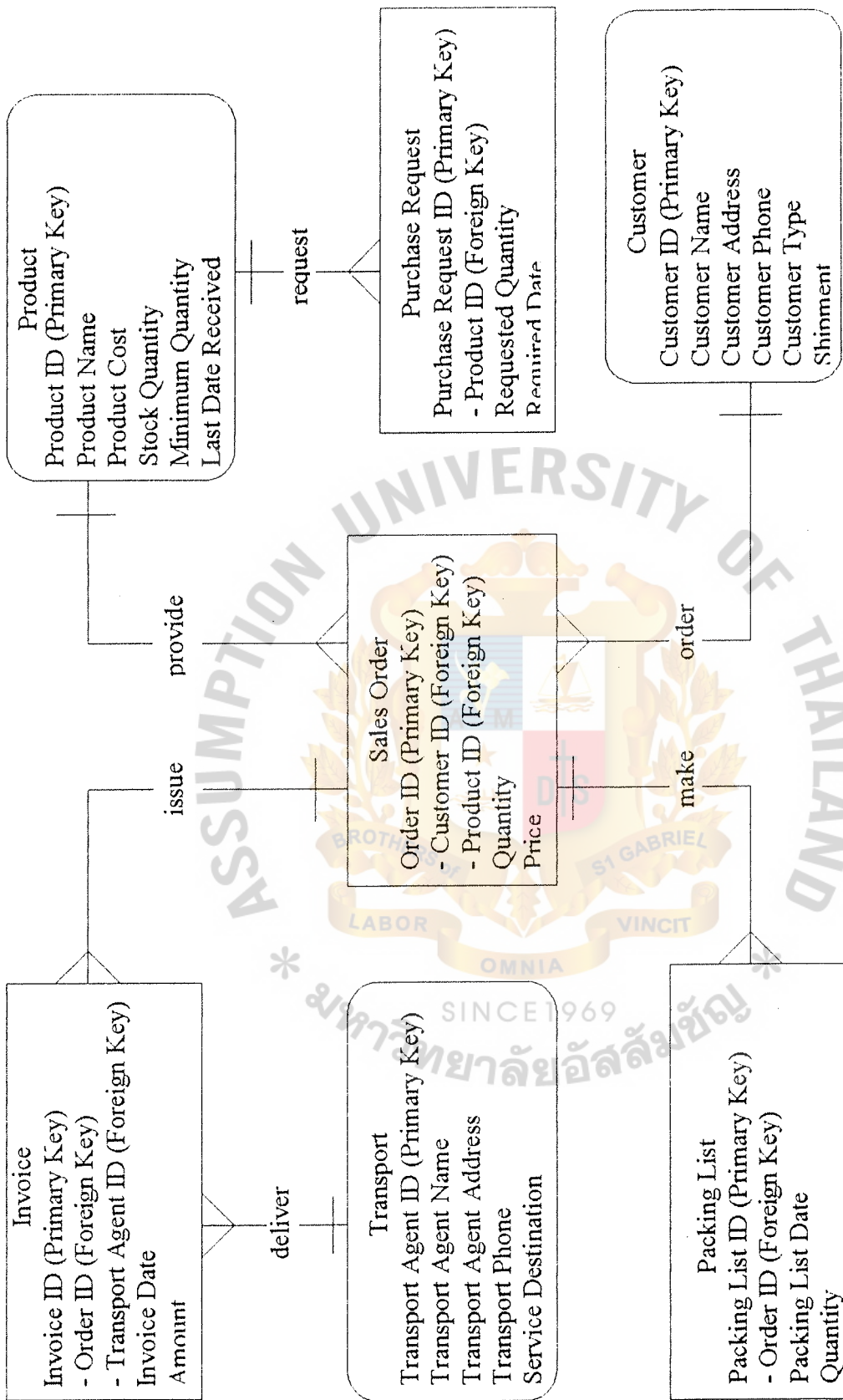


Figure E.1. Entity Relationship Diagram of the Proposed Logistics Information System.



APPENDIX F
STRUCTURE CHARTS

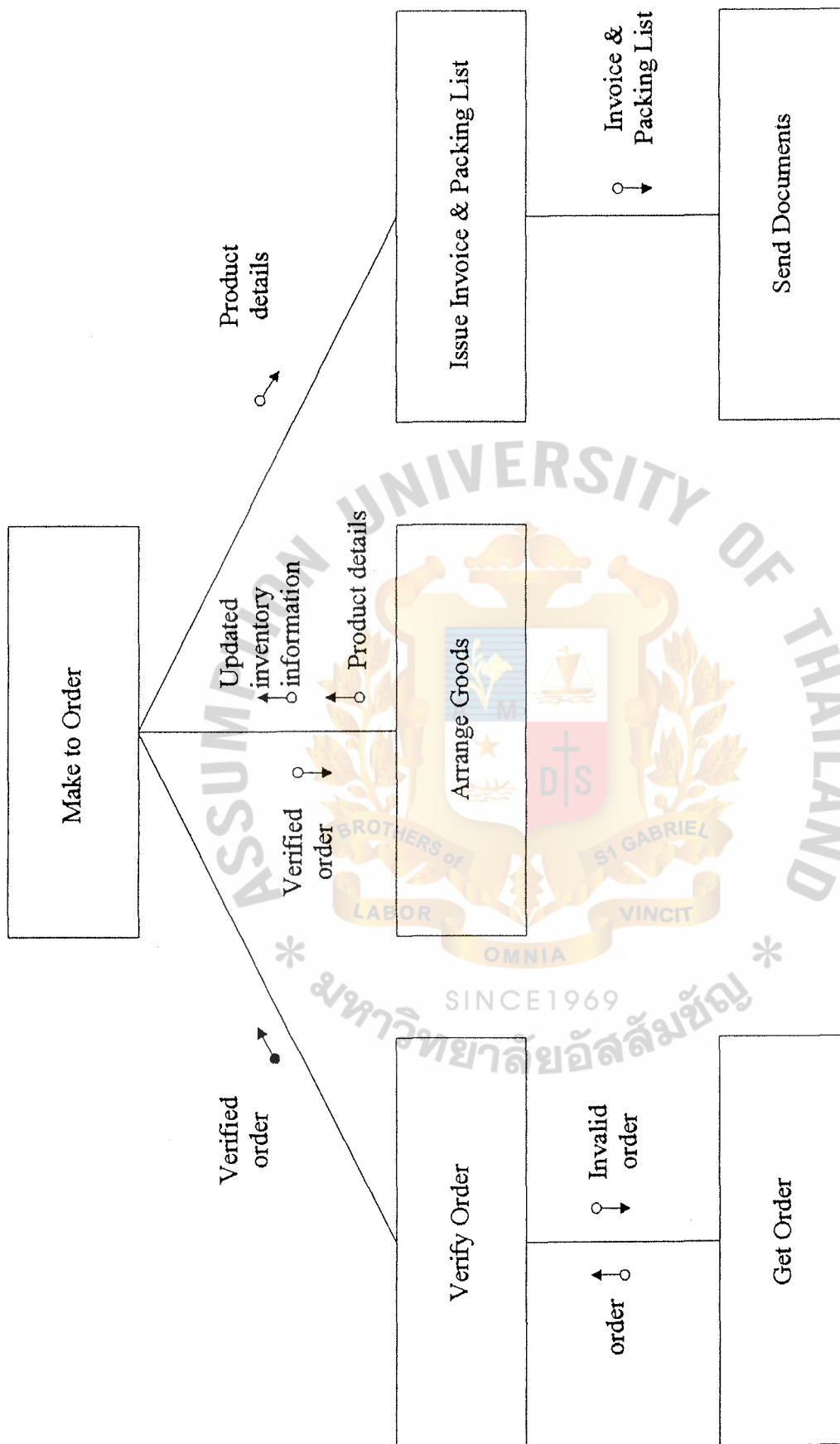


Figure F.1. Structure Chart of Make to Order.

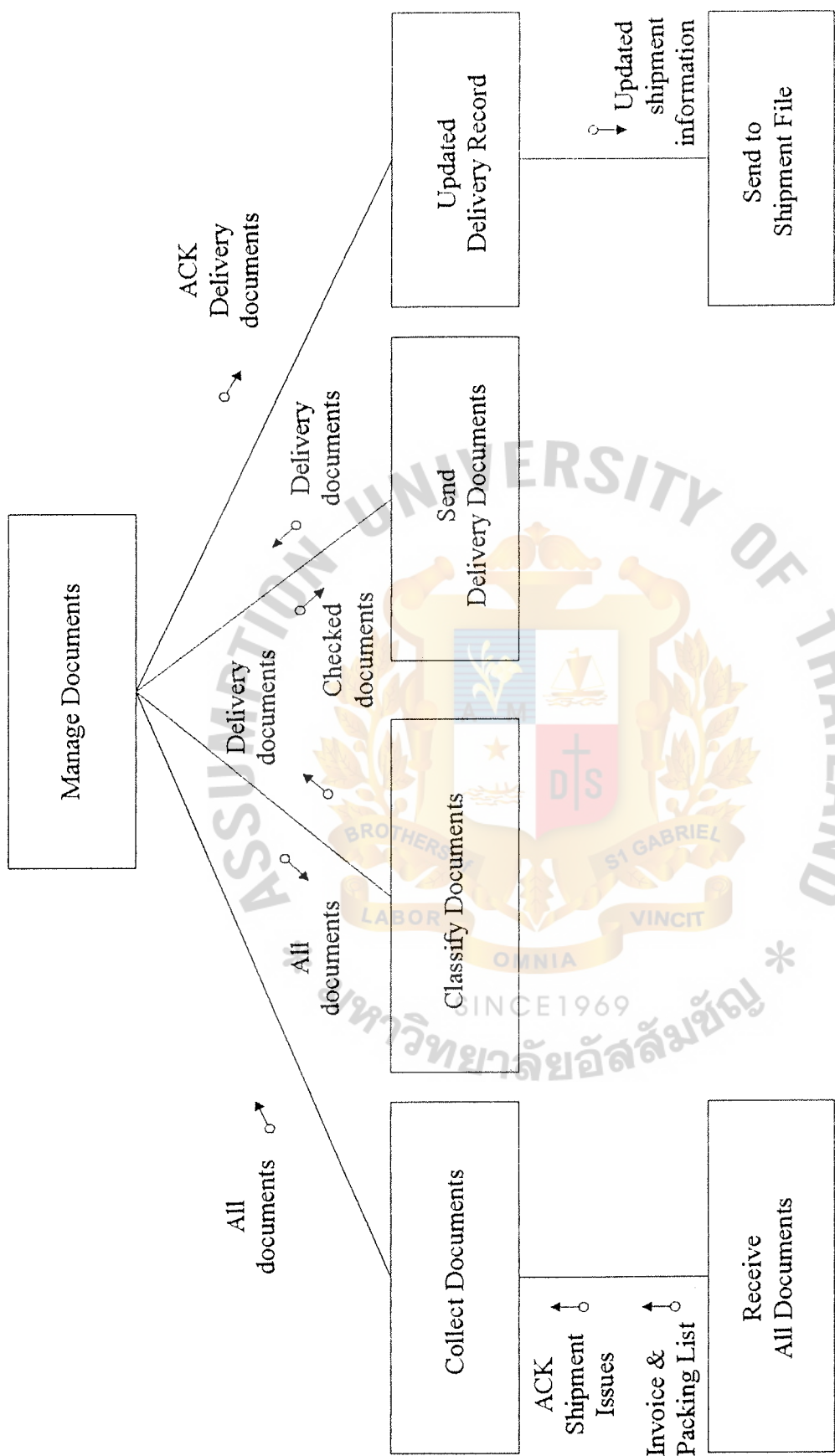


Figure F.2. Structure Chart of Manage Documents.

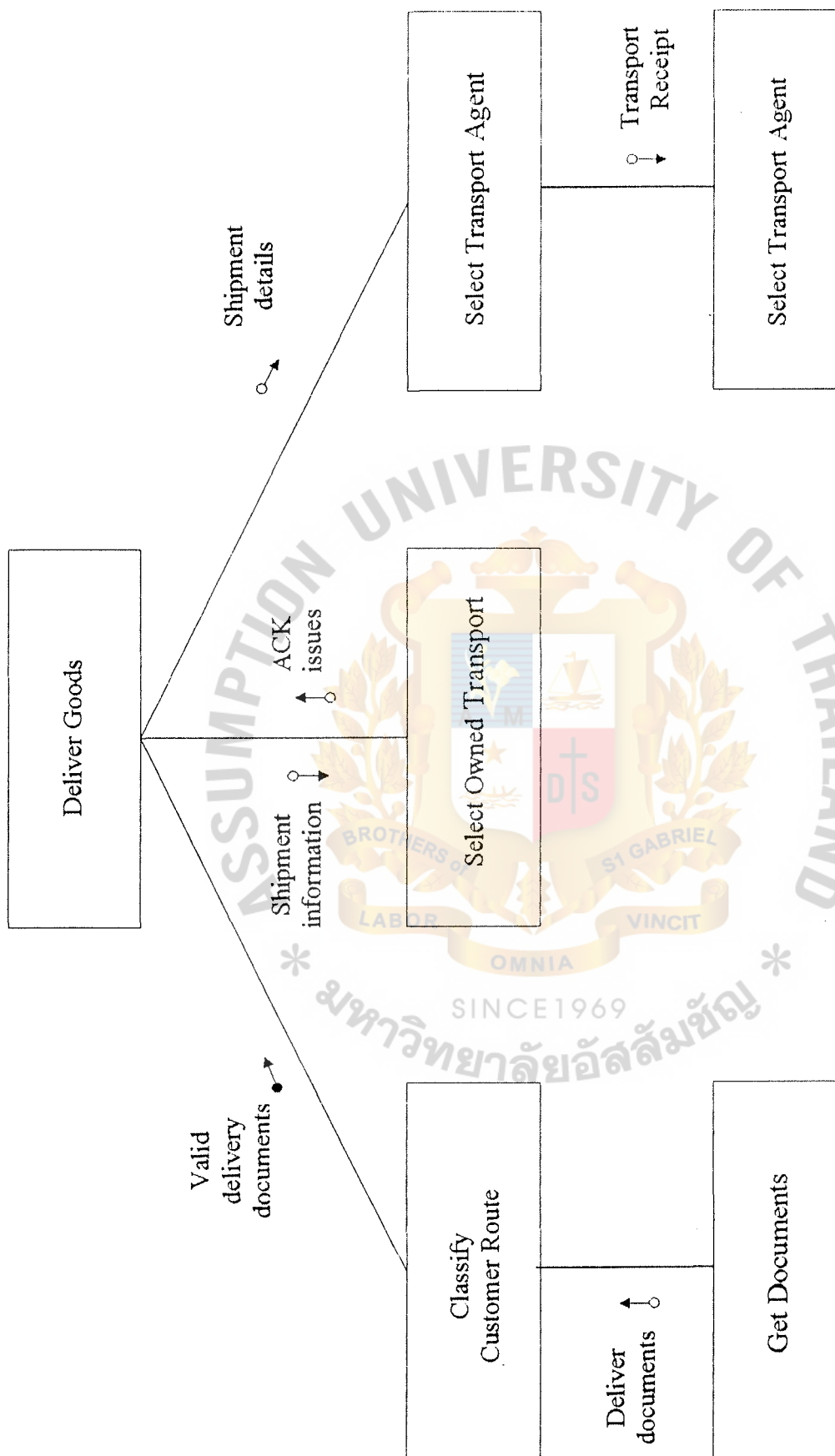


Figure F.3. Structure Chart of Deliver Goods.

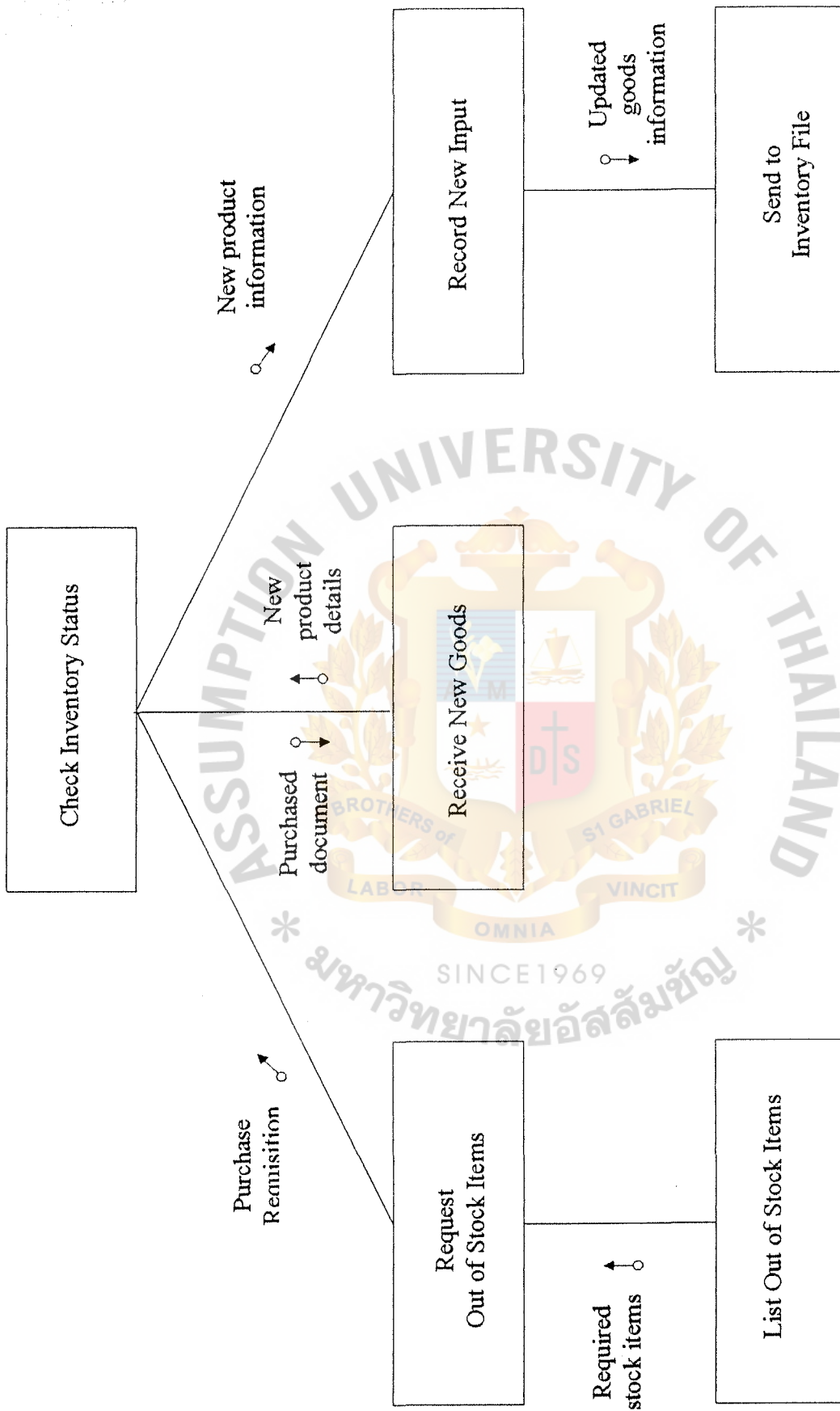


Figure F.4. Structure Chart of Check Inventory Status.

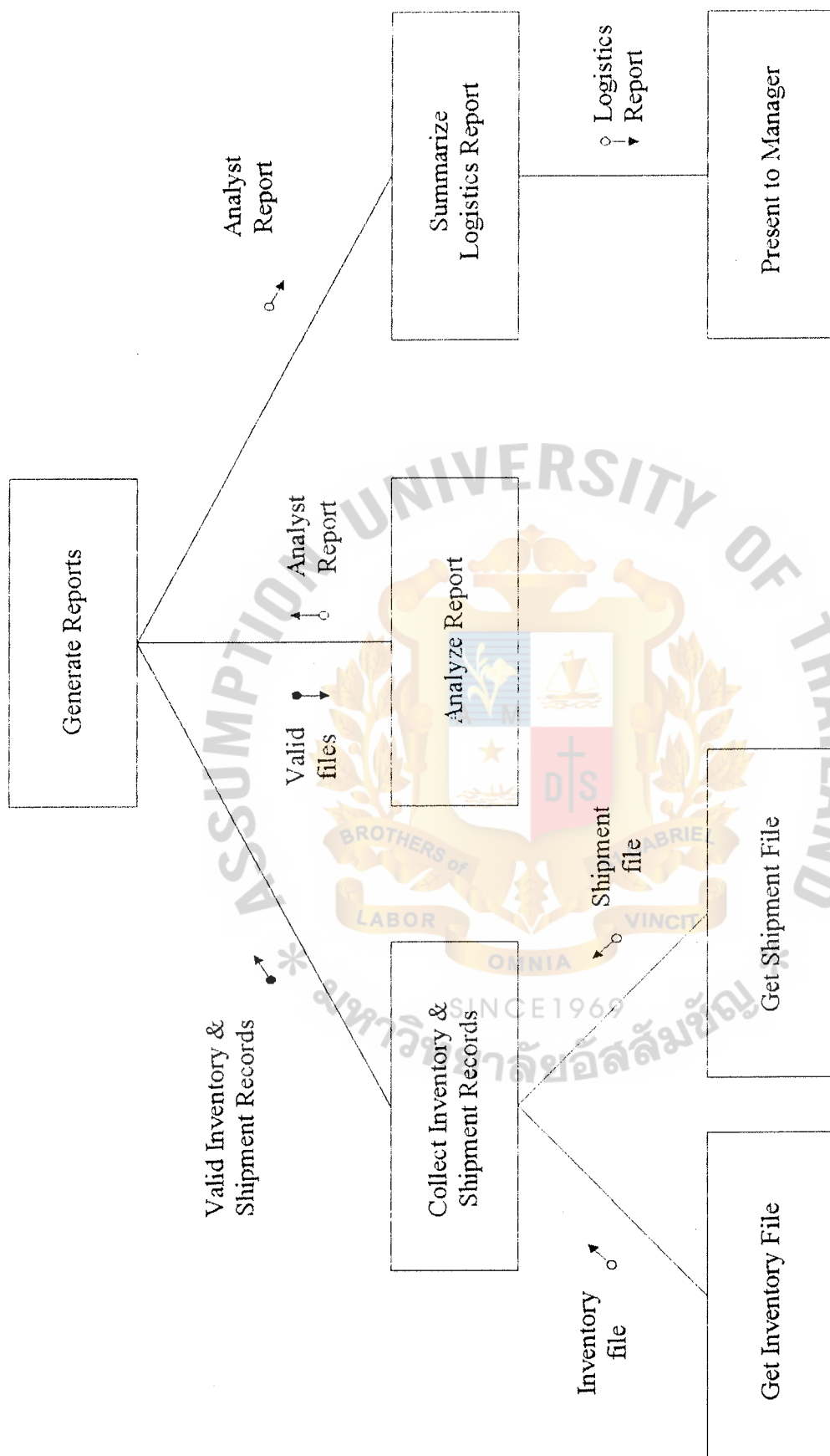
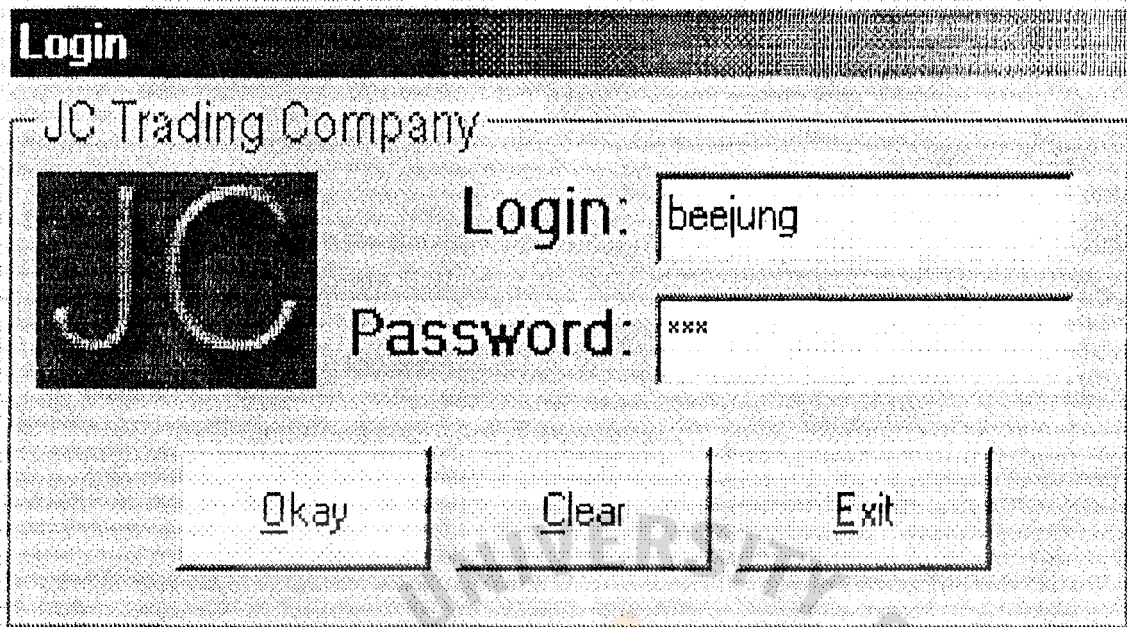


Figure F.5. Structure Chart of Generate Reports.



APPENDIX G
USER INTERFACE DESIGN



Login

JC Trading Company

JC

Login:

Password:

Figure G.1. Access Security Screen.

This interface fulfills the company security about access control. All users have their own login number and password for entering into the information system. The non-authorizers cannot retrieve any information out of the system.

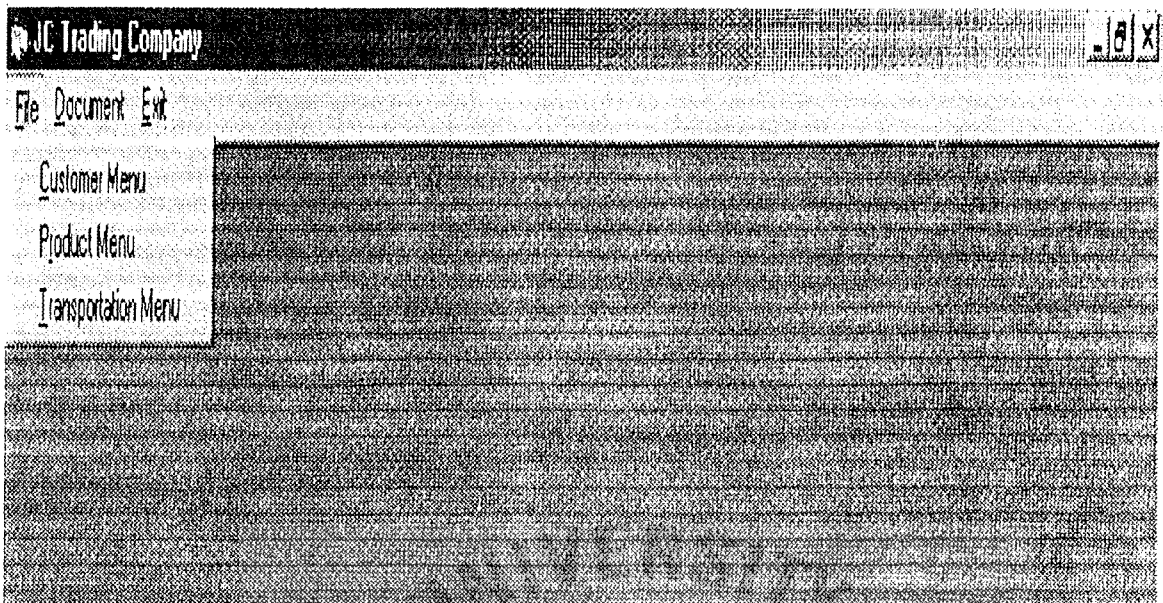


Figure G.2. Main Menu Screen.

This screen identifies Main Menu Interface in which all database information is stipulated in one page. However, not all users and supervisors can enter into all menus. They are limited entering up on any position.

Main Menu is separated into three titles as follows:

(1) File Menu

This title covers the information like Customer, Product, and Transport.

(2) Document Menu

The document details are contained in this menu; including Invoice, Packing List, Purchase Requisition, Sales Order, and Report.

(3) Exit Menu

The menu is used for logging out the program.


Customer Menu	
Customer Name	Asa Electric Company
Address	126 Family Road, Klongtoey, Bangkok
Tel	0212545568
Credit	30 days
Shipment	own transport
<div> <div>Customer ID</div> <div>20001</div> <div>  <div>Search</div> </div> <div> <div>Insert</div> <div>Delete</div> <div>Modify</div> </div> <div> <div>Save</div> <div>Cancel</div> </div> </div>	

Figure G.3. Customer Form.

This user Interface provides the facility for the user demand in searching customer details. For any adjustment like editing, removing, or updating, An end user cannot do these things. It is the responsibility of the supervisor to update the customer information.

Invoice ID	Order ID	Transport Agency ID	Invoice Date	Amount
8001	11	8	2/2/2544	2200
5002	10	3	2/2/2544	5000
8003	12	2	3/4/2544	16000
9001	13	3	4/4/2544	21000
9002	15	3	3/5/2544	12500
9003	14	1	5/5/2544	8300

Customer ID: 20004	Customer Name: Electrical Appliances Center, Pannatong	Order ID: 10		
Product ID	Product Name	Unit Price	Quantity	Total Price
20001	Disconnection Wiring	70	100	7000
20002	Telephone Wiring	10	1000	10000

Figure G.4. Invoice Form.

Invoice Issue is a vital document; it can identify all information of inventory, order, and shipment.

This critical menu cannot be modified. An end user can merely view it for issuing an invoice. All information in this invoice screen is transferred from the order screen. Moreover, the historical information of invoice is provided in the form of table record.

Packing List Menu	
Order ID	11
Customer Name	Companent Electrical Company
Packed Date	27/12/544
Quantity	20
Packing List ID	201
Search	Insert Delete Modify
Save Cancel	

Figure G.5. Packing List Interface.

This user interface operates with the order screen. All details are sent from the order menu except packed date. An end user mainly provides the product as this menu's details. All changing performances can be done in this menu.

The screenshot displays a 'Product Menu' window. On the left, there are input fields for 'Product Name' (Automatic Hair Machine), 'Cost' (4000), 'Stock Quantity' (5), and 'Last Date Received' (4/4/2544). On the right, there is a 'Product ID' field (11001), a 'Search' button with a magnifying glass icon, and a vertical stack of buttons: 'Insert', 'Delete', 'Modify', 'Save', and 'Cancel'.

Field	Value
Product Name	Automatic Hair Machine
Cost	4000
Stock Quantity	5
Last Date Received	4/4/2544
Product ID	11001

Figure G.6. Product Menu Screen.

This menu screen shows all product information. Product can be updated in the quantity, or other related details in this screen. Nevertheless, only supervisor can deal with it, general staffs are allowed only to view it for searching.

Purchase Requisition Menu	
Product ID	21000
Product Name	Hand Cade
Quantity	20
Required Date	4/2/2544
Purchase Requisition ID	301
Search	Insert
	Delete
	Modify
Save	Cancel

Figure G.7. Purchase Requisition Form.

This Purchase Requisition is concerned with the product request. According to the screen, only Product Number, name, quantity, and required data are needed to fill in.

This issue deals with the supervisors who control the inventory transaction. General staff is prohibited to do and to view it. This information will transfer to Purchase Department for the goods procurement.

Sales Order Menu

Customer ID: 20004 Product ID: 21001 Sales Order ID: 10

Product Name: Electrical Supplies Limited Partnership

Price: 35 Quantity: 100

Buttons: Insert, Delete, Modify, Search, Save, Cancel

Figure G.8. Sales Order Screen.

The screen contains all information about sales order. Warehouse staff does not perform this screen except insert. It is the work of Sales and Marketing Department to complete this form during receiving the order from the customer. This form will transfer to the inventory area for arranging the order. However, this form need to be filled carefully since any error occur the company will be at a loss.

Transport Menu

Transport Name: CUSTOMER

Transport Address:

Tel: 0

Service Destination: ECANBC

Transport ID: 1

Search

Insert

Delete

Modify

Save

Cancel

Figure G.9. Transport Form.

Whenever user needs to find out the suitable transport for delivery or search for historical transport transactions, this form can fulfill these requirements.

Firstly, user fills any known information like transport number and transport name, then click at search button for finding out that exact transport information. Moreover, the authorizer can modify transport information via this form.



APPENDIX H
REPORT DESIGN

J.C. TRADING COMPANY**SALES ORDER**

Customer No. : 20004

Name : Electrical Supplies Limited Partnership

Sales Order No.: 10

Sales Name : K. Pongsak

Date: 3/3/2544

Item	Product No.	Product Name	Unit	Quantity
1.	21001	Decoration Wiring	Pcs	580
2.	21002	Telephone Wiring	Pcs	1100

Total Item : 2 items

Total Quantity : 1680 pcs

Remark : PO No. 5421

Sales Department

Warehouse Department

Figure H.1. Sales Order Form.

J.C. TRADING COMPANY

Invoice No. : 8002
Date : 3/3/2544

INVOICE

Name : Electrical Supplies Limited Partnership	Customer No. : 20004
Address : 377/5 Rongmuang, Patumwan, Bangkok	Order No.: 10

P.O. No. : 5421	Sales : K.Pongsak	Terms : 30 days	Shipment : Tamrong
-----------------	-------------------	-----------------	--------------------

Item	Description	Quantity	Unit Price	Amount
1.	Decoration Wiring	580	25.00	14,500.00
2.	Telephone Wiring	1100	18.00	19,800.00
Subtotal				34,300.00

Issued by

Checked by

Authorized by

Figure H.2. Invoice Receipt.

PACKING LIST

Packing List No. : 203

Date : 3/3/2544

Item	Product No.	Product Name	Unit	Quantity
1.	21001	Decoration Wiring	Pcs	580
2.	21002	Telephone Wiring	Pcs	1100

Remark : -

Approved by _____

Figure H.3. Packing List.

J.C. TRADING COMPANY

PURCHASE
REQUISITION

J.C. TRADING COMPANY

No. : 301
Date : 2/4/2544

Item	Product No.	Product Name	Unit	Required Date
1.	21003	Hand Cable	20	4/4/2544
2.	21001	Decoration Wiring	1000	15/4/2544
3.	21002	Telephone Wiring	1000	15/4/2544

Total Item : 3 items
Total Quantity : 2020 pcs
Remark : -

Requested by

Approved by

Figure H.4. Purchase Requisition.

J.C. TRADING COMPANY

Order Status

On 5Th April 2001

Customer No.	Customer Name	Order No.	Order Date	Order Status
20004	Electrical Supplies Ltd.	10	3/3/2544	Finished
20003	Component Electrical	18	10/3/2544	Finished
20001	Asia Electric Company	25	23/3/2544	Finished
20004	Electrical Supplies Ltd.	34	2/4/2544	Partial Ship
Total No. of Order : 4 orders.				

Issued by : Ingorn

Date : 5 April 2001

Figure H.5. Order Status Report.

J.C. TRADING COMPANY

Weekly Inventory Status

On 5th April 2001

No.	Name	Units on hand	Minimum Status	Units Request
11001	Automatic Mark Machine	5	1	-
11002	Hydraulic Punch	10	1	-
11003	Hydraulic Crimp	10	1	-
11004	Pallet Truck	5	1	-
21001	Decoration Wiring	580	50	1000
21002	Telephone Wiring	1100	50	1000
21003	Hand Cable	5	5	20
21004	Terminal Crimp	29	5	-

Issued by : Ingorn

Date : 5 April 2001

Figure H.6. Weekly Inventory Status Report.

J.C. TRADING COMPANY

Weekly Inventory Transaction

On 5th April 2001

No.	name	Units Entry	Units Out	Cost	Price	Balance
11002	Hydraulic Punch	-	2	-	9500.00	10
21001	Decoration Wiring	-	580	-	25.00	-
21002	Telephone Wiring	-	1100	-	18.00	-
21003	Hand Cable	20	-	2000.00	-	-
		-	10	-	2200.00	15
21004	Terminal Crimp	20	-	1900.00	-	-
		-	15	-	2100.00	34

Recorded by : Ingorn

Checked by : Ladda

Figure H.7. Weekly Inventory Transaction Report.

J.C. TRADING COMPANY

Monthly Shipment Transaction

On 5th April 2001

Shipment No.	Mode Name	Date	Order No.	Destination	Cost
3	Tamrong Y.	3/3/2544	10	Bangkok	50.00
1	Customer	5/3/2544	14	Company	-
5	Chumporn Express	18/3/2544	20	Chumporn	100.00
2	Seksan M.	26/3/2544	28	Bangkok	50.00
3	Tamrong Y.	2/4/2544	34	Bangkok	50.00

Recorded by : Methee

Checked by : Ladda

Figure H.8. Monthly Shipment Transaction Report.

J.C. TRADING COMPANY

Required Product Ranked

On 5th April 2001

Rank No.	Product No.	Name	Required Units
1	21002	Telephone Wiring	1000
2	21001	Decoration Wiring	580
3	21003	Hand Cable	20
4	21004	Terminal Crimp	20

Analyst by : Ingorn

Checked by : Ladda

Figure H.9. Required Product Ranked Report.

J.C. TRADING COMPANY

Product Ranked by Order

On 5th April 2001

Rank No.	Product No.	Product Name	Product Type	Order Units
1	21001	Decoration Wiring	2	1200
2	21002	Telephone Wiring	2	1000
3	21001	Decoration Wiring	2	580
4	21002	Telephone Wiring	2	200
5	21004	Hand Cable	2	20
6	21005	Terminal Crimp	2	20
7	11002	Hydraulic Punch	1	2

Analyst by : Ingorn

Checked by : Ladda

Figure H.10. Product Ranked by Order Report.

J.C. TRADING COMPANY

Shipment Ranked

On 5th April 2001

Ranked No.	Shipment No.	Shipment Name	Times	Destination
1	2	Seksan Muangsai	20	Bangkok
2	3	Tamrong Yimdee	19	Bangkok
3	1	Customer	10	Company
4	8	NTC Express	4	North
5	5	Chumporn Express	2	South
Total No. of Shipment : 55 times				

Analyst by : Methee

Checked by : Ladda

Figure H.11. Shipment Ranked Report.

J.C. TRADING COMPANY

Logistics Report

On 5th April 2001

Aspects	Inventory	Transport
Most potential item by order	Decoration Wiring	Seksan Muangsri (Company Driver)
: Quantity	1200 units	20 times
Most potential item by number	Decoration Wiring	Bangkok (by destination)
: Quantity	1780 units	39 times
Most required product ranked (stock entry)	Telephone Wiring	
: Quantity	1000 units	
Most popular transport mode		Own Transport (Company Truck)
: Time		39 times

Summarized by : Ladda

Approved by : Siriwan

Figure H.12. Logistics Report.

BIBLIOGRAPHY

1. Ballou, Ronald H. Business Logistics Management, Third Edition. NJ: Prentice Hall International Company, 1992.
2. Date, C. J. An Introduction to Database System. MA: Addison-Wesley, 1995.
3. Eliason, Alan L. Systems Development Analysis, Design, and Implementation. Boston: Little, Brown, 1987.
4. Greer, Tyson. Understanding Intranets. Redmond, WA: Microsoft Press, 1998.
5. Kendall, Kenneth E. and Julie E. Kendall. System Analysis and Design, Third Edition. NJ: Prentice-Hall, 1995.
6. Kosiur, David. Understanding Electronic Commerce. WA: Microsoft Press, 1997.
7. Laudon, Kenneth C. and Jane P. Laudon. Management Information System, Sixth Edition. New Jersey: Prentice Hall International Company, 2000.
8. Loomis, Mary E. S. Data Management and File Structures, Second Edition. London: Prentice Hall International Company, 1988.
9. Page Jones, Meilir. The Practical Guide to Structured Systems Design, Second Edition. New Jersey: Prentice Hall International Company, 1992.
10. Senn, James A. Analysis and Design of Information Systems, Second Edition. NY: McGraw-Hill, 1989.
11. Trepper, Charles. E-Commerce Strategies. USA: Microsoft Press, 2000.
12. Whitten, Jeffrey L. and Lonnie J. Bentley. System Analysis and Design Methods, Fourth Edition. Irwin: McGraw-Hill, 1998.