



Sales Support Information System for
Multiple Assets Co., Ltd.

by

Ms. Prawit Kosumsawad

A Final Report of the Six-Credit Course
CS 6998 - CS 6999 System Development Project

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

November 2003

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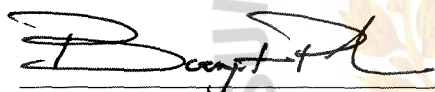
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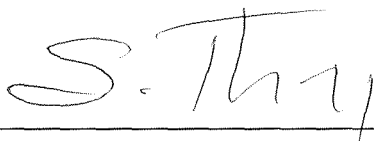
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ABSTRACT

The existing Sales Support Information System of Multiple Assets Co., Ltd. that is running currently is a combination of manual and computerized system; approximately ninety percent, and ten percent respectively. It is a cause and effect to the miscommunication and misunderstanding among the staffs in the organization which mostly occurred in the manual system.

In addition, data redundancy is one of the major concerns since it is quite complicated to inspect and to keep track of the existing customers' information. Data redundancy repeatedly happened when there are updating, deleting, and inserting the transactions by each individual department. Many administrative staffs in the existing system would say that there is a higher potential of errors; as a result it requires a higher maintenance cost compared to a computerized system.

In an attempt to improve Sales Support Information System, and database management system together, the proposed system is developed by Microsoft Visual Basic 6.0 and Microsoft SQL Server. They are used as a Development Tool and Database Software respectively. The interfaces are designed using friendly Graphical User Interface. Moreover, the new system can support the management in decision making by providing reliable and accurate information and reports.

The proposed system is found to solve the existing problems, reduces mistakes and improves overall marketing operation. The operating cost is also reduced because smaller number of marketing staffs and office supply are required.

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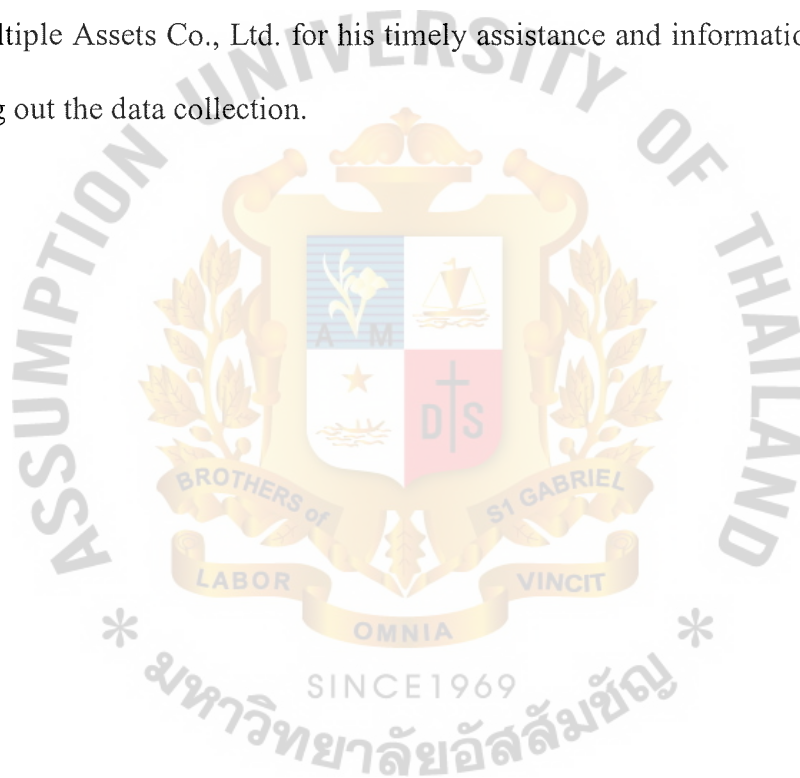


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I. INTRODUCTION

1.1 Background of the Project

At the moment, technology and computer environment have greatly affected human behaviors and lifestyles. In practical times, human resources, and accuracy of information are the most valuable resources for a company to achieve the goals. Many leaders in the industries use these resources as their business core competencies. With the limitation of resources, they are working against time which is fully loaded with multiple tasks, and many processes are needed to proceed concurrently and simultaneously. Moreover, the company must utilize the human resources, information, and budget to fulfill the assignment within a shorter period of time. Consequently, there is an enormous improvement of computer information system in the last decade, and networking in order to facilitate, accelerate, utilize, rightness of information.

Most companies today adapt new strategic planning. They play, and they move harder and faster to improve the organization. Switching from a Centralized system to Distributed system is one of the examples. Many organizations would no longer route the employees, and force them to follow the regulations. Hence, the company would keep their employees' initiative as a part of the organization such as Total Quality Management (TQM) to maximize customers' satisfaction. This is the first priority. As long as customers are satisfied with the goods and services, they would keep coming back again and again. On the other hand, to drive the business successfully and to achieve the goals, there is something behind the scenes. Likewise, computer information system is laid beneath the above strategic planning. It is just like the

backbone of the company that facilitates almost all of the transactions today. The bigger the company is, the larger the size of the information its needs.

Multiple Assets Co., Ltd. is a PVC pipe manufacturer, which was established in 1997. Most PVC pipes in the market nowadays can be separated into three main categories which are identified by a coloring system. PVC pipe for construction is black. Moreover, with its special properties in construction such as high temperature durability, and flexibility, it makes production costs much higher than other categories. Second, PVC pipe for drinking water, its color is light blue, which is produced from new resin mixed with white cement, and other chemicals and substances. The property of this kind of PVC pipe is thick, and solid. Lastly, PVC pipe for agriculture. The color of this category is gray. It is produced by recycling any kind of used PVC pipe, and mixed with white cement, and chemicals. Cost of agricultural PVC is the lowest in three categories. However, costs of manufacturing does not only depend on the chemical and raw materials, but it also depends on the diameter of PVC.

Multiple Assets Co., Ltd. (MAC) concentrated on the third category, PVC pipe for agriculture. The company is the leader in the market and earns more than forty percent of the market share. The management of MAC launched the production under two brand names for PVC pipe, MAC, and SPA, in order to reduce the gap of the market and gain the business core competency. Both brands are different in terms of chemical substances. MAC and SPA pipe are available in 3/8, 1/2, 3/4, 1, 1 1/2, 2, 2 1/2, 3, and 4 inches diameter respectively.

The growth rate of the company is higher during the last 3 years. Finished PVC pipes are daily stored in the warehouse, and wait for time to trigger the sales after rainy season passes. Now, the company is using a semi-computerized system; however, the

ratio of computerized system is limited compared to a manual system. MAC uses computers to issue invoices, and bill only in the spreadsheet format. The proportion of manual system and computerized system are ninety percent and ten percent respectively. Moreover, the company is facing difficulties in quoting the price, and checking the stock because all customers' file and information are kept as hard copy and sometimes they are noted on the company's whiteboard. In addition, the communication between departments of the company is not well connected. This situation not only created redundancy of the information, but also wastes time, and less efficient.

Next, the database of the customers, are not well designed, managed and controlled, therefore the management of MAC often has a hard time to keep track of the customers, and it is too sophisticated to explore the history of all customers at once. Therefore, the running system of MAC at the moment could not fulfill daily activities, and it can not support unpredictable requirements in the future. MAC also requires a good system to support the management level. Likewise, the database of the new system must allow the management to control, and manage the database effectively. Last but not least, this combination of manual and computerized system of Multiple Assets Co., Ltd. has created difficulties and complicates the communication among the staffs in the factory.

According to the partial computer system, the problem would be defined in terms of the following:

- (1) The difficulties of checking whether the customer's record already existed or not. Data redundancy possibly occurred, and difficulties in tracing the customers' records.

- (2) Inventory inconsistency. The management cannot track the amount of inventory in the warehouse; consequently, they could not interact with the customers immediately. Likewise, misunderstanding and misleading in the amount of the inventory may occur between the management level, and operation level, inaccurate results.
- (3) Invoice and billing in spreadsheet format could delay sales, inventory, and operation since they are complicated because they require many attributes from the data sources. Time consuming in price quoting, filing, and issuing invoice and billing. These things could slow down the whole system.
- (4) Excessive cost of hardcopy.
- (5) The existing system is sophisticated to perform the report. Not enough information for the management to make the right decision, and issue new policy in order to invest and to expand the business. It does not support decision-making at all.

1.2 Objectives of the Project

This project is intended to support Sale and Marketing Department of MAC during a period of dramatic changes in technology to increase the productivity of the system using new technology to support information system, processes and networking. Sales Support Information System is developed to generate all historical information of customers such as insert, update and delete customers' record. The records are automatically stored and retrieved in the database for further activities. Meanwhile, the new system should be able to calculate the total sales, and support decision-making for the management.

The objectives of developing the Sales Support Information System for Multiple Assets Co., Ltd. are as follows:

- (1) To reduce data redundancy by developing a good database schema that can support current and future changes.
- (2) To improve the processing time with accurate information for all staffs to better serve customers, and reduce duplicate activities.
- (3) To reduce the operation costs with a computerized system, and to facilitate the collaborative action of all departments in using networking and resource sharing.
- (4) To give accurate information for management to make the right decisions.
- (5) To ensure that the new database and network system is affordable and designed with an awareness of the needs and capacities of the organization.

We attempt to design the data file system that is very useful and practical in the business. New designed data improve the performance of the system easily. However, the basic design of the system is very significant to lead to the next level of the development.

1.3 Scope of the Project

This project focuses on Sales & Marketing Department of Multiple Assets Co., Ltd. in order to deliver accurate information to bring further activities, which can be described as follows:

- (1) Customer Information should be accurate and unique for each customer, to provide the facilities for staffs to search by categories of customer's information, and filing the records for Sales & Marketing Department in order to issue the report for decision-making.

- (2) Support request quotation, and product availability to the customers from front end, and reduce unnecessary and duplicate activities in the department.
- (3) Gather needed information from other departments such as product availability, credit status, and total costs from Inventory department, Accounting Department, and Purchasing Department respectively, then analyze that information and distribute to the customers and the management.

1.4 Deliverables

The deliverables of the project can be identified as follows:

- (1) Data Modeling (ER Diagram)
- (2) Process Modeling (Context Diagram, Data Flow Diagram)
- (3) System Specification (Hardware and software specification)
- (4) Cost Benefit Analysis (Payback Period, Net Present Value)
- (5) Input Design (Input Screen of proposed system)
- (6) Output Design (Report from proposed system)
- (7) Structured Design (Structured Chart)
- (8) Process Specification (Detail of each process of proposed system)
- (9) Data Dictionary

1.5 Project Plan

A project plan of the Automobile Service Information System is given in Figure

1.1.

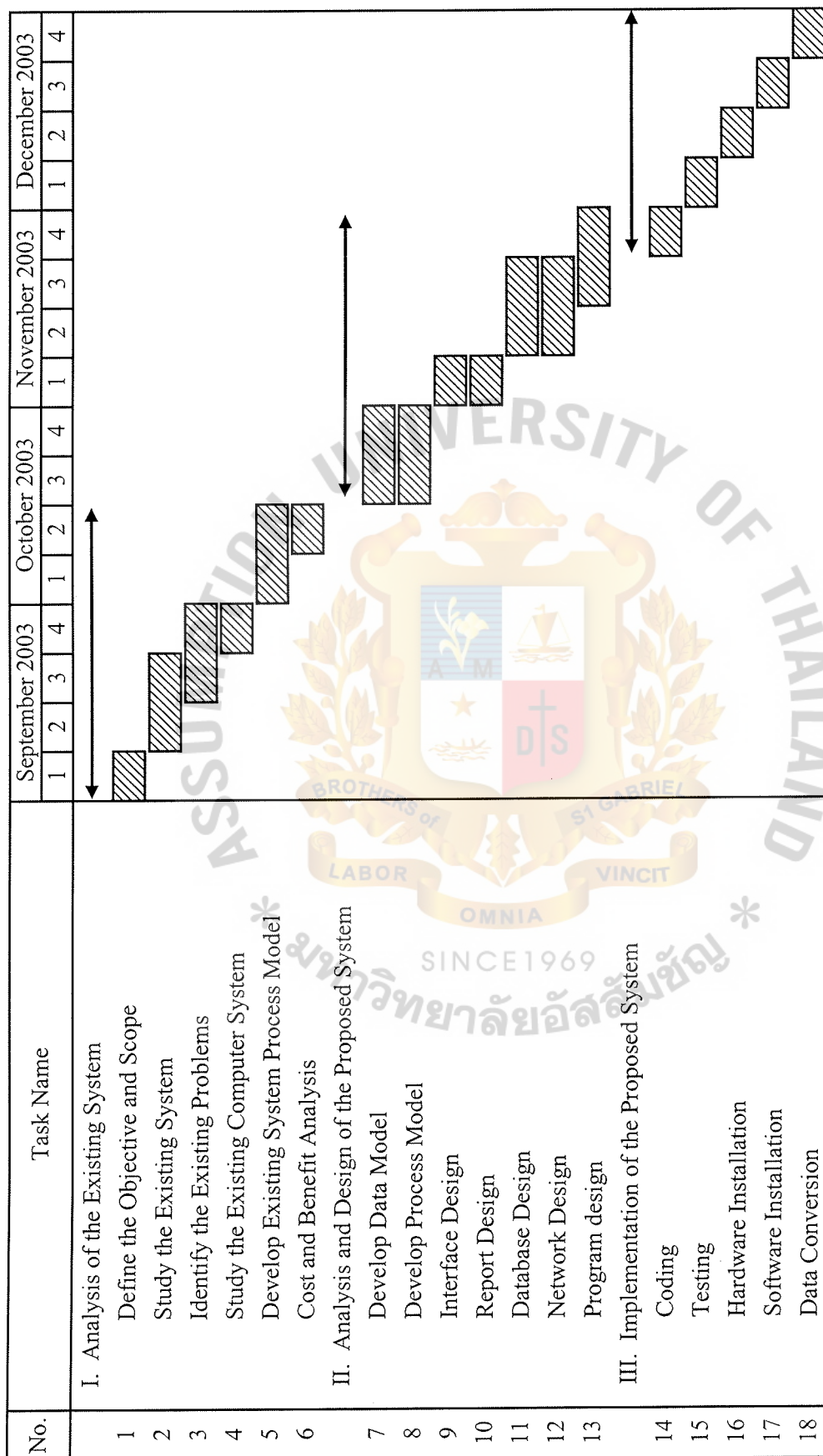


Figure 1.1. Project Plan for Sales Support Information System.

II. THE EXISTING SYSTEM

2.1 Background of the Organization

Firstly, this PVC pipe manufacturing was established and driven by a Singaporean investor with a small volume of sales, and less market share. Unfortunately, the investor also faced difficulties in controlling production and managing workforces, He had a hard time to push the business in a row. As a result, it ran out of business. By that time, a businessman named, Mr. Somchai Kosumsawad, decided to take over the factory even though he did not have any experience in the PVC pipe industry. Nevertheless, with his 35 years experiences in marketing, he began to study and do business research such as feasibility analysis, and SWOP. He found a great opportunity for a new entry to get into the PVC pipe market. After the acquisition in year 1997, Mr. Somchai renamed the factory as “Multiple Assets Co., Ltd.” or MAC, he reorganized the system, and reengineered all the machines and tools in the production line.

The factory is now located in Samutprakarn province on 2,000 square meters. MAC plays a major role in the recycled PVC pipe industry with different sizes of PVC pipe. It offers the market $\frac{3}{8}$, $\frac{1}{2}$, $\frac{3}{4}$, 1, $1\frac{1}{2}$, 2, $2\frac{1}{2}$, 3, and 4 inches diameter with the same length of 4 meters. Primary market concerns of MAC are farmers, and agriculturists. With this reason, it is not essential to occupy brand new raw materials such as resin, and PVC. More than fifty percent of the raw materials used in the PVC pipe production are all recycled, mixing with chemical substance such as white cement, etc., passing through pipe extruder machine, cooler, and cutting. It finally becomes finished goods. Furthermore, the management of MAC plans to launch new products that are complementary to PVC pipe. Link or connector, which is generally

used to connect PVC pipes together. Connector comes with different designs such as angle-joint connector, 2 ways-joint connector, 3 ways-joint connectors, etc. MAC also proposes new useful features of PVC pipe, it facilitates consumers to connect two PVC pipes together without using the connectors, and it also helps consumers to reduce the costs. This excellent idea is to bloom one end of PVC pipe for about four inches long to work as a connector. Customers can connect one normal end to the one blooming end directly. It means that customers do not need to pay a dime for a 2 ways-joint connector since it is instantly integrated. Blooming one end of the PVC is the final process of the production before packaging. Customers may choose whether to bloom the head off or not.

The structure of MAC is consisted of five different departments, Management, Marketing/Sales, Account/Finance, Operating & Maintenance, and Warehousing. Each department is independent in terms of information, and process. They may respond to the demands of other departments upon request. For example, Warehousing department would place an order of the spare parts of the machine, tools, and raw materials only when they receive the request from the Operating department. Nevertheless, sometimes Inventory department may fill up the stockpiles with raw materials without notice. Another example is sales staffs in the Marketing department may not have enough information to enhance their sales while they are visiting their customers. The source of information that could support their sales are from Warehousing department, and Operating department such as available stock, production plan and production quantity respectively.

(1) Management

General Manager of MAC, Mr. Surawong, his major responsibilities are planning business, managing and scheduling all the staffs because they

are working as a shift, and organizing the factory. An enormous amount of related data is needed to support decision making in this department.

(2) Marketing/Sales

After the businesses strategies and planning are set by the management, all marketing staffs would follow the same fashion in order to gain the competitive advantages, and to achieve business goals.

(3) Account/Finance

Account/Finance mainly deals with all paper work such as invoice, receipts, customer records, and all major reports to the management.

(4) Operating & Maintenance

This is the production department, running every single machine such as PVC extrusion machine, crushing machine, mixer & cutter. They also have to keep the maintenance and machine overhauled if it is required.

(5) Warehouse

This department would supply the customers' wants when an order is placed. Mostly, warehouse has to coordinate with Operating, and Marketing department. They are offering stock in hand, and also responds to all in and out materials and finished products.

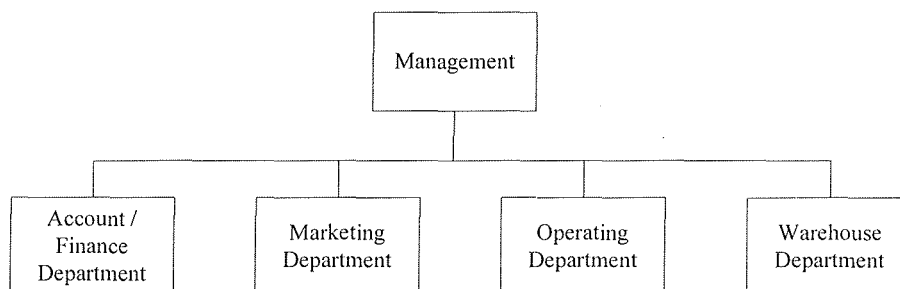


Figure 2.1. Organization Chart of Multiple Assets Co., Ltd.

2.2 The Existing Problems and Areas for Improvement

The existing problems of the system of Multiple Assets Co., Ltd. are as follows:

(1) Loss of Important Data

Difficult to check the records of the customer whether it already existed or not, Data redundancy may arise, and it is also difficult to follow up the customers if new promotion is launched.

(2) Inaccuracy and errors

Inaccuracy and errors may occur because inputs and outputs are entered by humans. Delay of and unspecific information is written on the white board, and also noted on a piece of paper may cause misunderstanding and misleading.

(3) Time Consuming

Required information on hand is not well organized and arranged in the proper way. Therefore, they spend a lot of time to find out the answer for the customers with the manual system.

(4) Lack of supported information

Inaccuracy and lack of information that support the management in decision making, difficult to plan the business marketing, strategic planning, and expand the business.

Areas for Improvement

The areas for improvement of the systems can be defined as changes that will result in incremental yet worthwhile benefits. The computerized system must be implemented to four major departments (Marketing, Account and Finance, Operating and Warehouse in order to improve the system, and to add the value of Multiple Assets

Co., Ltd. according to the mission statements, and strategic planning. The following are the areas that must be improved.

- (1) Speeding up the processes to reduce time and documentation.
- (2) Reducing errors in data input to improve the accuracy of information and data integrity.
- (3) Not only reducing workload of all staffs by using computerized system, but it also reduces misunderstanding and miscommunication among them.
- (4) Improve the quality of documentation such as Purchasing Order, service rate, and response time serving the customers in order to create good will.
- (5) Increase the profits from the efficient use of data, and reduce the costs by cutting unnecessary and redundant tasks.



2.3 The Existing Computer System

Before we start designing a new system, first we have to understand clearly about the perception of the existing system as a whole; then, studying the details of the existing system from the documentation. This is one of the examples of the requirement discovery processes. Requirement discovery of the existing system would provide us what the inputs are, what the processes do, what the throughputs and outputs are, and where the outputs go. In addition, we may need to learn more about the network of the existing system. After gathering all the information needed, analyzing the existing system is the next major concerns. We are able to identify the problems and find the solution from this phase. To solve the problems that we have learnt from the analysis phase, we must apply new technology and redesign the control flow of the data and processes according to the functional and nonfunctional requirements from the users that would bring us to the proposed system. During the requirement analysis, we may need to perform the feasibility analysis of the proposed system whether the proposed system is worth enough to invest or continue. These are the advantages of revising the existing system. Therefore, in this section the existing system of MAC would be examined and decomposed into details. The following diagrams will be performed to help us understanding the existing system clearly, Context Data Flow Diagram, Functional Decomposition Diagram, and Data Flow Diagram. However, we may not be able to study the existing system if we develop a new system from scratch. Therefore, using other fact-finding techniques to gather the functional requirement is necessary, and it depended on the requirement of the stakeholders.

2.3.1 The Process Modeling

The process modeling is created to show how the data is captured and used (data in motion) represented by using data flow diagrams. The context diagram is constructed to establish the initial project scope. It depicts the system as a whole in correlation with its environment that is the “external agents” involved. The context diagram of the current system is shown in Figure 2.2.

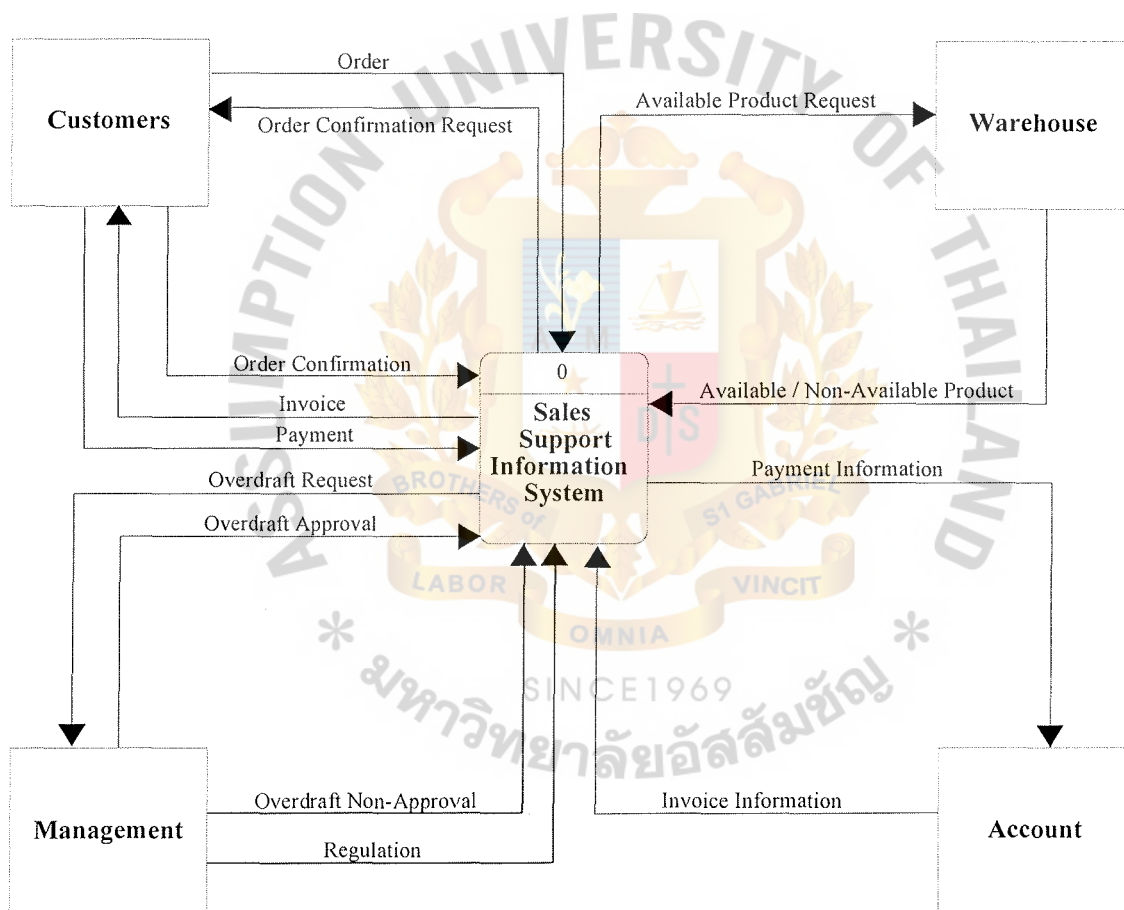


Figure 2.2. The Context Diagram of the Existing System.

The existing system is composed of four major external agents. Each time a customer places an order, no matter whether it is ordered by call or ordered by faxing

the Purchasing Order in, sales staffs would find out the profile of that customer. If it is a new customer, they would pass this profile to the management level that always take care of new accounts. Management level would find out and set up a credit line for the new account at once. It is mandatory for new customers to trade in cash for the first couple of transactions, they also can apply bank guarantee. As time goes by, a new account becomes a trustworthy and valuable customer, they would be given a credit line, and be able to trade on credit. However, the limitation of the credit line relies on the credit history.

For the existing customer, sales staffs would handle the account themselves. If an order is placed, they would note down in paper, the size of PVC and quantity, which matches the customer's requirements. Comparing the demands of the customer, and the information they have on the white board and paper notes, sales staffs could confirm an order. Nevertheless, in terms of short inventory, the customer would be informed immediately, but it might take a while since sales people have to calculate the stock themselves. Less volume sales in the Purchasing Order with the inventory would yield a positive number. Assume that one category of the product would take fifteen seconds to find out and to calculate, five categories would approximately take one minute and fifteen seconds to find out all the availabilities. This is a very straightforward example because supply is surplus, the calculation is not complicated.

Now, let us take a look on another side of this transaction. At warehouse's point of view, we may have a negative number of the inventory in the system after subtraction of the demand and supply, but there is no such negative inventory physically. Tangible goods cannot be negative, it can only be positive or zero. The negative inventory is just the number that shows the shortage of inventory, demand is over the supply. One question is why MAC does not increase the productivity to fulfill

the orders? Firstly, keep in mind that this PVC pipe is complementary to agricultural industry or we may probably say that it is homogeneous agricultural industry since farmers lay them like a net to crop the plants during summer and winter. During this period, demand is always over the supply. Despite the quantity of the PVC pipe in the stockpile that MAC has kept for a certain period of time, and with full capacity of the manpower, and machine that MAC can handle with, the stockpile is empty within two weeks without a doubt. The answer is the investment is limited. Nonetheless, agricultural PVC pipe is not essential in the rainy season. MAC has room during this period to boost up the stockpile again.

Therefore, MAC is searching for a way to serve customers better when the stock is empty. Back order is one of the choices that best fits MAC. People may think that stocking more and more inventory could also solve such a problem. The answer is yes, but they cost more. The more stocks in the inventory, the more cost and problems the company will face. For example, MAC needs more space to keep all raw materials and finished products, opportunity costs, exchange rate, etc. Hence, back order is chosen to serve customers when inventory becomes shortage. After sales staffs check the inventory, and declare an order as a shortage. They must get the verification from the customers to start the production, Back Order. Otherwise, back order transaction is canceled and customer waits for the delivery of the regular order, invoice is attached. Payment and billing are followed respectively, and filed as a record in each individual profile.

The existing system of MAC uses a less computerized system. There are only two machines and one printer, which are operated in the system, and they share the printer but they are standalone machines. Only the office staffs and management level use the computers. Generally, the staffs will key in the information regarding the

purchasing order, calculate and issuing bills, transactions, and keeps the records of the customers. Management often uses Microsoft Excel to record all major expenses, incomes, personnel, and print out as a report. Functional Decomposition Diagram and Data Flow Diagram of the existing system are shown in Figure 2.3 and 2.4 respectively.



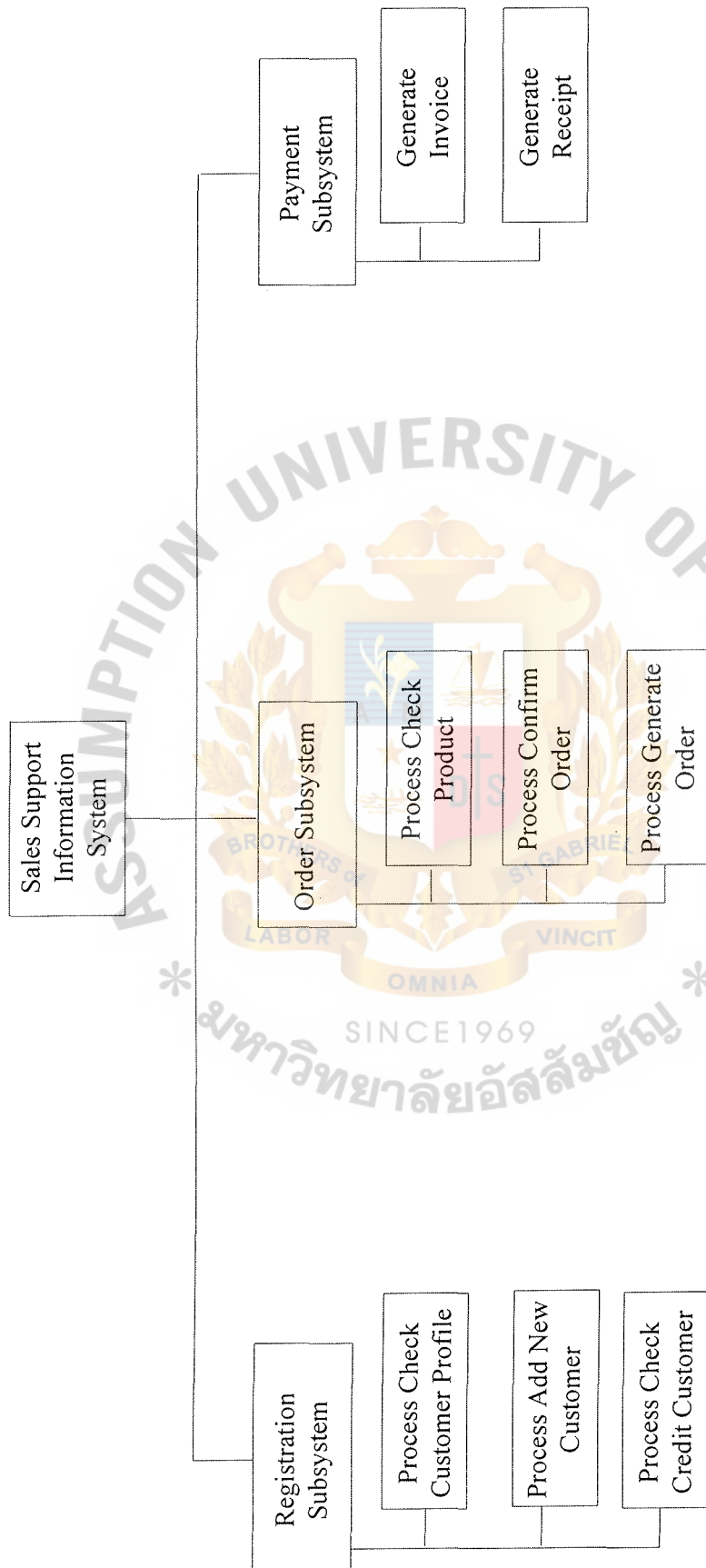


Figure 2.3. The Functional Decomposition Diagram of Sales Support Information System.

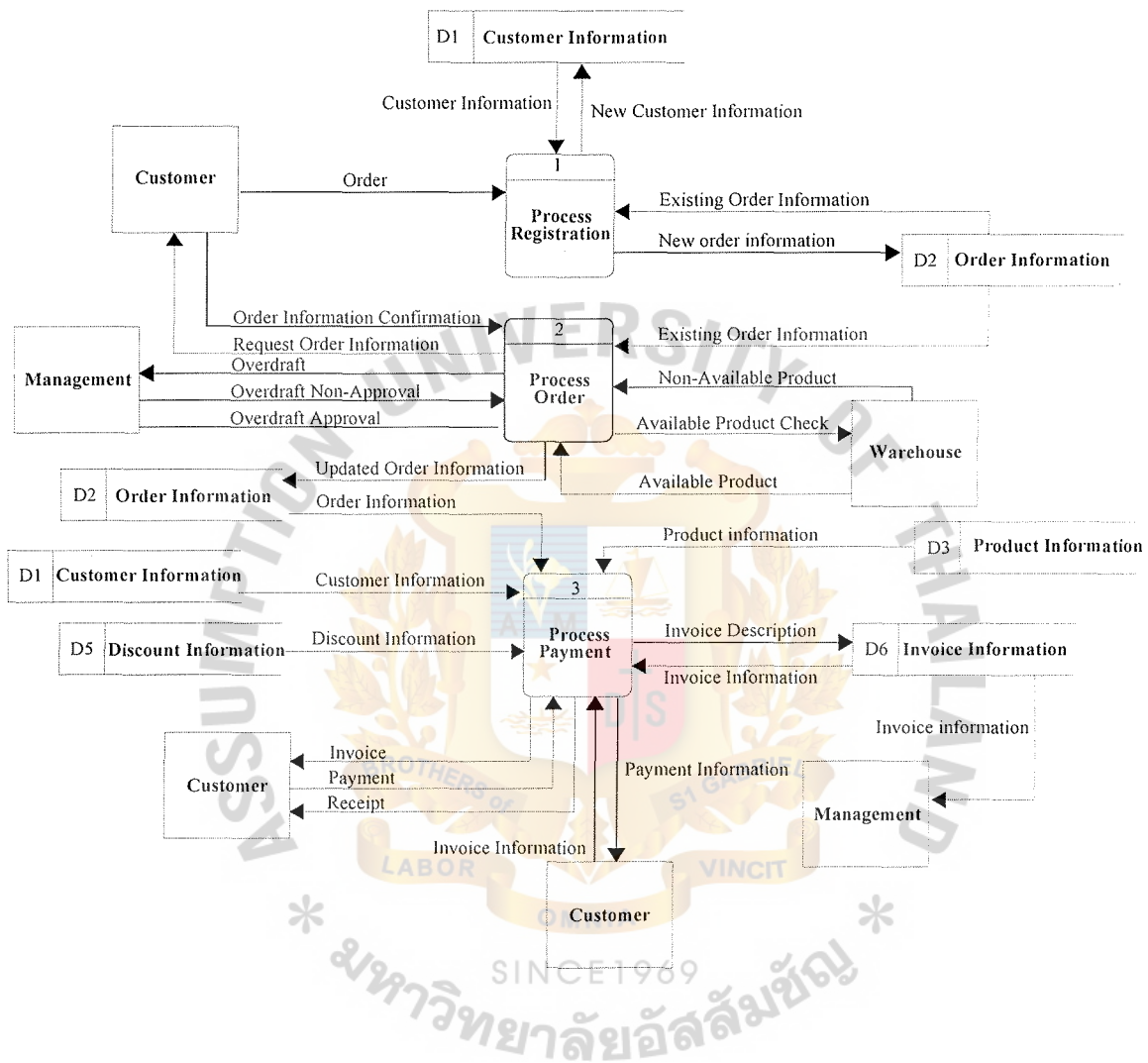


Figure 2.4. The Data Flow Diagram of Sales Support Information System.

III. PROPOSED SYSTEM

3.1 System Specification

According to the previous section, Multiple Assets Co., Ltd. now requires an effective Sales Support Information System, which can facilitate various processes such as registration, order processing, back order processing in order to solve the problems occurring in the existing system.

In order to achieve the specific objectives, the new proposed Sales Support Information System should have the components as follows:

- (1) Customer Database will be redesigned, developed and converted to the higher performance database server, available for marketing staffs to manage the data, make a query and facilitate the marketing staffs to systematically keep track of customer.
- (2) Switching the database from the spreadsheet application files to effective database format designed and developed on database server, to support information system.
- (3) Developing the database that corresponds to the system in order to assist marketing staffs in updating the product description, and unit prices that are varied from product to product.
- (4) The DBMS at server supports and allows multi-user to retrieve information from database simultaneously.
- (5) All functions are displayed by GUI, which is easy to use and has nice graphic display. The system user and system owner will be highly satisfied.

3.2 Requirement Analysis

The study of the existing system reveals many problems, such as high operating cost and human errors, which lead to the new requirement that is a computerized system to handle the work more efficiently. After all problems are identified and evaluated, the business requirement for the new system can be summarized as follows:

- (1) The proposed system should facilitate the user in searching customers' profile and credit balance, and should shorten the response time to access information.
- (2) Users require input screen that allows direct manipulation of the graphical representation on screen, which can be accomplished with keyboard input and mouse. New users, who are unfamiliar with the computer environment can use new system easily.
- (3) To calculate the total purchase for customer, the new system should provide the embedded arithmetic function within the system to generate calculation result automatically.
- (4) To encourage the paperless office, the proposed system should provide users with the requested report or document by introducing real time information display screen.
- (5) The developed system should enhance the existing data entry process, and eliminate human data entry errors, through the use of electronic form such as providing the verification mechanism for the input data from the users.

To gain a better understanding of the new system requirement, the logical model is drawn to depict the system independent of any technical implementation. In this project, data modeling and process modeling techniques are used to document business

requirement, and serve as the logical design of the proposed system. The detail of each technique can be explained as follows:

Data Modeling

It is a technique for organizing and documenting a system's data. The complete data model is usually implemented as a database. Typically, the data model is called an entity relationship diagram (ERD). There are three levels of entity relationship diagram: context data model, key-based data model and fully attributed data model.

The context data model includes only entities and relationships, but the attributes are excluded. The intent is to refine the understanding of scope, not get in to detail about the entities and business rules.

The key-based data model will eliminate nonspecific relationships, add associative entities, and include primary and foreign keys. This model will also include precise cardinalities and any generalization hierarchies.

The final data model, fully attributed data model includes all the remaining descriptive attributes and subsetting criteria. To identify all attributes, it requires the understanding of the data attributes for the system. These facts can be discovered through the study of the existing reports and documents to be the naming standard for attribution.

The complete entity relationship diagram of the proposed system is shown in Appendix A.

Process Modeling

Process modeling is a technique for organizing and documenting the structure and the flow of data through the system's process and/or the logic, policies, and procedures to be implemented by a system's process. To construct the process model, the context diagram is firstly drawn to establish the initial project scope, which defines how the developed system interacts with other systems and the business as a whole. Figure 3.1 illustrates the context diagram of the proposed system. Three external entities, which are Customer, Management, and Warehouse, interact with the developed system.

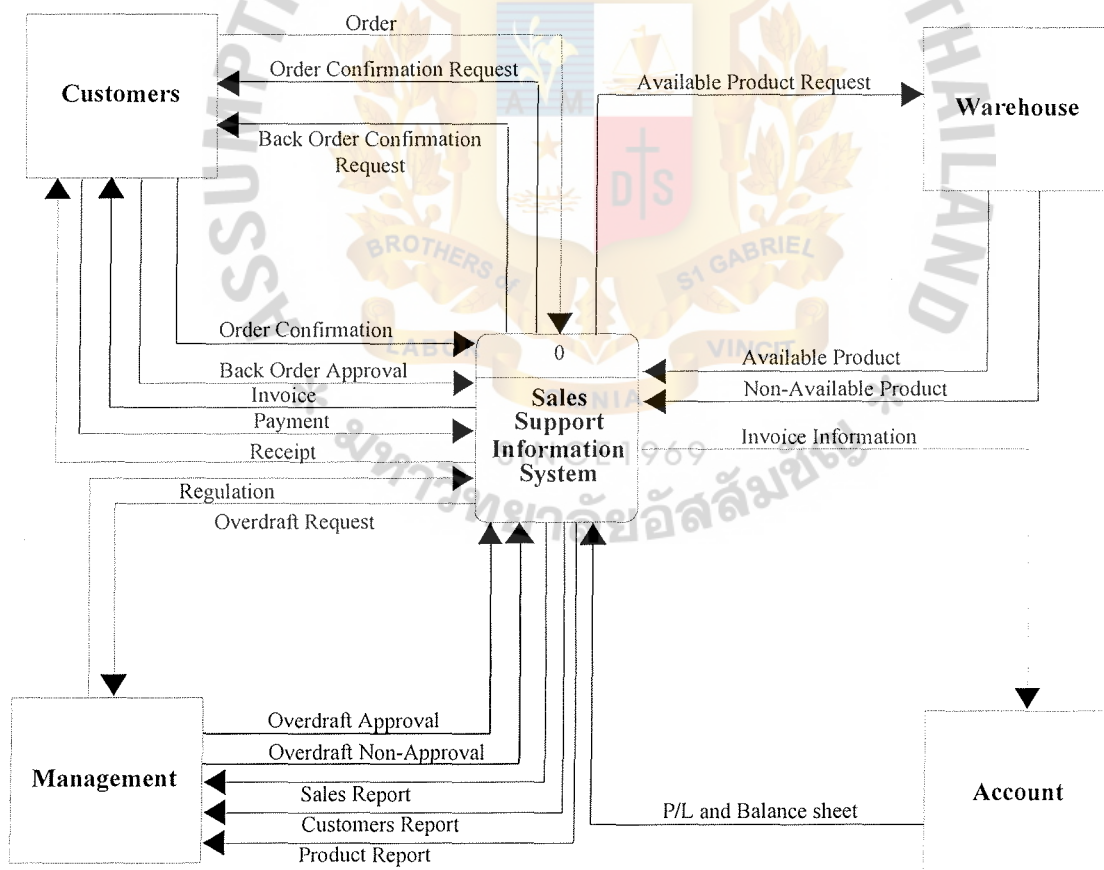


Figure 3.1. Context Data Flow Diagram of the Proposed System.

Next, the functional decomposition diagram is created to show the top-down structure of the system. This diagram also serves as an outline for drawing the data flow diagram. The functional decomposition diagram of the proposed system is shown in Figure 3.2, which composes of five major subsystems. The higher-level data flow diagrams (DFDs), which map the subsystems, sub-functions, and primitive events, are constructed in the FDD.

The Sales Support Information System consists of five major subsystems. They are customer registration subsystem, order approval subsystem, back order subsystem, payment subsystem, and report subsystem. Each subsystem comprises many sub-processes with distinct functionality. The brief description of each subsystem is explained as follows:

(1) Customer Registration Subsystem

This subsystem is the front desk of the system which performs inputting customers' information into the system to ensure that all necessary attributes will be stored into the system. If the profile already existed, the system will retrieve the information from the database for update. Otherwise, the system will create new profiles, and print out the report to the management level for further process. Moreover, this subsystem is able to show the credit history of the customer. Staffs are able to check the credit line and credit balance of the existing customers. If the value of new order exceeds credit limit, management would evaluate whether to extend the credit line or not, called overdraft.

(2) Order Approval Subsystem

Before this subsystem would carry out the physical orders, they must perform Credit Checking, and Inventory Checking. If the value of new order exceeds credit limit, management would approve whether to extend the credit line or not, called overdraft. Moreover, for those who are new customers, the management would evaluate new customers' credit line based on credit bureau or bank guarantee before they move to new process. Next, Inventory Checking is to compare the specification and volume of the order with the stock on hand would yield a completed order if it is not a shortage. Products will be delivered as promised with invoice and billing afterward.

(3) Back Order Subsystem

This subsystem performs recording of the orders when inventory becomes shortage or out of stock. Pending order will pass through the inventory and operating department to prepare stock and produce the required volume and sizes that match to back order. Back order is accomplished when finished goods are delivered to the customers' site.

(4) Payment Subsystem

This subsystem performs calculation such as total sales, volume, discount, taxes, and due date for the customers. Bills or receipts are also included in this process. Discount is calculated from the marking in percentage based on each individual activities and credit history.

(5) Report Subsystem

Account and Finance acts as an actor who initiates this subsystem. Issuing bills and receipt after invoice and packing list are passed through

the customers, and generating sales monthly report, customers' profile, and back order report to the management.

The complete Data Flow Diagram of the proposed system is shown in Appendix

B.



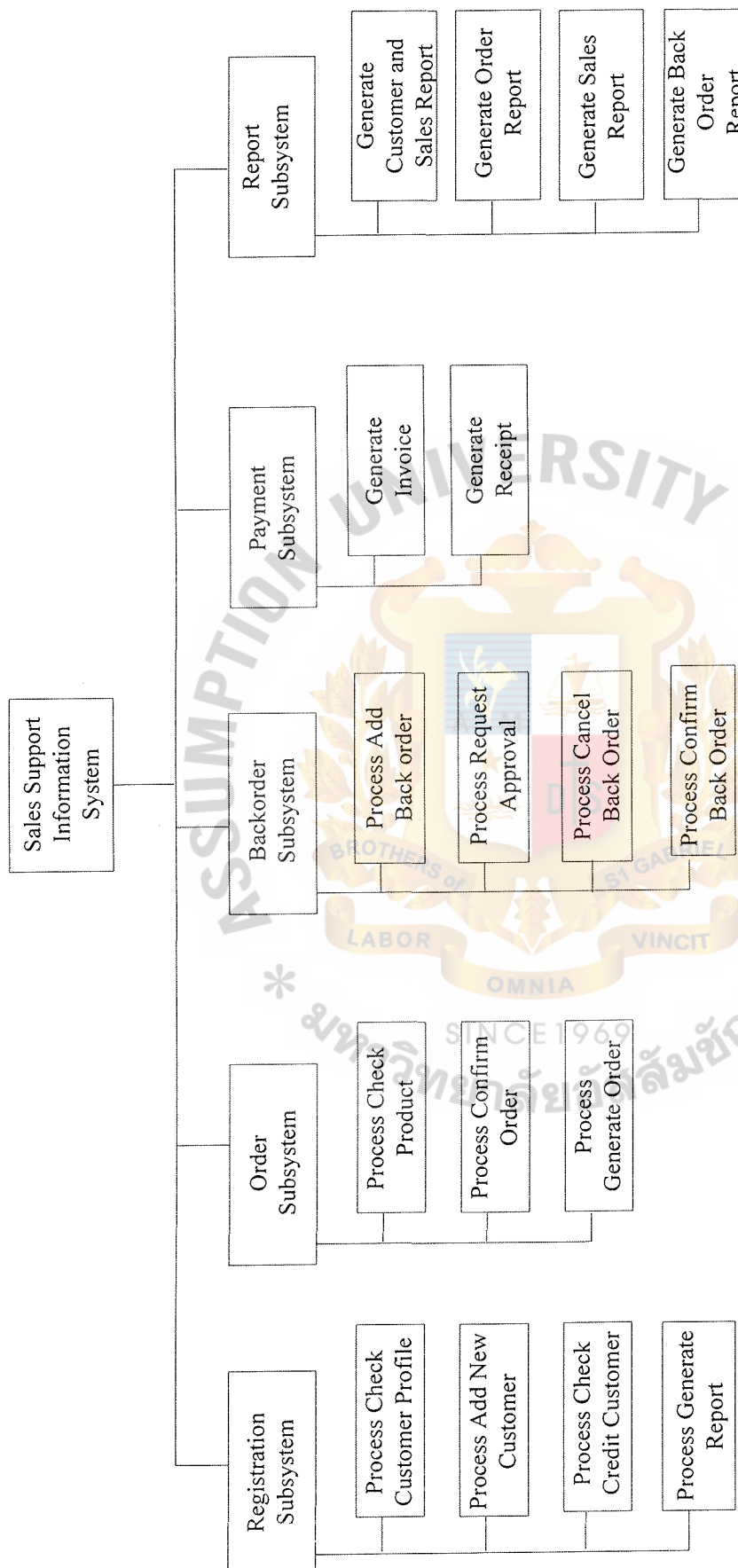


Figure 3.2. Functional Decomposition of the Proposed System.

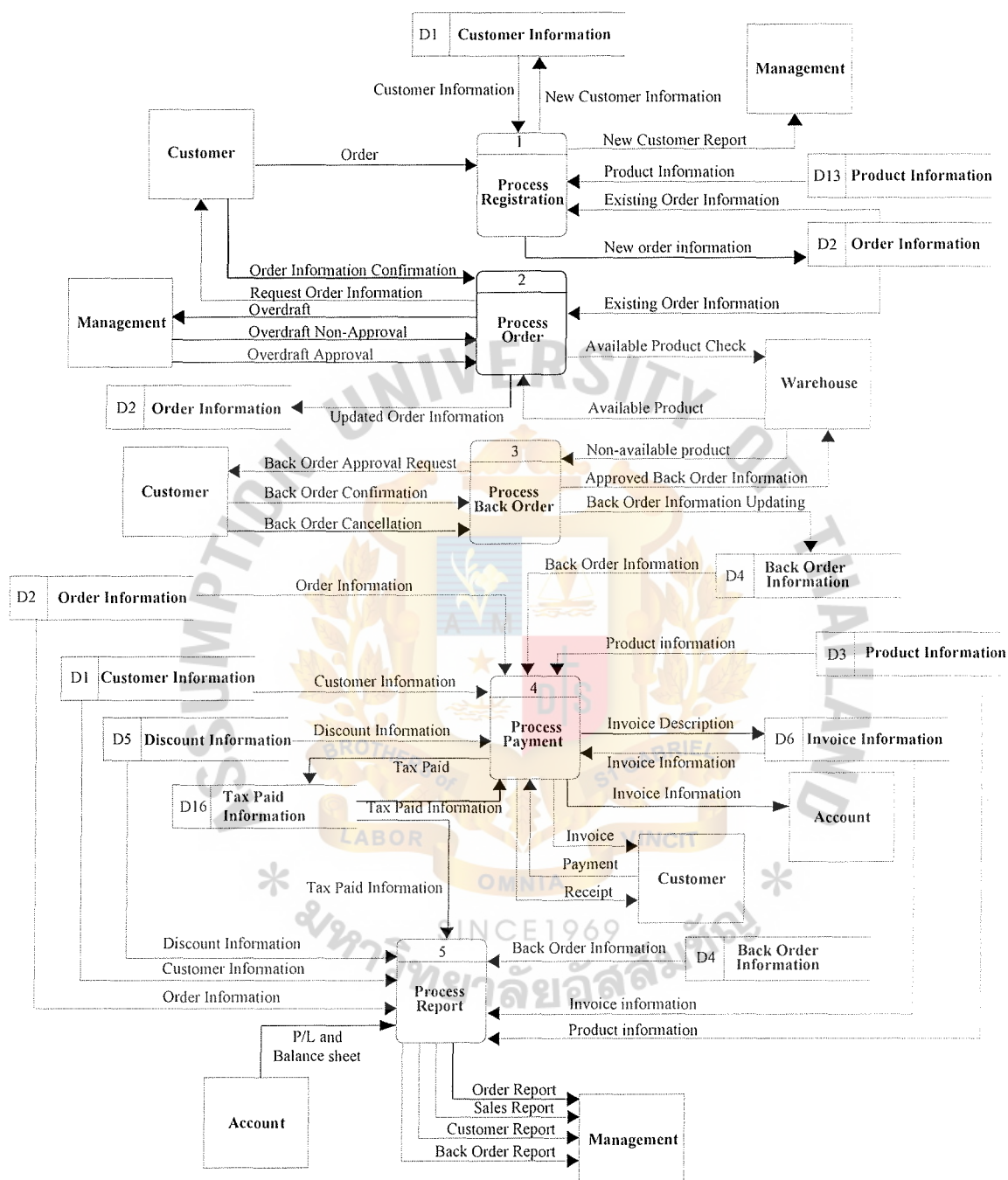


Figure 3.3. The Data Flow Diagram of Sales Support Information System.

3.3 System Design

The previous requirement analysis section primarily focuses on the logical aspects of a system, whereas system design deals with the physical implementation aspects of a system. Various design techniques are applied to construct the system to accomplish the objectives of the project. The details of each design technique can be explained as follows:

Candidate Solutions

Given the business requirement established in the previous section, the alternative candidate solutions can be identified from the idea and opinion of the development team and user. Along with reviewing the system specification, the three candidate solutions can be defined for the proposed system.

- (1) Candidate 1: Two-tier Client/Server Computing – Window 2000 Server and MS Access 2000 are used as Development Tool and Database Software respectively. This solution supports the multi-user environment and relational database technology. Database Server is used to follow the concept of two-tier Client/Server Computing. This candidate provides the best way of developing the new system by introducing the effective development tool and database software.
- (2) Candidate 2: Two-tier Client/Server Computing – MS Visual Basic 6.0 & MS SQL Server 7.0 MS Visual Basic 6.0 is used for application development, because of its rapid application development (RAD) environment. With its visual style, it makes application development easier. For DBMS, MS SQL Server 7.0 is chosen, because it is a standard DBMS for Windows platform.

- (3) Candidate 3: Oracle can be effectively used to design and build the system.

Oracle Developer is employed to design the user interface, which is compatible to Oracle' DBMS. This system is an excellent and widely used in the industry because it supports large database that can be expanded in the future. The network architecture for this solution is the same as Candidate 1, which is Two Tier Client/Server Computing.

In order to achieve the target, the alternative candidate solutions of the business requirements defined during systems analysis are identified. The amount of information describing the characteristics of any candidate solution may become overwhelming. A matrix is a useful tool for effectively capturing, organizing, and communicating the characteristics for candidate solutions. Three candidate solutions of the Sales Support Information System are demonstrated by using a completed candidate matrix as shown in Table 3.1.

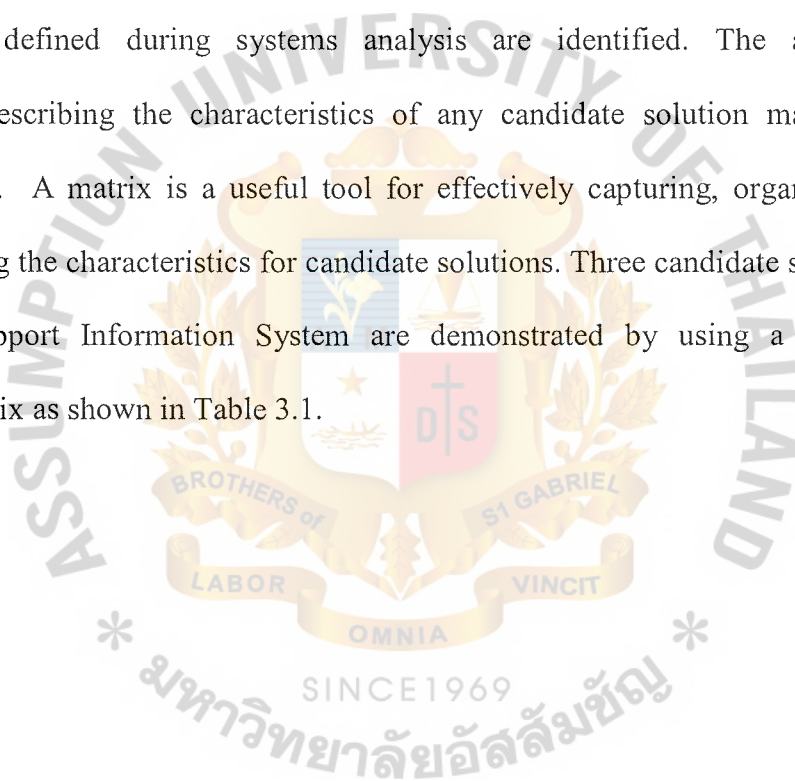


Table 3.1. Completed Candidate Matrix.

Characteristics	Candidate 1	Candidate 2	Candidate 3
Portion of system computerized Brief description of that portion of the system that would be computerized in this candidate.	Fully support order processing operations and other concerning functions.	Same as candidate 1.	Same as candidate 1.
Benefits Brief description of the business benefits that would be realized for this candidate.	Application development is easy with the existing tools	Powerful DBMS and application that perform tasks more efficiently.	Powerful DBMS and application that enable user to perform their tasks more efficiently.
Servers and Workstations A description of the servers and workstations needed to support this candidate.	Windows 2000 Server Windows ME MS Access 2000	Windows 2000 MS Visual Basic 6 MS SQL Server 7.0	Developer 2000 Personal Oracle 8.0
Software Tools Needed Software tools needed to design and build the candidate (e.g., database management system, emulators, operating systems, languages, etc). Not generally applicable if applications software packages are to be purchased.	Windows 2000 Server Windows ME MS Access 2000	Windows ME MS Visual Basic 6 MS SQL Server 7.0	Developer 2000 Personal Oracle 8.0
Application Software A description of the software to be purchased, built, accessed, or some combination of these techniques.	Custom Solution	Custom Solution	Custom Solution
Method of Data Processing Generally some combination of: on-line, batch, deferred batch, remote batch, and real-time.	Database stored on server and processed on workstation	Database stored on server and processed on workstation	Oracle uses a two-tier Client/Server architecture with a powerful database server
Output Devices and Implications A description of output devices that would be used, special output requirements (e.g., network, preprinted forms, etc.), and output considerations (e.g., timing constraints).	Laser and Dot Matrix Printer (Network Printer)	Same as candidate 1.	Same as candidate 1.
Input Devices and Implications A description of input methods to be used, input devices (e.g., keyboard, mouse, etc), special input requirements (e.g., new or revised forms from which data would be input), and input considerations (e.g., timing of actual inputs).	Keyboard & Mouse	Keyboard & Mouse	Keyboard & Mouse

Table 3.1. Completed Candidate Matrix (Continued).

Characteristics	Candidate 1	Candidate 2	Candidate 3
Storage Devices and Implications Brief description of what data would be stored, what data would be accessed from existing stores, what storage media would be used, how much storage capacity would be needed, and how data would be organized.	MS Access with 40 GB storage capacity	MS SQL Server DBMS with 40 GB storage capacity	Oracle SQL Server DBMS with 80 GB storage capacity

After alternative candidate design solutions have been identified, each candidate must be analyzed for feasibility. It should not be limited to costs and benefits, but follow these four sets of criteria.

- (1) Operational feasibility is a measure of how well the solution will work in the organization. It is also a measure of how people feel about the system and project.
- (2) Technical feasibility is a measure of the practicality of a specific technical solution and the availability of technical resources and expertise
- (3) Economic feasibility is a measure of the cost-effectiveness of a project or solution. This is often called a cost-benefit analysis.
- (4) Schedule feasibility is a measure of how reasonable the project timetable is. Can the solution be designed and implemented within an acceptable time period?

The feasibility analysis is performed on each individual candidate regardless of the feasibility of other candidates in order to evaluate the alternative candidate solutions according to their economic, operational, technical, and schedule feasibility as shown in Table 3.2 below. The full details of cost-benefit calculations (Economic

Feasibility) are shown in Appendix C, which are all Candidate Cost tables, Payback table and graph, and Net Present Value (NPV) table.

Table 3.2. Completed Feasibility Matrix.

Feasibility Criteria	Wt.	Candidate 1	Candidate 2	Candidate 3
Operational Feasibility Functionality. A description of to what degree the candidate would benefit the organization and how well the system would work. Political. A description of how well received this solution would be from both user management, user, and organization perspective.	30%	Fully support user requirements in term of both functionality and business process. Score : 85	Same as candidate 1. score : 95	Fully supports their requirements, and can be expanded to support other functions in the future. It may use long time of implementation. score : 90
Technical Feasibility Technology. An assessment of the maturity, availability (or ability to acquire), and desirability of the computer technology needed to support this candidate. Expertise. An assessment of the technical expertise needed to develop, operate and maintain the candidate system.	30%	Programmer is familiar with Microsoft products therefore this reduces development process. MS Access 2000 for both Client and Server This solution is using MS-access, which has been understood by current system so it decreases software and training cost. Changing integrity rules of store application will be increase maintenance cost score : 79	Programmer is familiar with Microsoft products therefore this reduces development process. Microsoft Visual Basic 6.0 and MS SQL Server 7.0 is a company standard for application development. score : 90	Oracle is very good at supporting large database system but current technical staff has a little experience with oracle product. Oracle requires the continuous training course for operating and maintaining the system with additional cost because it has no guarantee of its future version. score : 85
Economic Feasibility Cost to develop: Payback period (discounted): Net present value: Detailed calculations:	35%	Approximately 734,900 Baht Approximately 1.7 years Approximately 3,502,413.06 Baht See Appendix D. score : 90	Approximately 827,450 Baht Approximately 1.8 years Approximately 3,268,372.81 Baht See Appendix D. score : 87	Approximately 871,900 Baht Approximately 1.9 years Approximately 3,144,647.06 Baht See Appendix C score : 80
Schedule Feasibility An assessment of how long the solution will take to design and implement.	5%	4 - 6 months Score : 90	5 - 7 months score : 87	8 months score : 82
Ranking	100 %	86	91	85

Candidate 2 is selected as a target system. The main purpose of this target system is to support the user required functionality including order processing operations and other concerning functions and the system owner satisfaction. The best candidate is selected based on the best ranking that is shown in the feasibility analysis in term of Operational, Technical, Economical, and Schedule feasibility. The selected system should provide the benefits to the present Sales Support Information System as following:

- (1) The applications for the new system can be easily obtained and there are varieties of choices to select from. The applications such as Microsoft Visual Basic will offer variety of tools to lower application expense, and time spending in the system development life cycle.
- (2) All the functions are displayed by GUI, which is easy to use and has nice graphic display. The system user and system owner will be highly satisfied.
- (3) Less training is needed for the new system because all the information and system guide can be easily obtained or searched for. In addition, the new system can be learnt and understood by the users themselves. Thus, the suggested system will not have any additional training cost incurred.
- (4) The new DBMS is located at the server. It is capable of calculating and selecting the best way to draw information from database. Therefore, all information is retrieved very quickly from the database without any traffic problem.
- (5) The DBMS at server supports and allows multi-user to retrieve information from database simultaneously.

Structure Design

Structure Design is a process-centered technique that transforms the structured analysis models into good software design models. Structured design introduces a modeling tool called structured charts that are used to illustrate software structure to fulfill business requirements. They are used to graphically depict a modular design of a program. A structure diagram is a hierarchical, modular breakdown of a program. Between levels on the tree, there are links, with symbols to indicate the sort of information that is being passed back and forth. The structure chart is usually the end result of the activity known as structured analysis, in which the functions of a system are partitioned in a top-down manner.

Specifically, they show how the program has been partitioned into smaller more manageable modules, the hierarchy and organization of those modules, and the communication interfaces between modules. Structure charts; however, do not show the internal procedures performed by the module or the internal data used by the module. The output of structure design is partitioned data flow diagram and structure chart, which is illustrated in Appendix D.

Process Specification

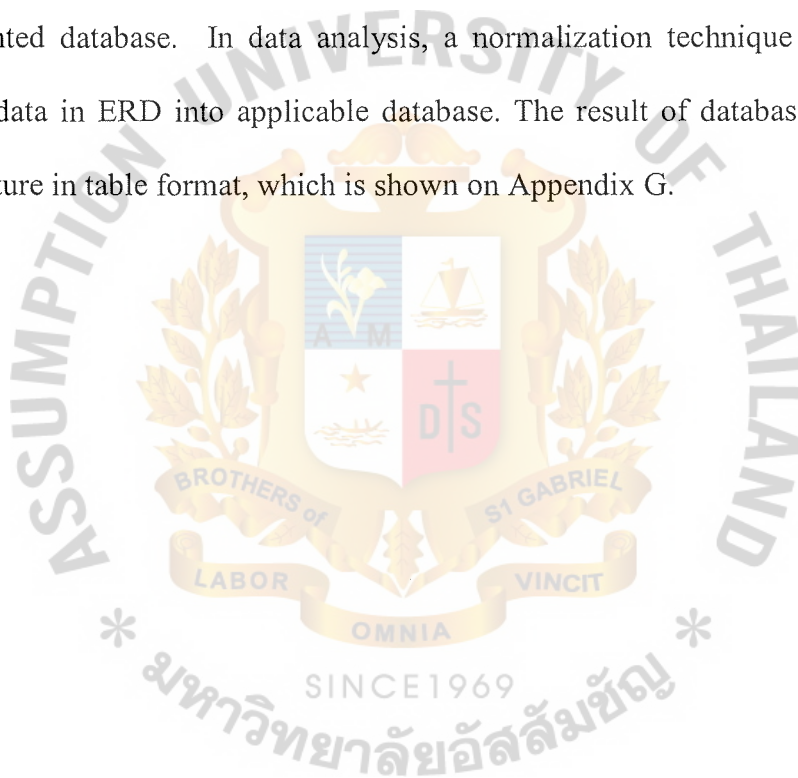
The purpose of a process specification is to define what the system does to transform inputs into outputs. It provides the details of system processes in table format, which is easier to look at all related input, output, and relevant process than in a diagram. All specified tables, which are the processes from the logical data flow diagram, are shown on Appendix E.

Data Dictionary

To support system design, data dictionary provides a list of terms and definition for all data items and data stores within the developed system. The data dictionary for both entity relationship diagram and data flow diagram is shown on Appendix F.

Database Design

Referring to the data model (ERD) in the previous section, it requires some additional processes, called data analysis, to convert the designed logical data model into implemented database. In data analysis, a normalization technique is used to transform all data in ERD into applicable database. The result of database design is database structure in table format, which is shown on Appendix G.



3.4 Hardware and Software Requirement

The proposed Sales Support Information System will be developed in the form of graphical user interface, which can transform a normal Intel based PC server, application server, and database server. The software is designed to integrate with Microsoft Windows 2000 Server, and Microsoft SQL Server 7.0 as the major software for the purpose of client/server based system. The hardware and software specifications for MS SQL based server are shown in Tables 3.3 and 3.4 respectively.

Table 3.3. Hardware Specification for Server.

Hardware	Specification
CPU	Pentium IV 2.8 GHz or higher
Cache Memory	512 KB or higher
Main Memory	512 MB or higher
Hard Disk	40 GB Ultra3 SCSI 15,000 rpm X 3
CD-Writer Drive	48X or higher
Floppy Drive	1.44 MB
Network Adapter	Ethernet 10/100 TX UTP
Display Adapter	SVGA Card
Display	15" Monitor
Printer	Dot Matrix and Laser
UPS	UPS 1KVA

Table 3.4. Software Specification for Server.

Software	Specification
Operating System	Microsoft Windows 2000
Database Server	Microsoft SQL Server Version 7.0
Application Server	Microsoft Visual Basic 6.0

In the MS Window 2000 based client/server system, the qualification of the server machines would be higher than the client' machines in order to execute Microsoft SQL Server Version 7.0, to handle many nodes, huge amount of information, and to provide good respond time. For client machine, they are running Microsoft Windows ME that need less powerful machines. The hardware and software specifications for each client machine are shown in the Tables 3.5 and 3.6 respectively.

Table 3.5. Hardware Specification for Client Machines

Hardware	Specification
CPU	Pentium IV 1.8 GHz or higher
Cache Memory	256 KB or higher
Main Memory	128 MB or higher
Hard Disk	20GB 7200 rpm SMART III ULTRA ATA/100
CD-ROM Drive	48X or higher
Floppy Drive	1.44 MB
Network Adapter	Ethernet 10/100 TX UTP
Display Adapter	SVGA Card
Display	15" Monitor

Table 3.6. Software Specification for Client Machines.

Software	Specification
Operating System	Microsoft Windows ME
Application Software	Microsoft Office 2000 Professional Edition

Other important hardware needed for the proposed system is hub and cable that are used to establish the connection. The specification of all the hardware are illustrated in Table 3.7 as below:

Table 3.7. Other Hardware Requirements.

Hardware	Specification
Hub	Share Hub 8 ports
Cable	LAN Cable UTP



The developed application applies the concept of Client/Server technology that distributes application and database to a separate server.

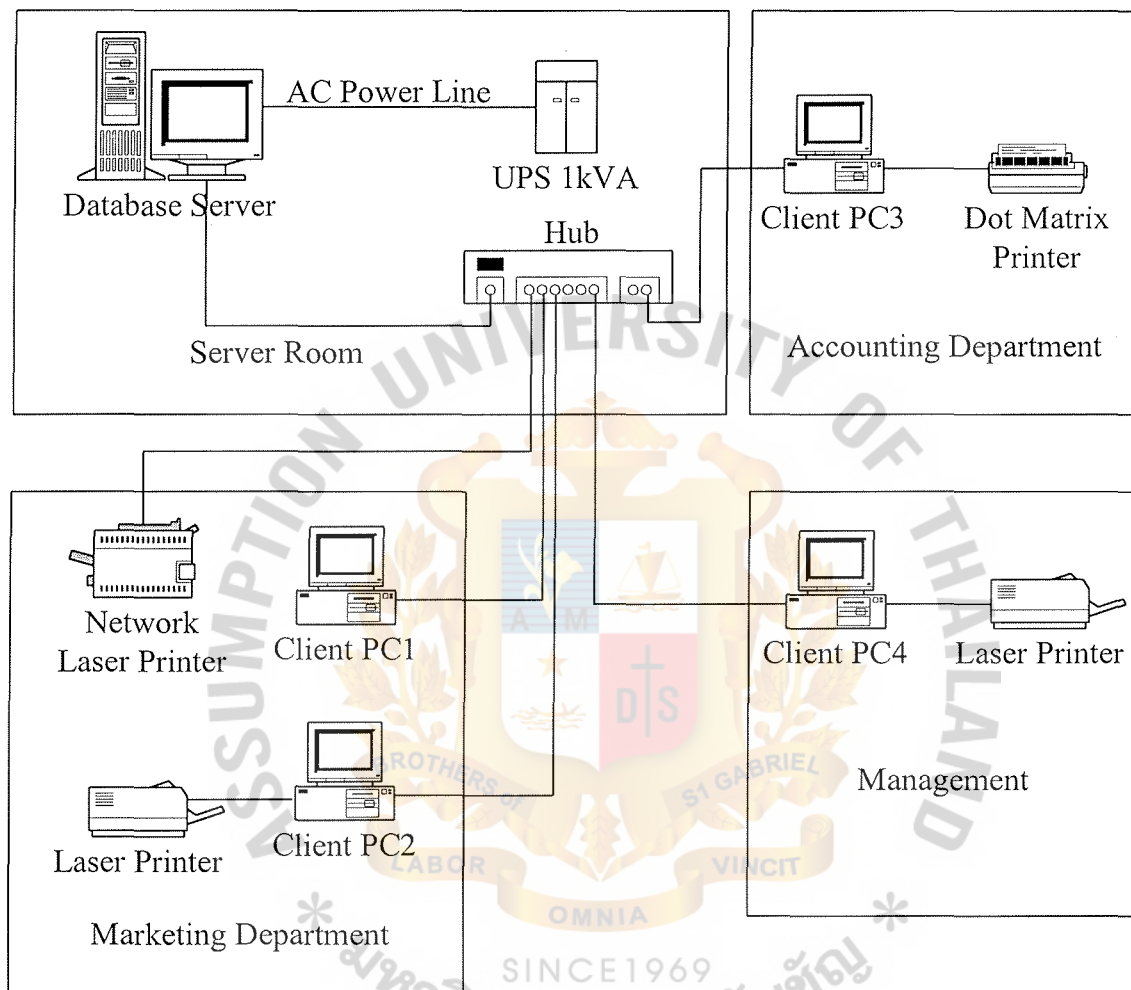


Figure 3.4. Network Configuration of the Proposed System.

3.5 Security and Control

The information in Order Processing System is important to many departments. The data in database must always be available to users when needed. A satisfactory level of share ability must be achieved and the unauthorized access must be prevented. The following security and controls should be attained by the proposed computerized system.

- (1) The user's password is a must for log-in security control in order to prevent unauthorized users from accessing the system.
- (2) There must be security checking for each menu and program by using the password authority file.
- (3) There must be back up diskettes or CD-ROM for data and programs.
- (4) Data correction must be done immediately after errors in the data listing report are found.
- (5) The report must be produced upon the predetermined schedule or the management request, as needed.
- (6) Data must be inputted, created, updated, and deleted during working hours only.

3.6 System Cost and Benefit Analysis

(1) Cost of Manual System

The cost and benefit analysis is used to determine whether the project is worthwhile. When the proposed system is developed to replace the existing system, the details of both cost and benefit of the new system compared with the old system must be illustrated. Cost and benefit analysis provides quantitative analysis for the system owner and management to make decision on the system development. The break-even analysis and payback period are also applied to show the benefits over the cost after the proposed system is implemented.

(a) Fixed Cost

The office equipment that the marketing team uses in their operation is desktop computers and dot matrix printer.

(b) Operating Cost

For annual operating cost, it includes salary cost, office supplies & miscellaneous expense and utility expense. To operate the existing system, the marketing team requires one general manager, one marketing manager and seven marketing staff. The details of the existing system cost are summarized on Table 3.8.

Table 3.8. Manual System Cost Analysis, Baht.

Cost Items		Years				
		1	2	3	4	5
<u>Fixed Cost</u>						
Desktop computer	2units@20,000	2,000	2,000	2,000	2,000	2,000
Dot Matrix Printer	1unit@ 8,200	1,640	1,640	1,640	1,640	1,640
Total Fixed Cost		3,640	3,640	3,640	3,640	3,640
<u>Operating Cost</u>						
Sales Region Manager	2persons@35,000	70,000	77,000	84,700	93,170	102,487
Sales Assistant Manager	2persons@28,000	56,000	61,600	67,760	74,536	81,989.6
Sales Supervisor	6persons@22,000	132,000	145,200	159,720	175,692	193,261.2
Salesperson	12persons@15,000	180,000	198,000	217,800	239,580	263,538
Sales Administrator	2persons@13,000	26,000	28,600	31,460	34,606	38,066.6
Office Staffs	2persons@11,000	22,000	24,200	26,620	29,282	32,210.2
Total monthly salary Cost		486,000	534,600	588,060	646,866	711,552.6
Total annual salary Cost		5,832,000	6,415,200	7,056,720	7,762,392	8,538,631
<u>Office Supplies & Miscellaneous Cost</u>						
Stationary	Per Annual	33,000	36,300	39,930	43,923	48,315.3
Office Supplier	Per Annual	20,650	22,715	24,986.5	27,485.15	30,233.6
Utility	Per Annual	84,000	29,502	32,452.2	35,697.42	39,267.2
Miscellaneous	Per Annual	26,820	92,400	101,640	111,804	122,984.4
Total Annual Office Supplies & Miscellaneous Cost		164,470	180,917	199,008.7	218,909.6	240,800.5
Total Annual Operating Cost		5,996,470	6,596,117	7,255,729	7,981,302	8,779,432
Total Manual System Cost		6,000,110	6,599,757	7,259,369	7,984,942	8,783,072

Table 3.9. Five Years Accumulated Manual System Cost, Baht.

Year	Total Manual Cost	Accumulated Cost
1	6,000,110	6,000,110
2	6,599,757	12,599,867
3	7,259,369	19,859,236
4	7,984,942	27,844,177
5	8,783,072	36,627,249
Total	36,627,249	-

(2) Cost of Computerized system

(a) Fixed Cost

Fixed cost for the proposed system includes the cost of hardware cost, software cost, people-ware cost (only the salary cost of specialized persons who are involved in developing the new system), maintenance cost including hardware and software, and implementation cost. Hardware cost includes computer server, personal computer, laser printer, dot matrix printer cost, scanner, UPS and hub. With the newly computerized system, software copyright is mandatory. The maintenance cost for new hardware and software is also paid to the vendor with the proposed option to have the free of maintenance charge in the first year of the system implementation. Before implementing the proposed system, the system construction and training cost are spent according to the project budget.

(b) Operating Cost

The proposed system introduces downsizing in the human resources to the company. For example, the number of sales staffs should be declined from twelve to eight persons. Nevertheless, the company is necessary to recruit IT specialists in order to implement the computerized system such as System Analyst, the consultants for the system users in case of the malfunctions of the system, and Network Administrator who is responsible for the connection of the developed system. Office supplies, and miscellaneous cost would be reduced as a result of implementing the proposed system.

The details of the proposed system cost are summarized on

Table 3.10.

Table 3.10. Computerized System Cost Analysis, Baht.

Cost Items		Years				
		1	2	3	4	5
<u>Fixed Cost</u>						
Hardware Cost:						
Computer Server Cost	1 set@125,000	25,000	25,000	25,000	25,000	25,000
Workstation Cost	4 units@39,000	31,200	31,200	31,200	31,200	31,200
Laser Printer	3Unit@56,800	34,080	34,080	34,080	34,080	34,080
Dot Matrix Printer	1 Unit@5,600	1,120	1,120	1,120	1,120	1,120
Hub (10/100 Mbps)	1Unit@5,500	1,100	1,100	1,100	1,100	1,100
UPS 1000 VA	1 Unit@11,500	2,300	2,300	2,300	2,300	2,300
Total Hardware Cost		94,800	94,800	94,800	94,800	94,800
Maintenance Cost:						
Total Maintenance Cost		-	-	18,000	18,000	18,000
Software Cost		167,500	167,500	167,500	167,500	167,500
Network Cost		26,750	26,750	26,750	26,750	26,750
Total Software Cost		194,250	194,250	194,250	194,250	194,250
Implementation Cost:						
Basic Training Cost		137,600	-	-	-	-
Set up Cost		84,300	-	-	-	-
Total Implementation Cost		316,500	-	-	-	-
Total Fixed Cost		827,450	289,050	311,050	311,050	311,050
<u>Operating Cost</u>						
People Ware Cost:						
System Analyst	6 months@35,000	210,000	-	-	-	-
Programmer	4 months@28,000	112,000	-	-	-	-
Network Specialist	1 month@25,000	25,000	-	-	-	-
Sales Region Manager	2person@35,000	70,000	77,000	84,700	93,170	102,487
Sales Assistant Manager	2 person@28,000	56,000	61,600	67,760	74,536	81,990
Sales Supervisor	4person@22,000	88,000	96,800	106,480	117,128	128,841
Salesperson	12Person@15,000	180,000	198,000	217,800	239,580	263,538
Sales Administrator	1 person@13,000	13,000	14,300	15,730	17,303	19,033
Office Staffs	1 person@11,000	11,000	12,100	13,310	14,641	16,105
Total monthly salary Cost		418,000	459,800	505,780	556,258	611,994
Total annual salary Cost		5,363,000	5,517,600	6,069,360	6,676,296	7,343,926
Miscellaneous Cost:						
Stationary	Per Annual	21,000	23,100	25,410	27,951	30,746
Office Supplies		12,000	13,200	14,520	15,972	17,569
Utilities		84,000	92,400	101,640	111,804	122,984

Table 3.10. Computerized System Cost Analysis, Baht. (Continued)

Cost Items	Years				
	1	2	3	4	5
Miscellaneous	22,000	24,200	26,620	29,282	32,210
Total Miscellaneous Cost	139,000	152,900	168,190	185,009	203,510
Total Operating Cost	5,502,000	5,670,500	6,237,550	6,861,305	7,547,436
Total Computerized System Cost	6,329,450	5,959,550	6,548,600	7,172,355	7,858,486

Table 3.11. Five Years Accumulated Computerized Cost, Baht.

Year	Total Computerized Cost	Accumulated Cost
1	6,329,450	6,329,450
2	5,959,550	12,289,000
3	6,548,600	18,837,600
4	7,172,355	26,009,955
5	7,858,486	33,868,441
Total	33,868,441	-

- (3) The comparison between computerized system cost and manual system cost.

Table 3.12. The Comparison of System Cost, Baht.

Year	Accumulated Manual Cost	Accumulated Computerized Cost
1	6,000,110	6,329,450
2	12,599,867	12,289,000
3	19,859,236	18,837,600
4	27,844,177	26,009,955
5	36,627,249	33,868,441

(4) Benefit Analysis

The benefits of the proposed system can be classified into tangible and intangible benefits. The tangible benefit can be expressed in monetary value, whereas the intangible benefit is quantitative, and difficult to measure. The details of these benefits can be summarized as follows:

(1) Tangible Benefits

The tangible benefit of the proposed system is shown on Table 3.13.

(a) Cost Saving

The proposed system introduces the new way in handling marketing task. Fewer staffs are required to operate the system. The demand of office supplies, miscellaneous expense and utility expenses are reduced.

(b) Operation Time Improvement

From the comparison of the total operation time between existing system and proposed system, it can be concluded that the new system can improve the operation time.

(c) Expected Productivity Increased

Due to the operation time improvement, the proposed system relieves the staff to perform other tasks. Therefore it can be expected that the productivity will be increased by 20%.

(2) Intangible Benefits

- (a) Providing more accurate information than that of the existing system.
- (b) Reducing work processing time and improving the efficiency of the operation.
- (c) Reducing human errors in doing documentation.

- (d) Providing up-to-date information and reports to support the management's decision making.
- (e) Making it easier and faster to search the required information.
- (f) Making it easier and faster to produce the reports.

Table 3.13. Tangible Benefit of Proposed System, Baht

Cost Items		Years				
		1	2	3	4	5
Personnel Reduction :						
Sales Region Manager	1person@35,000	35,000	38,500	42,350	46,585	51,244
Sales Assistant Manager	1person@28,000	28,000	30,800	33,880	37,268	40,995
Sales Supervisor	2persons@22,000	528,000	580,000	638,880	702,768	773,045
Salesperson	4persons@15,000	60,000	66,000	72,600	79,860	87,846
Sales Administrator	1person@13,000	156,000	171,600	188,760	207,636	228,400
Office Staffs	1person@11,000	132,000	145,200	159,720	175,692	193,261
Total Annual Personnel Reduction Benefit		528,000	580,800	638,880	702,768	773,045
Operating Time Saving :						
Sales Supervisor	2persons@2hours/day	66,000	72,600	79,860	87,846	96,631
Salesperson	2persons@2hours/day	48,000	52,800	58,080	63,888	70,277
Sales Administration	1person@2hours/day	25,000	27,500	30,250	33,275	36,603
Office Staffs	1person@2hours/day	18,000	19,800	21,780	23,958	26,354
Expected Productivity Increased 20%						
25 Persons @ 2 Hour/Day		3,784,500	4,162,950	4,579,245	5,037,170	5,540,886
Annual Operating time Saving :		1,812,300	1,993,530	2,192,883	2,412,171	2,653,388
Net Annual Operating time Saving :		5,596,800	6,156,480	6,772,128	7,449,341	8,194,275
Office Supplies & Miscellaneous Cost Reduction :						
Stationary	Per Annual	12,000	13,200	14,520	15,972	17,565
Office Supplier	Per Annual	8,650	9,515	10,467	11,513	12,664
Miscellaneous	Per Annual	4,820	5,302	5,832	6,415	7,057
Total Miscellaneous Cost Saving		25,470	28,017	30,819	33,901	37,291
Total Benefit from implementing Computerized System		6,150,270	6,765,297	7,441,827	8,186,009	9,004,610

(5) Break-even Analysis

Break-even Analysis shows the point where the accumulative cost of the existing system is equal to the accumulative cost of the proposed system, so called equilibrium point. In the first year of the project, the cost of the proposed system is greater than the cost of the proposed system because there is a big investment for the proposed system. However, this surplus is dramatically changed, and becomes a deficit in the cost of the proposed system to the cost of the existing system after the project is implemented because the investment in the computerized system is deteriorated, and also gradually reduced in annual operating costs. Consequently, the cost of the proposed system is below the cost of the existing system in the long run. The break-even point of the proposed system of approximately 1 year and 1 month, is depicted in Figure 3.4.

Accumulated Cost, Baht

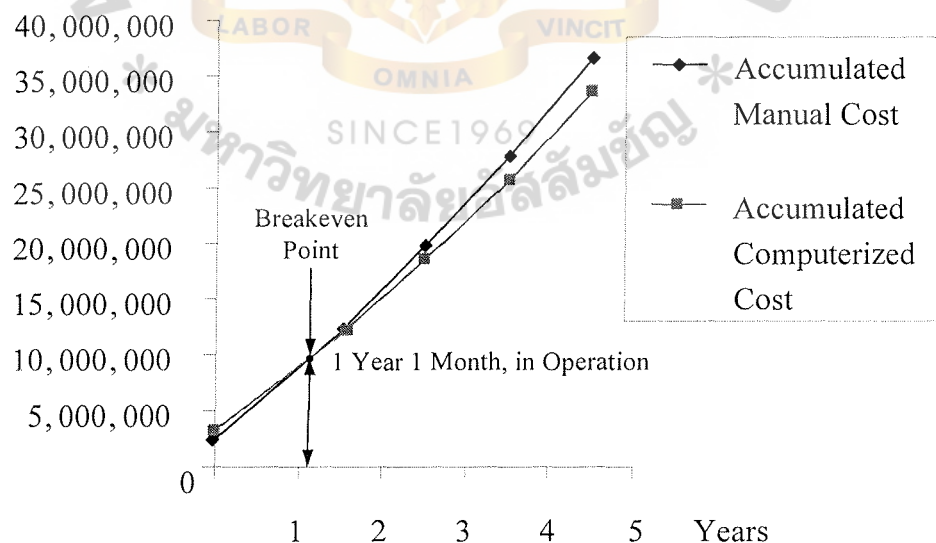


Figure 3.5. Cost Comparison between Manual and Proposed System.

(6) Payback Period

Payback period is the commonly used technique to assess the value of investment. Generally, payback period is the period that the return can recover the initial investment within a specific period. To reflect the real value of money, the time value of money concept also applies in this analysis. The discount rate or inflation rate is required to calculate the discount value of all costs and benefits after the first year back to present value at the present year.

After the lifetime cost and benefit are discounted, payback period can be computed. The acceptance of the project occurs only when the project's payback period is less than or equal to predefined payback period guideline, generally 3 years.

Figure 3.5 shows the payback period of the proposed system that has already been calculated to evaluate the candidate solution (See the full details of payback calculation in Appendix C). The lifetime costs are gradually increasing over the five-year period because operating costs are being incurred. But it also can be noticed that the lifetime benefits are occurring at a much faster pace. The result of payback period is 1 year 9 months, which is less than the predefined maximum desired payback period (3 years). Thus this project is acceptable to implement with the return on investment to recover the initial investment within three years.

Cumulative Cost, Baht

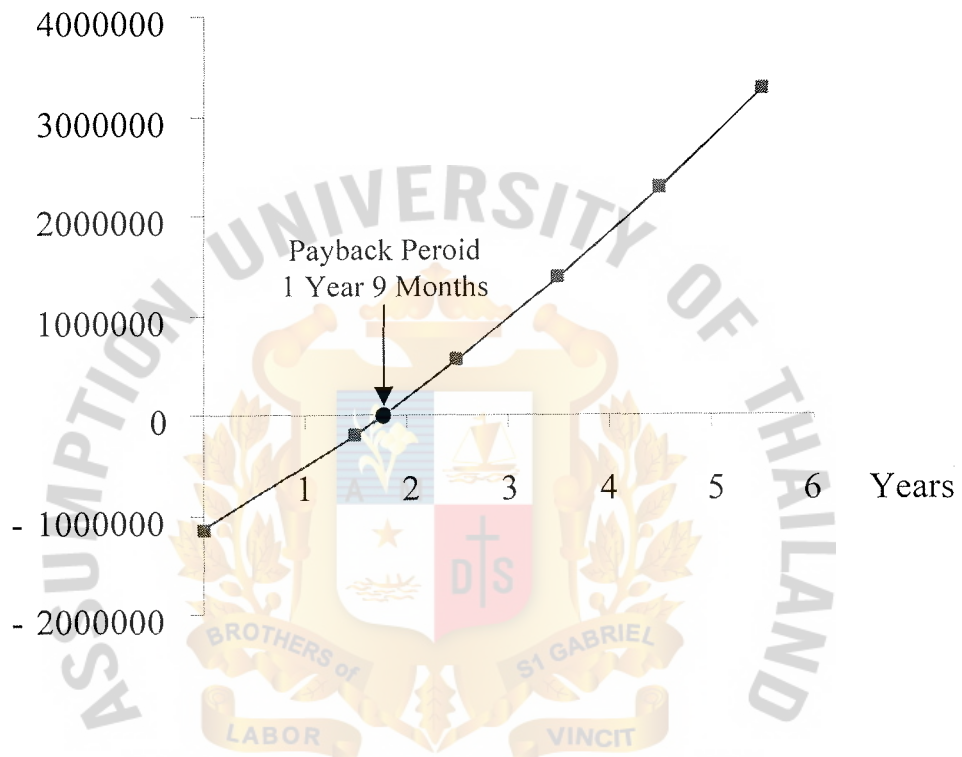


Figure 3.6. Payback Period of the Proposed System.

IV. PROJECT IMPLEMENTATION

4.1 Overview of Project Implementation

System Implementation is the conversion process from a current manual system to the new computerized information system. The final design should be evaluated first by the users and management teams to guarantee that the new computerized system can meet the requirements and objectives, then the other remaining processes will be performed. It is expected that the system implementation would take approximately six weeks. The duration may vary depending on the readiness of the staffs to use the new system. The processes of System Implementation are:

- (1) Software development
- (2) Hardware installation
- (3) Personnel training
- (4) Test Plan
- (5) Conversion
- (6) Documentation

4.2 Software Development

Using Microsoft SQL Server 7.0 as DBMS, and Visual Basic 6.0 to develop Sales Support Information System, the computerized system is developed under user friendly environment and with the useful functions that correspond to the requirements. The system allows user to add, edit and delete the data and also search for desired data. In order to generate reports, the system will integrate information gather from various tables in database file and make the calculation in the required field based on user and management requirements.

4.3 Hardware Installation

In order to establish the computerized system, the company requires new File Server as shown in the Cost/ Benefit Analysis section in previous section. Four clients and one server need to be installed with LAN card so they can work in the network system in the proposed system.

4.4 Personnel Training

User training course is an important process in the system implementation phase. The objective of training course is to make users understand clearly, be familiar and able to use the program correctly. Training course should include computer concepts, functions of hardware and software, functions of the proposed system and how to use the system properly and efficiently. Users should be given the system manual, class lecture about the procedure and hands on experience on using new equipment. Furthermore, the programmer or system analyst when initially using the system also should supervise the users.

4.5 Test Plan

After the program has been designed and installed, module testing, program testing and system testing are required to ensure that the new system is free from errors and can work well with the other systems in the company.

Module testing would help to check errors in program module. It can detect errors in coding and errors in logic. After finishing all modules testing, program testing is used to check the program to verify the way the system works and to check whether each module can work together or not. System testing checks whether the proposed system can share data or work with the other manual systems properly, and whether the proposed system can work well on the operating system or not. After finishing all testing, the testing document plans and testing results should be filed as a

benchmark. Therefore, whenever the company runs testing again in the future, programmers can use benchmark as a reference. Moreover, security and recovery testing is tested to ensure that the system can protect unauthorized users from access into the system. If failure happens to the database, the system should be able to recover those data.

The following tests are essential and recommended:

- (1) Unit Testing ensures that the stand-alone program fixes the bug without side effects.
- (2) System Testing ensures that the entire application, of which the modified program was a part, still works.

Security and Recovery Testing ensure that the system is secured enough to protect unauthorized users to access into the system. Moreover, if failure happens to the database, the system should be able to recover those data.

However, the effective testing of the program does not guarantee system reliability. Therefore, the test case should include the Input Validation, Functionality, and Access Control.

4.6 Conversion

Conversion is the process of switching from the existing system to a new proposed system. The conversion process is set up based on the replacing concept. Since the existing system is a combination of manual and computer system, users have to key in the data to create the database because the records from the existing system are not convertible.

4.7 Documentation

Documentation of the proposed system is separated into two documents. Firstly, user's guide or manual, which describes how to access and use the program, how to

correct the problems and how to use interface screens, secondly, the flow of the system and data dictionary. Both documents can help the users whenever they need or get the problem when using the program and also can help programmer to develop and maintain the system.



V. CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

After the proposed system is implemented, all the data is input in the database server, which can guarantee that it is data redundancy free and inconsistency free. All reports are automatically generated by the system. Customers' records are simply retrieved from the system such as credit balance, current sales volume, and pending order. Sales administrator is able to view the inventory upon the demand of the management or customers. The information is synchronous in real time. Hence, time spending for an office staff or sales administrator that would serve one customer is completely declined. Moreover, the system also offers less errors of input and output that created by human. In addition, the customers' records are well organized and stored. Not only the data redundancy problems such as insert, delete, and update anomaly are minimized, but the flow of the data and the direction of the processes are also redesigned to utilize the productivity, increase the accuracy and speed. Last but not least, time that each customer spends during the process is shortened.

According to Cost/Benefit Analysis in the third section, the result is that the breakeven point between accumulated existing system cost and accumulated proposed system cost is approximately one year and one month. As in international organization standard, the payback period of the investment should not take more than five years generally. Therefore, the proposed system is considered as a good investment because the payback period is one year and six months.

The following table is time spending comparison between the existing system and the proposed system.

Table 5.1. The Degree of Achievement of the Proposed System.

Process	Existing System	Proposed System
Customer Registration	20 Minutes	3 Minutes
Customer Credit Check	20 Minutes	2 Minutes
Inventory Check	30 Minutes	1 Minute
Order Approval	5 Minutes	2 Minutes
Back Order Approval	1 Hour	10 Minutes
Generate Invoice & Bill	20 Minutes	2 Minutes
Generate Report	4 Hours	12 Minutes

The details of the operation time improvement can be summarized as the follows:

(1) Customer Registration:

The existing system spends 5 minutes average in searching the customers' information. With semi-computerized system, if the office staffs cannot find customer' record in the list, he or she must look through the entire records of the customers in the hardcopies to ensure that customer' record does exist, which will take more than 6 to 10 minutes. If the records are not recognized, then a new record is created. Creating new records would take another 5 minutes at least. The proposed system uses Client-Server approach as a solution to eliminate such problem. One server serves all the information of the customers, and files in the main memory. It will take 3 minutes approximately to input new record through the graphical user interface form.

(2) Customer Credit Check:

This process in the existing system is the longest task time for new customers. They need to get bank guarantee according to the reference bank or contract bank. However, new customers may start the transaction in cash. If that is the case, customers may save a lot of time because bank as an intermediate is off. The management would upgrade new customers to trustworthy customers, meanwhile they could be also degraded. It depends on the each individual behavior. For the existing customers, this process should take less time because the credit line and credit balance are shown if the records are called. Moreover, the management may allow overdraft to a specific customer just case by case.

(3) Inventory Check:

The proposed system offers a better way to shortcut this process, using daily stock output in the database, retrieving the information shown in the ordering process. It shortened time up to thirty minutes with the proposed system compared to the existing system.

(4) Order Approval:

Sales administrator or office staffs must gather all information from the customers and database, then they need to pass through all the ordering processes before the approval. For example, customer profile, credit record, and inventory check must be performed.. These requirements are the key words that will be shown in the hardcopy for approval. The existing system requires office staffs to key in the above information, and print out the document, it takes five minutes approximately. In contrast, just retrieving the information with GUI connected to the database, and just

a couple of clicks offered by the proposed system, this process is done within no time.

- (5) Back Order Approval: Similar to Order Approval process, the requested information is retrieved and printed out as a document. Back Order Process would occur if and only if the ordered quantity or inventory becomes shortage.
- (6) Generate Invoice & Bill: Recording and printing invoices and bills in the spreadsheet format are redundant in the existing system because the necessary information has already appeared once in the Order Approval process if recognized. Administrator must repeat the inputs again. Therefore, they may spend twenty minutes to issue the above two documents with the existing system. With the proposed system, the function of generating Invoice and Bill are integrated. Therefore, it should take just a minute to print out the documents.
- (7) Generate Report: Rather than spending four hours to generate a report by the existing system, the officers can now spend twelve minutes approximately start from retrieving the information and printing the report to the management. With the powerful features and GUI embedded in the new system, it allows the officers to generate a report as much as they need.

5.2 Recommendations

The proposed system emphasizes on the database management in order to minimize the redundancy, increase the speed of the service, utilize the workforce, and maximize the profits. With the computerized system, Multiple Assets Co., Ltd. needs to increase the investment such as capitals and assets; however, balance sheet may turn

out negative in the first couple of years. The return on investment would yield more benefits in the long run after the payback period or breakeven point. Computerized system also reduces the number of total expenditures for Multiple Assets Co., Ltd. in the long run.

However, the new system is not yet a completed system that covers all the departments in the factory because Sales Support Information System is the first and only computerized system of MAC. It does not fully support purchasing, inventory, accounting, and levy. Therefore, after the new system is implemented, MAC should further develop new systems that support and cover all the above requirements. Furthermore, the future system should assist the accounting of the company to calculate the cash inflow, cash outflow, expenses, net income, and all other reports needed by the management. Giving the management a full report would help them in decision-making. Another function that MAC should focus on is accounting, to calculate the levy or income tax.

Finally, to increase the business core competency for MAC., they should apply the internet. Nowadays, the internet is a powerful tool that interconnect thousands of networks together. It is open twenty four hours a day, seven days a week. Multiple Assets Co., Ltd. can promote their business on the internet, they can save a lot of dimes spending such as using an e-mail, and web-board. Meanwhile, they can use the internet as a gateway to gain more and more customers using the web-based application. Each customer may have his or her own account and password in order to login and check the profile, balance due, and credit history. With the advantages of the internet, salesperson may visit a customer with on-line information. They can check the availability of the products, tracking orders status, and retrieve the customers' information.



APPENDIX A

ENTITY RELATIONSHIP DIAGRAM

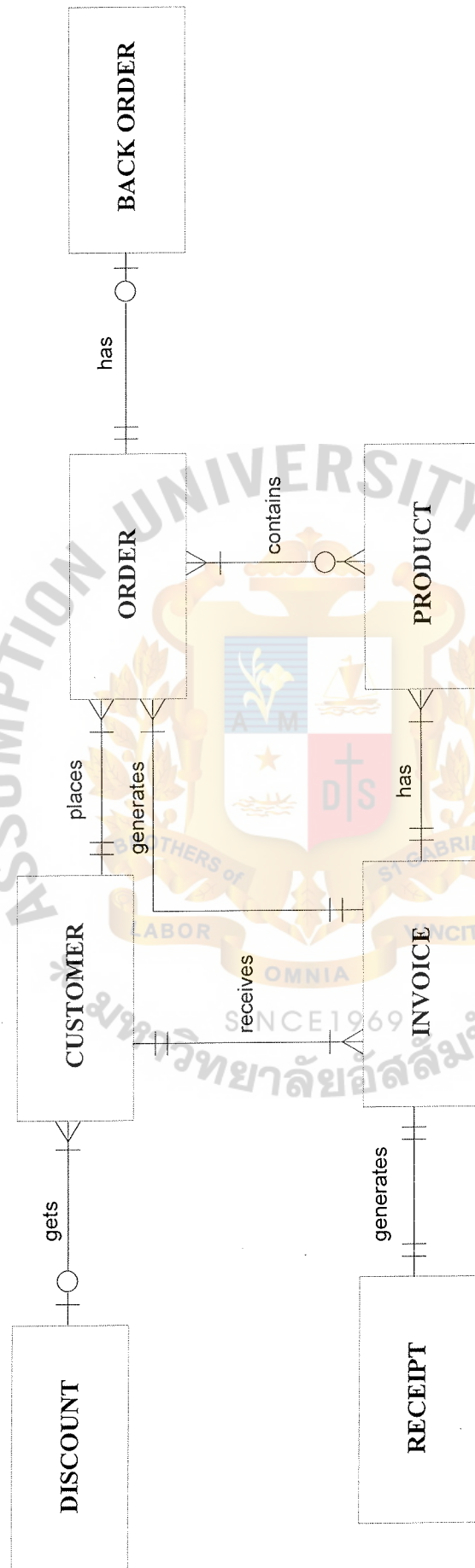


Figure A.1. Context Data Model of the Proposed System.

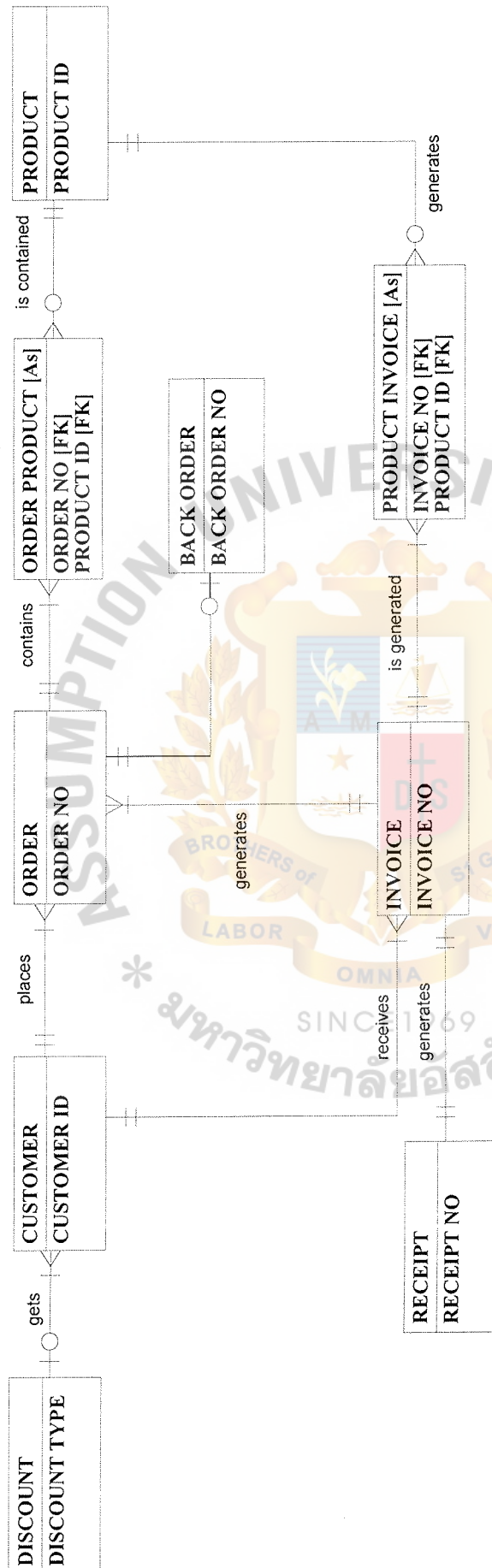


Figure A.2. Key-based Data Model of the Proposed System.

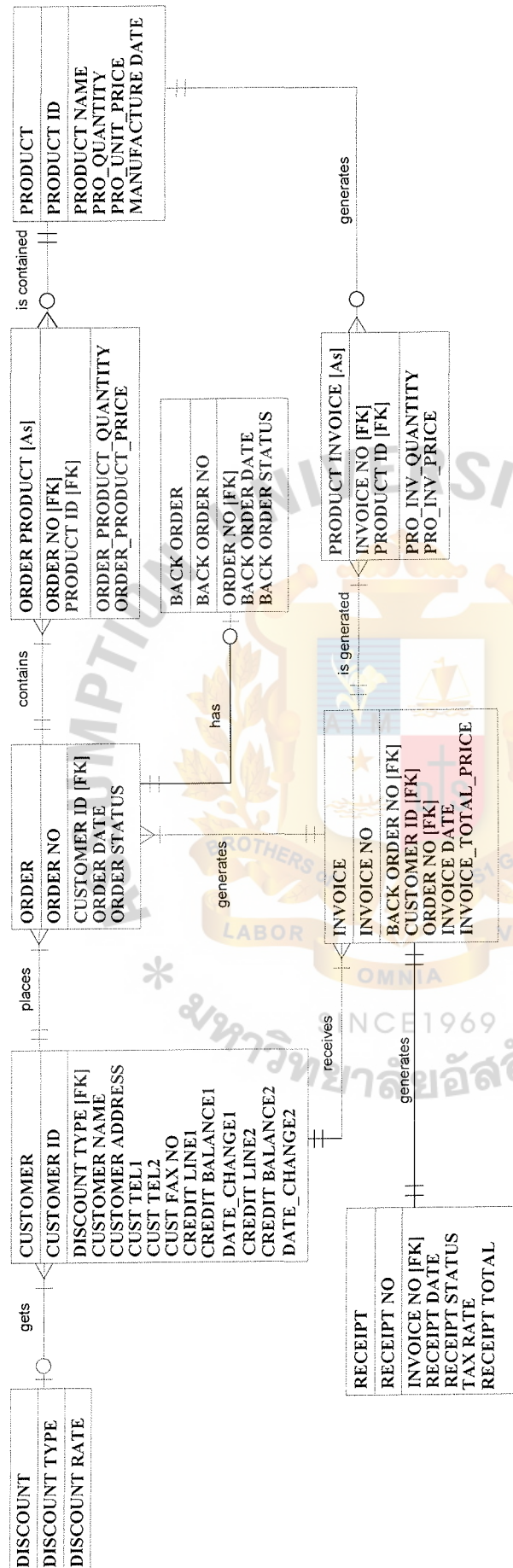
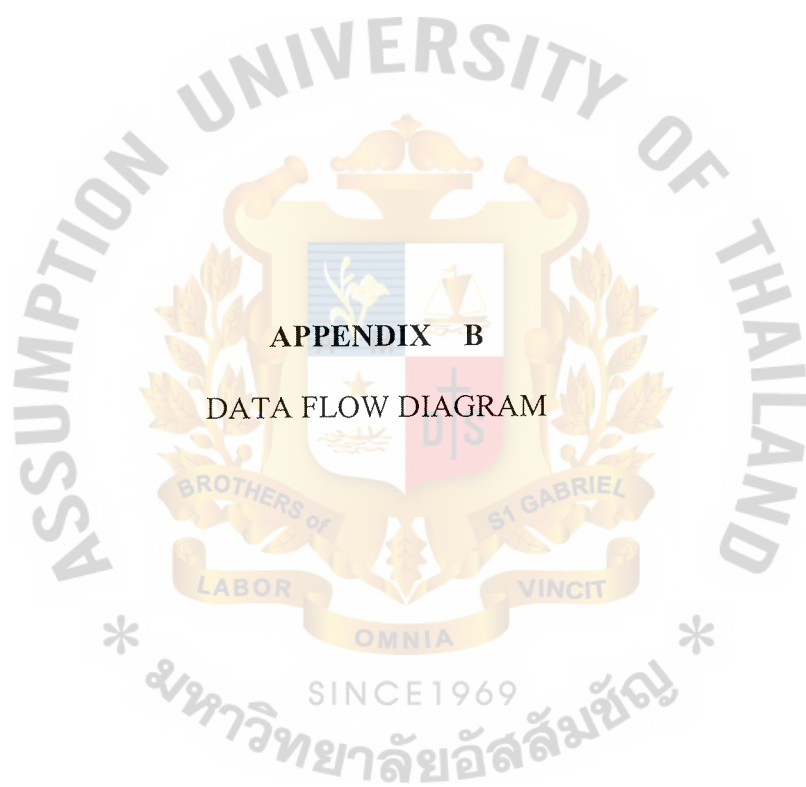


Figure A.3. Fully Attributed Data Model of the Proposed System.



APPENDIX B

DATA FLOW DIAGRAM

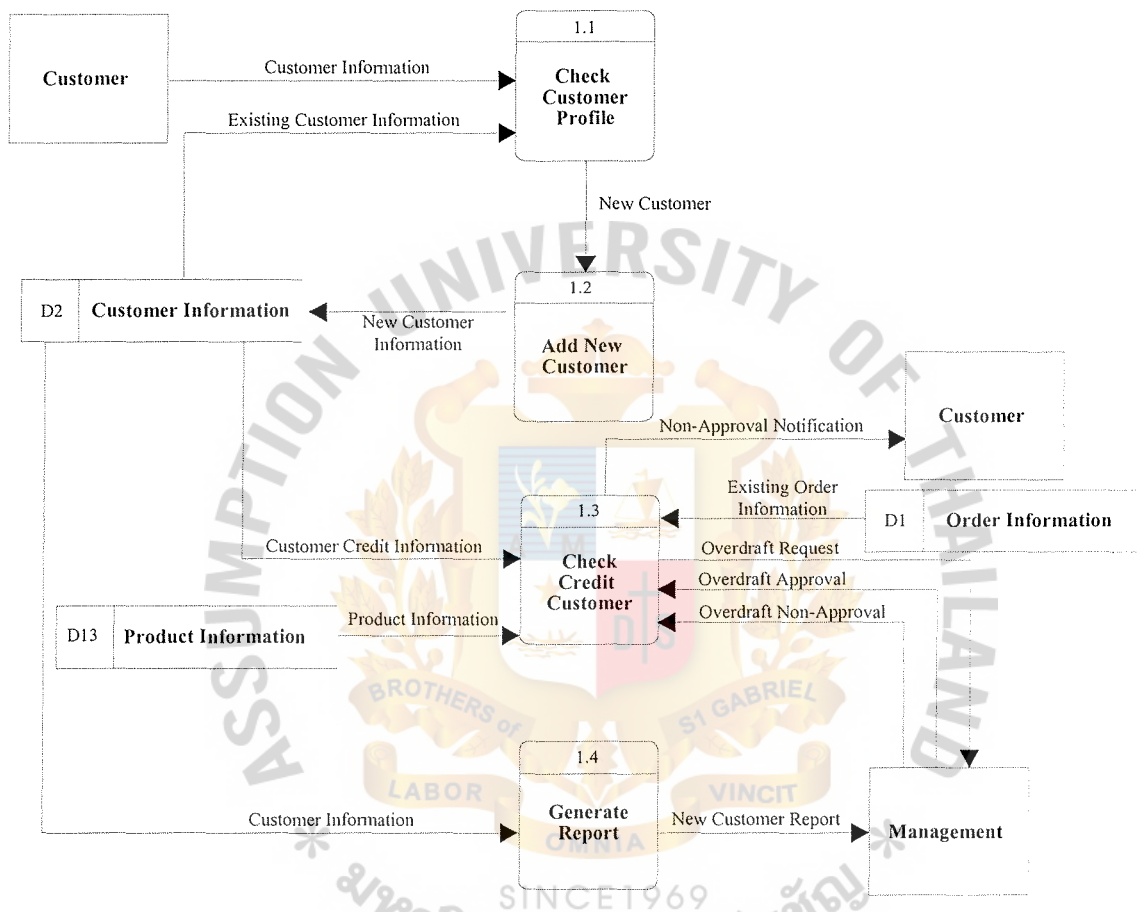


Figure B.1. Data Flow Diagram of Customer Registration Process.

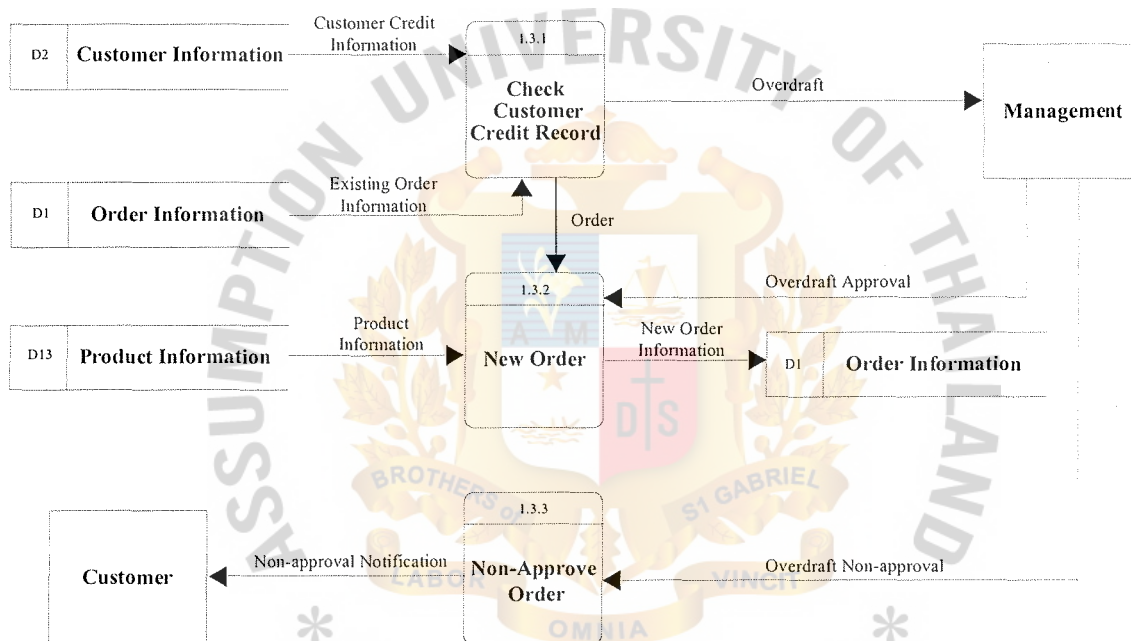


Figure B.2. Data Flow Diagram Level 2 of Customer Registration Process.

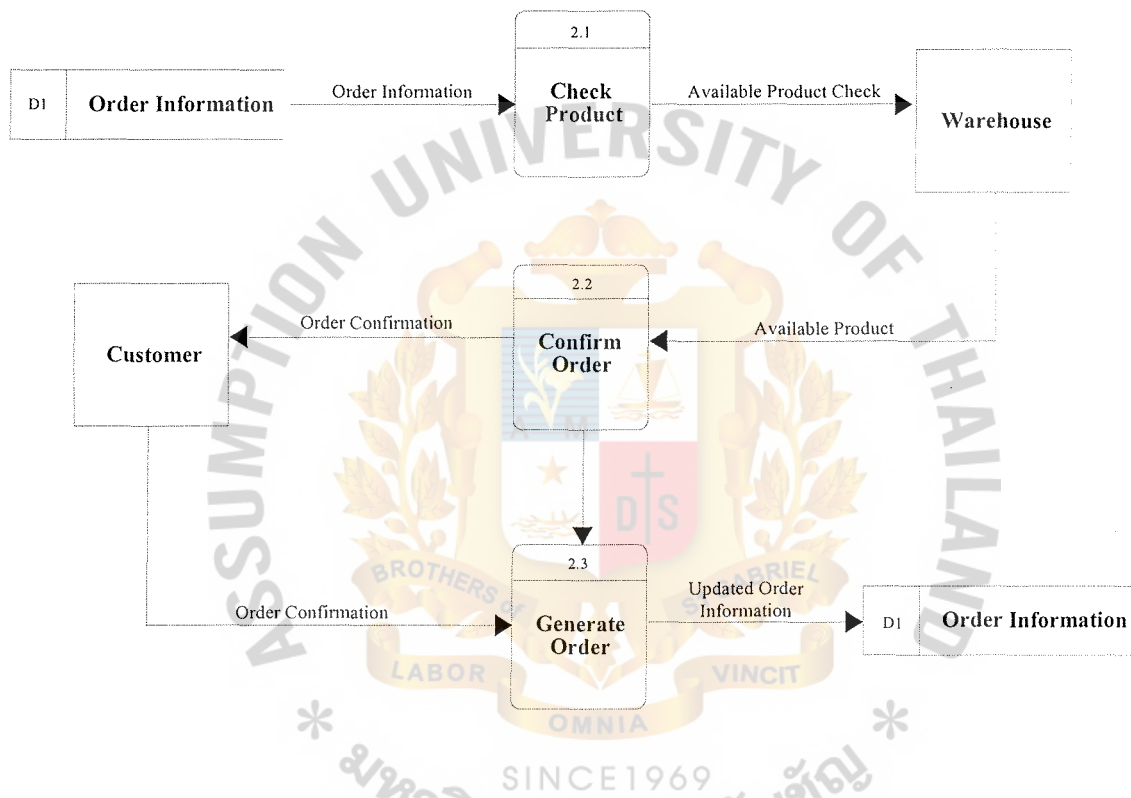


Figure B.3. Data Flow Diagram of Order Process.

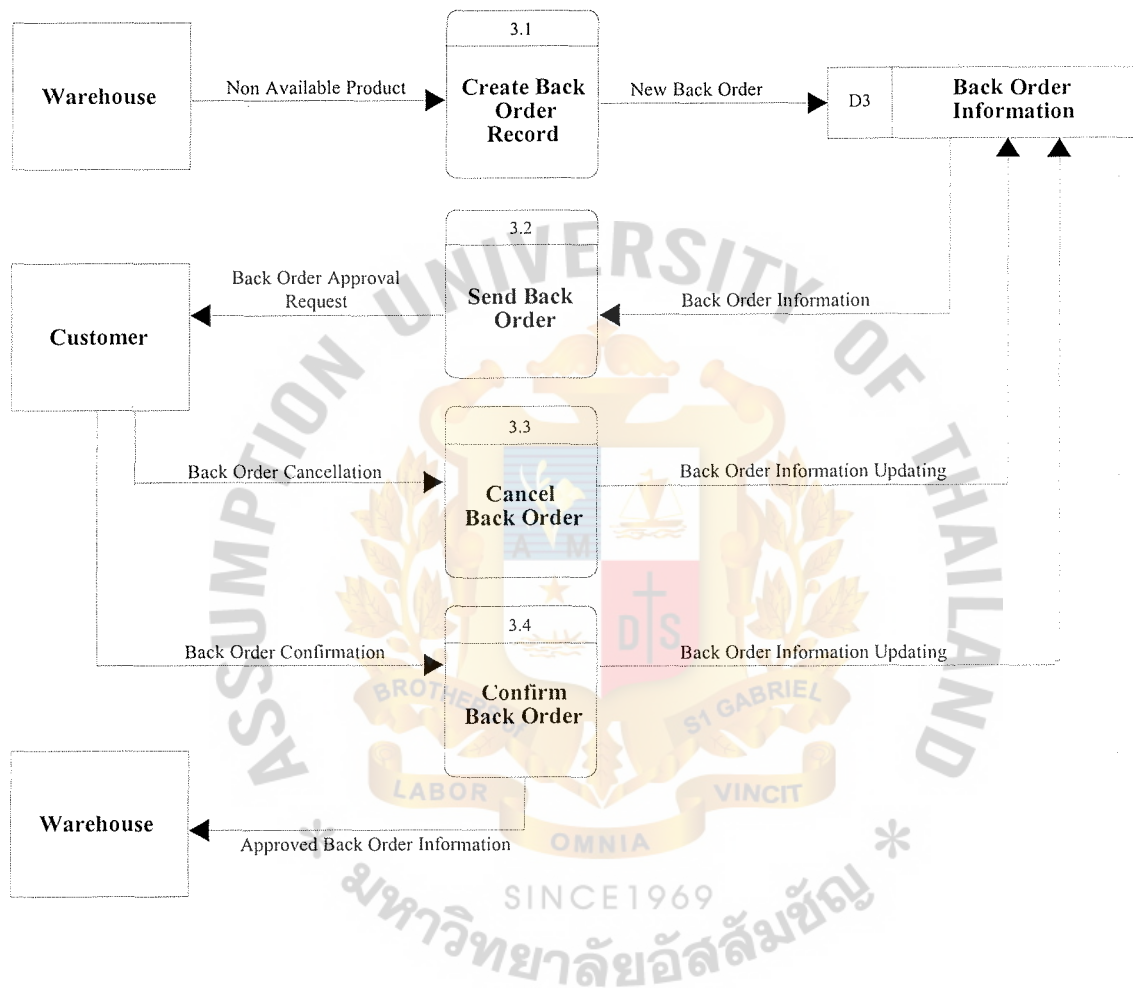


Figure B.4. Data Flow Diagram of Back Order Process.

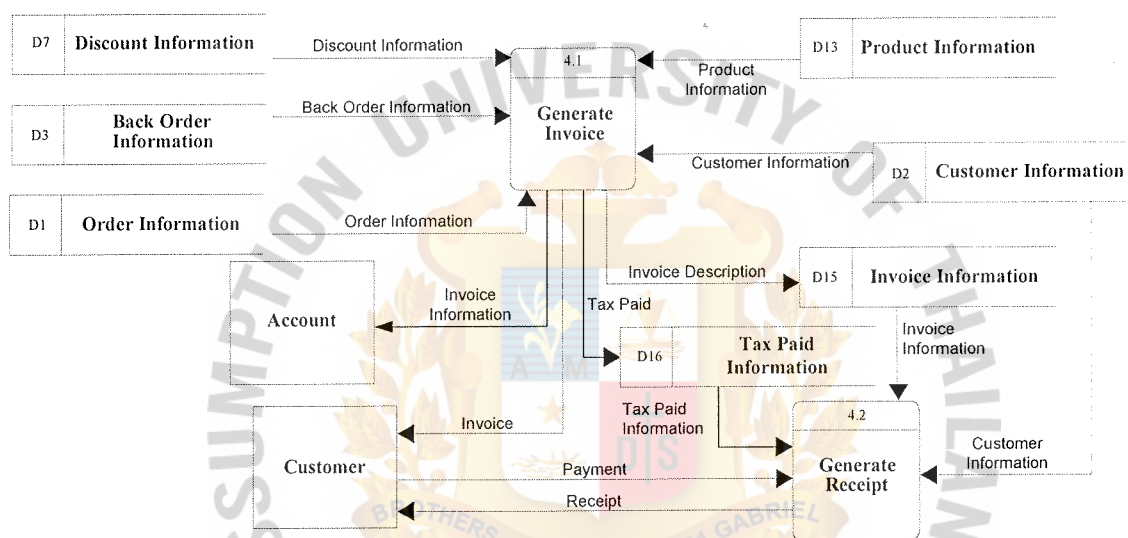


Figure B.5. Data Flow Diagram of Payment Process.

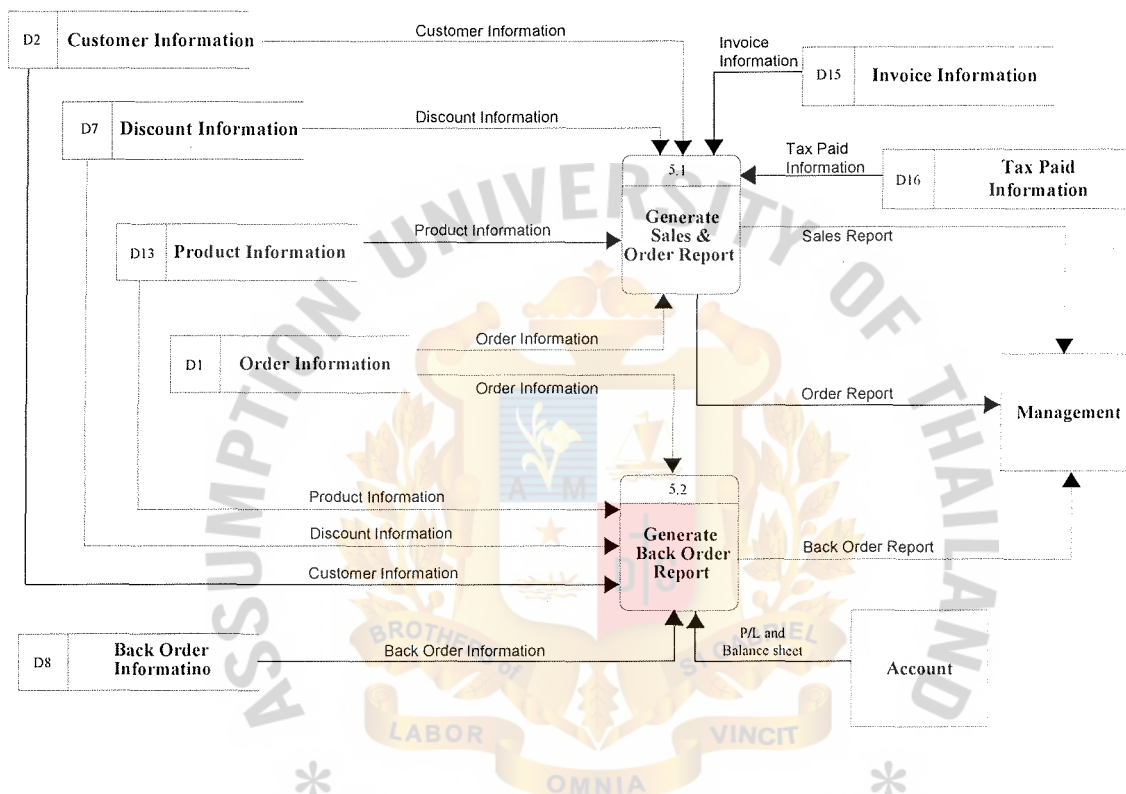
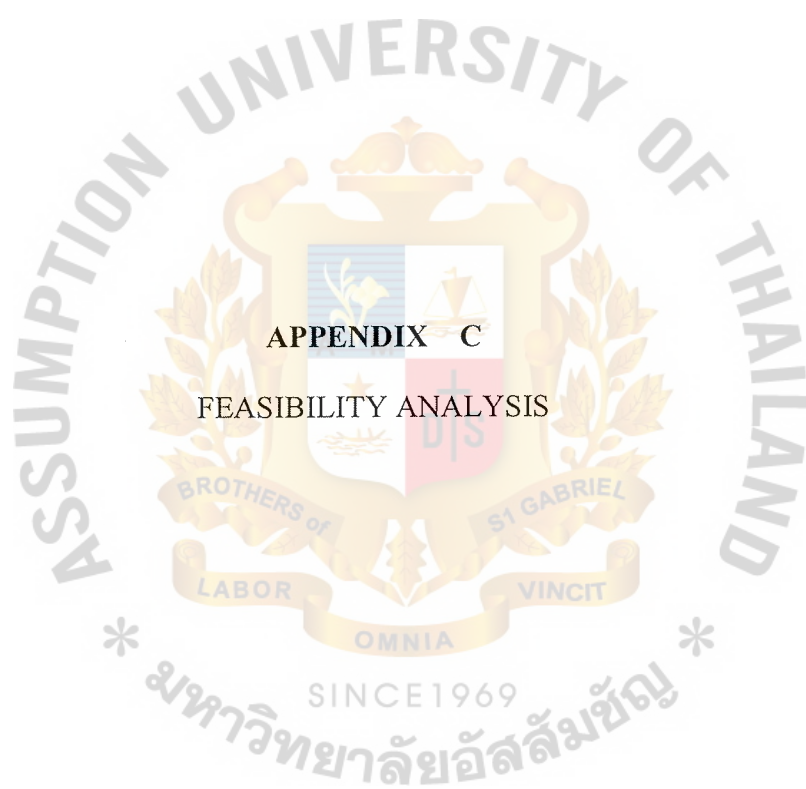


Figure B.6. Data Flow Diagram of Generate Report Process.



APPENDIX C

FEASIBILITY ANALYSIS

Table C.1. The Cost of the Candidate 1, Baht.

Cost Items		Years				
		1	2	3	4	5
Fixed Cost						
Hardware Cost:						
Computer Server Cost	1set@125,000	25,000	25,000	25,000	25,000	25,000
Workstation Cost	4units@39,000	31,200	31,200	31,200	31,200	31,200
Laser Printer	3 Unit@56,800	34,080	34,080	34,080	34,080	34,080
Dot Matrix Printer	1 Unit@8,600	1,120	1,120	1,120	1,120	1,120
Hub (10/100 Mbps)	1Unit@5,500	1,100	1,100	1,100	1,100	1,100
UPS 1000 VA	1 Unit@11,500	2,300	2,300	2,300	2,300	2,300
Total Hardware Cost		94,800	94,800	94,800	94,800	94,800
Maintenance Cost:						
Total Maintenance Cost		-	-	18,000	18,000	18,000
Software Cost		134,000	134,000	134,000	134,000	134,000
Network Cost		24,000	24,000	24,000	24,000	24,000
Total Software Cost		158,000	158,000	158,000	158,000	158,000
Implementation Cost:						
Basic Training Cost		120,000	-	-	-	-
Set up Cost		75,600	-	-	-	-
Total Implementation Cost		286,500	-	-	-	-
Total Fixed Cost		734,900	252,800	270,800	270,800	270,800
Operating Cost						
People Ware Cost:						
System Analyst	6 months@35,000	210,000	-	-	-	-
Programmer	4 months@28,000	112,000	-	-	-	-
Network Specialist	1month@25,000	25,000	-	-	-	-
Sales Region Manager	2person@35,000	70,000	77,000	84,700	93,170	102,487
Sales Assistant Manager	2person@28,000	56,000	61,600	67,760	74,536	81,990
Sales Supervisor	4person@22,000	88,000	96,800	106,480	117,128	128,841
Salesperson	12person@15,000	180,000	198,000	217,800	239,580	263,538
Sales Administrator	1person@13,000	13,000	14,300	15,730	17,303	19,033
Office Staffs	1person@11,000	11,000	12,100	13,310	14,641	16,105
Total monthly salary Cost		418,000	459,800	505,780	556,358	611,994
Total annual salary Cost		5,363,000	5,517,600	6,069,360	6,676,296	7,343,926
Miscellaneous Cost:						
Stationary	Per Annual	21,000	23,100	25,410	27,951	30,746
Office Supplier	Per Annual	12,000	13,200	14,520	15,972	17,569
Utility	Per Annual	84,000	92,400	101,640	111,804	122,984
Miscellaneous	Per Annual	22,000	24,200	26,620	29,282	32,210
Total Miscellaneous Cost		139,000	152,900	168,190	185,009	203,510
Total Operating Cost		5,502,000	5,670,500	6,237,550	6,861,305	7,547,436
Total Computerized System Cost		6,236,900	5,923,300	6,508,350	7,132,105	7,818,236

Table C.2. The Cost of the Candidate 2, Baht.

Cost Items		Years				
		1	2	3	4	5
Fixed Cost						
Hardware Cost:						
Computer Server Cost	1set@125,000	25,000	25,000	25,000	25,000	25,000
Workstation Cost	4units@39,000	31,200	31,200	31,200	31,200	31,200
Laser Printer	3 Unit@56,800	34,080	34,080	34,080	34,080	34,080
Dot Matrix Printer	1 Unit@8,600	1,120	1,120	1,120	1,120	1,120
Hub (10/100 Mbps)	1Unit@5,500	1,100	1,100	1,100	1,100	1,100
UPS 1000 VA	1 Unit@11,500	2,300	2,300	2,300	2,300	2,300
Total Hardware Cost		94,800	94,800	94,800	94,800	94,800
Maintenance Cost:						
Total Maintenance Cost		-	-	22,000	22,000	22,000
Software Cost		167,500	167,500	167,500	167,500	167,500
Network Cost		26,750	26,750	26,750	26,750	26,750
Total Software Cost		194,250	194,250	194,250	194,250	194,250
Implementation Cost:						
Basic Training Cost		137,600	-	-	-	-
Set up Cost		84,300	-	-	-	-
Total Implementation Cost		316,500	-	-	-	-
Total Fixed Cost		827,450	289,050	311,050	311,050	311,050
Operating Cost						
People Ware Cost:						
System Analyst	6 months@35,000	210,000	-	-	-	-
Programmer	4 months@28,000	112,000	-	-	-	-
Network Specialist	1month@25,000	25,000	-	-	-	-
Sales Region Manager	2person@35,000	70,000	77,000	84,700	93,170	102,487
Sales Assistant Manager	2person@28,000	56,000	61,600	67,760	74,536	81,990
Sales Supervisor	4person@22,000	88,000	96,800	106,480	117,128	128,841
Salesperson	12person@15,000	180,000	198,000	217,800	239,580	263,538
Sales Administrator	1person@13,000	13,000	14,300	15,730	17,303	19,033
Office Staffs	1person@11,000	11,000	12,100	13,310	14,641	16,105
Total monthly salary Cost		418,000	459,800	505,780	556,358	611,994
Total annual salary Cost		5,363,000	5,517,600	6,069,360	6,676,296	7,343,926
Miscellaneous Cost:						
Stationary	Per Annual	21,000	23,100	25,410	27,951	30,746
Office Supplier	Per Annual	12,000	13,200	14,520	15,972	17,569
Utility	Per Annual	84,000	92,400	101,640	111,804	122,984
Miscellaneous	Per Annual	22,000	24,200	26,620	29,282	32,210
Total Miscellaneous Cost		139,000	152,900	168,190	185,009	203,510
Total Operating Cost		5,502,000	5,670,500	6,237,550	6,861,305	7,547,436
Total Computerized System Cost		6,329,450	5,959,550	6,548,600	7,172,355	7,858,486

Table C.3. The Cost of the Candidate 3, Baht.

Cost Items		Years				
		1	2	3	4	5
Fixed Cost						
Hardware Cost:						
Computer Server Cost	1set@125,000	25,000	25,000	25,000	25,000	25,000
Workstation Cost	4units@39,000	31,200	31,200	31,200	31,200	31,200
Laser Printer	3 Unit@56,800	34,080	34,080	34,080	34,080	34,080
Dot Matrix Printer	1 Unit@8,600	1,120	1,120	1,120	1,120	1,120
Hub (10/100 Mbps)	1Unit@5,500	1,100	1,100	1,100	1,100	1,100
UPS 1000 VA	1 Unit@11,500	2,300	2,300	2,300	2,300	2,300
Total Hardware Cost		94,800	94,800	94,800	94,800	94,800
Maintenance Cost:						
Total Maintenance Cost		-	-	25,000	25,000	25,000
Software Cost		186,000	186,000	186,000	186,000	186,000
Network Cost		28,000	28,000	28,000	28,000	28,000
Total Software Cost		214,000	214,000	214,000	214,000	214,000
Implementation Cost:						
Basic Training Cost		157,600	-	-	-	-
Set up Cost		85,000	-	-	-	-
Total Implementation Cost		320,500	-	-	-	-
Total Fixed Cost		871,900	308,800	333,800	333,800	333,800
Operating Cost						
People Ware Cost:						
System Analyst	6 months@35,000	210,000	-	-	-	-
Programmer	4 months@28,000	112,000	-	-	-	-
Network Specialist	1month@25,000	25,000	-	-	-	-
Sales Region Manager	2person@35,000	70,000	77,000	84,700	93,170	102,487
Sales Assistant Manager	2person@28,000	56,000	61,600	67,760	74,536	81,990
Sales Supervisor	4person@22,000	88,000	96,800	106,480	117,128	128,841
Salesperson	12person@15,000	180,000	198,000	217,800	239,580	263,538
Sales Administrator	1person@13,000	13,000	14,300	15,730	17,303	19,033
Office Staffs	1person@11,000	11,000	12,100	13,310	14,641	16,105
Total monthly salary Cost		418,000	459,800	505,780	556,358	611,994
Total annual salary Cost		5,363,000	5,517,600	6,069,360	6,676,296	7,343,926
Miscellaneous Cost:						
Stationary	Per Annual	21,000	23,100	25,410	27,951	30,746
Office Supplier	Per Annual	12,000	13,200	14,520	15,972	17,569
Utility	Per Annual	84,000	92,400	101,640	111,804	122,984
Miscellaneous	Per Annual	22,000	24,200	26,620	29,282	32,210
Total Miscellaneous Cost		139,000	152,900	168,190	185,009	203,510
Total Operating Cost		5,502,000	5,670,500	6,237,550	6,861,305	7,547,436
Total Computerized System Cost		6,373,900	5,979,300	6,571,350	7,195,105	7,881,236

Table C.4. The Benefits of the Proposed System, Baht.

Benefit items		Year1	Year2	Year3	Year4	Year5
Presonnel Reduction :						
Sales Region Manager	1person@35,000	35,000	38500	42350	46585	51243.5
Sales Assistant Manager	1person@28,000	28,000	30800	33880	37268	40994.8
Sales Supervisor	2person@22,000	528,000	580,800	638,880	702,768	773,045
Salesperson	4person@15,000	60,000	66,000	72,600	79,860	87,846
Sales Adinistration	1person@13,000	156,000	171,600	188,760	207,636	228,400
Office Staffs	1person@11,000	132,000	145,200	159,720	175,692	193,261
Total Annual Personnel Reduction Benefit		528,000	580,800	638,880	702,768	773,045
Operating Time Saving :						
Sales Supervisor	2person@2 hours/ day	66,000	72,600	79,860	87,846	96,631
Saleperson	2person@2 hours/ day	48,000	52,800	58,080	63,888	70,277
Sales Adinistration	1person@2 hours/ day	25,000	27,500	30,250	33,275	36,603
Office Staffs	1person@2 hours/ day	18,000	19,800	21,780	23,958	26,354
Expected Productivity Increased 20%:						
25 Persons @ 2 Hour/Day		3,784,500	4,162,950	4,579,245	5,037,170	5,540,886
Annual Operating time Saving:		1,812,300	1,993,530	2,192,883	2,412,171	2,653,388
Net Annual Operating time Saving:		5,596,800	6,156,480	6,772,128	7,449,341	8,194,275
Office Supplies & Miscellaneous Cost						
Reduction:						
Stationary	Per Annual	12,000	13,200	14,520	15,972	17,569
Office Supplier	Per Annual	8,650	9,515	10,467	11,513	12,664
Miscellaneous	Per Annual	4,820	5,302	5,832	6,415	7,057
Total Miscellaneous Cost		25,470	28,017	30,819	33,901	37,291
Total Benefit from implementing Computerized System		6,150,270	6,765,297	7,441,827	8,186,009	9,004,610

Table C.5. Payback Period for the Candidate 1, Baht.

Cost Items	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
System Development Cost:	-734,900					
Annual Operating Cost:		-5,502,000	-5,923,300	-6,508,350	-7,132,105	-7,818,236
Discount factor for 3%	1.000	0.971	0.943	0.915	0.888	0.863
Time-Adjusted Costs (Adjusted to Present Value)	-734,900	-5,342,442.00	-5,585,671.90	-5,955,140.25	-6,333,309.24	-6,747,137.24
Cumulative time-adjusted costed over life time:	-734,900	-6,077,342.00	-11,663,013.90	-17,618,154.15	-23,951,463.39	-30,698,600.63
Benefits derived from operation of the new system	0	6,150,270	6,765,297	7,441,827	8,186,009	9,004,610
Discount factor for 3%	1.000	0.971	0.943	0.915	0.888	0.863
Time-Adjusted Costs (Adjusted to Present Value)	0	5,971,912.17	6,379,675.07	6,809,271.43	7,269,176.32	7,770,978.69
Cumulative time-adjusted benefits over life time:	0	5,971,912.17	12,351,587.24	19,160,858.67	26,430,034.99	34,201,013.69
Cumulative Life Time Time-Adjusted Costed + Benefit	-734,900	-105,429.83	688,573.34	1,542,704.52	2,478,571.60	3,502,413.06

Table C.6. Payback Period for the Candidate 2, Baht.

Cost Items	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
System Development Cost:	-827,450					
Annual Operating Cost:		-5,502,000	-5,959,550	-6,548,600	-7,172,355	-7,858,486
Discount factor for 3%	1.000	0.971	0.943	0.915	0.888	0.863
Time-Adjusted Costs (Adjusted to Present Value)	-827,450	-5,342,442.00	-5,619,855.65	-5,991,969.00	-6,369,051.24	-6,781,872.99
Cumulative time-adjusted costed over life time:	-827,450	-6,169,892.00	-11,789,747.65	-17,781,716.65	-24,150,767.89	-30,932,640.88
Benefits derived from operation of the new system	0	6,150,270	6,765,297	7,441,827	8,186,009	9,004,610
Discount factor for 3%	1.000	0.971	0.943	0.915	0.888	0.863
Time-Adjusted Costs (Adjusted to Present Value)	0	5,971,912.17	6,379,675.07	6,809,271.43	7,269,176.32	7,770,978.69
Cumulative time-adjusted benefits over life time:	0	5,971,912.17	12,351,587.24	19,160,858.67	26,430,034.99	34,201,013.69
Cumulative Life Time Time-Adjusted Costed + Benefit	-827,450	-197,979.83	561,839.59	1,379,142.02	2,279,267.10	3,268,372.81

Table C.7. Payback Period for the Candidate 3, Baht.

Cost Items	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
System Development Cost:	-871,900					
Annual Operating Cost:		-5,502,000	-5,979,300	-6,571,350	-7,195,105	-7,881,236
Discount factor for 3%	1.000	0.971	0.943	0.915	0.888	0.863
Time-Adjusted Costs (Adjusted to Present Value)	-871,900	-5,342,442.00	-5,638,479.90	-6,012,785.25	-6,389,253.24	-6,801,506.24
Cumulative time-adjusted costed over life time:	-871,900	-6,214,342.00	-11,852,821.90	-17,865,607.15	-24,254,860.39	-31,056,366.63
Benefits derived from operation of the new system	0	6,150,270	6,765,297	7,441,827	8,186,009	9,004,610
Discount factor for 3%	1.000	0.971	0.943	0.915	0.888	0.863
Time-Adjusted Costs (Adjusted to Present Value)	0	5,971,912.17	6,379,675.07	6,809,271.43	7,269,176.32	7,770,978.69
Cumulative time-adjusted benefits over life time:	0	5,971,912.17	12,351,587.24	19,160,858.67	26,430,034.99	34,201,013.69
Cumulative Life Time Time-Adjusted Costed + Benefit	-871,900	-242,429.83	498,765.34	1,295,251.52	2,175,174.60	3,144,647.06

Table C.8. Net Present Value for the Candidate 1, Baht.

Cost Items	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
System Development Cost:	-734,900					
Annual Operating Cost:		-5,502,000	-5,923,300	-6,508,350	-7,132,105	-7,818,236
Discount factor for 3%	1.000	0.971	0.943	0.915	0.888	0.863
Time-Adjusted Costs (Adjusted to Present Value)	-734,900	-5,342,442.00	-5,585,671.90	-5,955,140.25	-6,333,309.24	-6,747,137.24
Cumulative time-adjusted costed over life time:	-734,900	-6,077,342.00	-11,663,013.90	-17,618,154.15	-23,951,463.39	-30,698,600.63
Benefits derived from operation of the new system	0	6,150,270	6,765,297	7,441,827	8,186,009	9,004,610
Discount factor for 3%	1.000	0.971	0.943	0.915	0.888	0.863
Time-Adjusted Costs (Adjusted to Present Value)	0	5,971,912.17	6,379,675.07	6,809,271.43	7,269,176.32	7,770,978.69
Cumulative time-adjusted benefits over life time:	0	5,971,912.17	12,351,587.24	19,160,858.67	26,430,034.99	34,201,013.69
Cumulative Life Time Time-Adjusted Costed + Benefit	-734,900	-105,429.83	688,573.34	1,542,704.52	2,478,571.60	3,502,413.06

Table C.9. Net Present Value for the Candidate 2, Baht.

Cost Items	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
System Development Cost:	-827,450					
Annual Operating Cost:		-5,502,000	-5,959,550	-6,548,600	-7,172,355	-7,858,486
Discount factor for 3%	1.000	0.971	0.943	0.915	0.888	0.863
Time-Adjusted Costs (Adjusted to Present Value)	-827,450	-5,342,442.00	-5,619,855.65	-5,991,969.00	-6,369,051.24	-6,781,872.99
Cumulative time-adjusted costed over life time:	-827,450	-6,169,892.00	-11,789,747.65	-17,781,716.65	-24,150,767.89	-30,932,640.88
Benefits derived from operation of the new system	0	6,150,270	6,765,297	7,441,827	8,186,009	9,004,610
Discount factor for 3%	1.000	0.971	0.943	0.915	0.888	0.863
Time-Adjusted Costs (Adjusted to Present Value)	0	5,971,912.17	6,379,675.07	6,809,271.43	7,269,176.32	7,770,978.69
Cumulative time-adjusted benefits over life time:	0	5,971,912.17	12,351,587.24	19,160,858.67	26,430,034.99	34,201,013.69
Cumulative Life Time Time-Adjusted Costed + Benefit	-827,450	-197,979.83	561,839.59	1,379,142.02	2,279,267.10	3,268,372.81

Table C.10. Net Present Value for the Candidate 3, Baht.

Cost Items	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
System Development Cost:	-871,900					
Annual Operating Cost:		-5,502,000	-5,979,300	-6,571,350	-7,195,105	-7,881,236
Discount factor for 3%	1.000	0.971	0.943	0.915	0.888	0.863
Time-Adjusted Costs (Adjusted to Present Value)	-871,900	-5,342,442.00	-5,638,479.90	-6,012,785.25	-6,389,253.24	-6,801,506.24
Cumulative time-adjusted costed over life time:	-871,900	-6,214,342.00	-11,852,821.90	-17,865,607.15	-24,254,860.39	-31,056,366.63
Benefits derived from operation of the new system	0	6,150,270	6,765,297	7,441,827	8,186,009	9,004,610
Discount factor for 3%	1.000	0.971	0.943	0.915	0.888	0.863
Time-Adjusted Costs (Adjusted to Present Value)	0	5,971,912.17	6,379,675.07	6,809,271.43	7,269,176.32	7,770,978.69
Cumulative time-adjusted benefits over life time:	0	5,971,912.17	12,351,587.24	19,160,858.67	26,430,034.99	34,201,013.69
Cumulative Life Time Time-Adjusted Costed + Benefit	-871,900	-242,429.83	498,765.34	1,295,251.52	2,175,174.60	3,144,647.06

Candidate Solution 1

Cumulative Cost, Baht

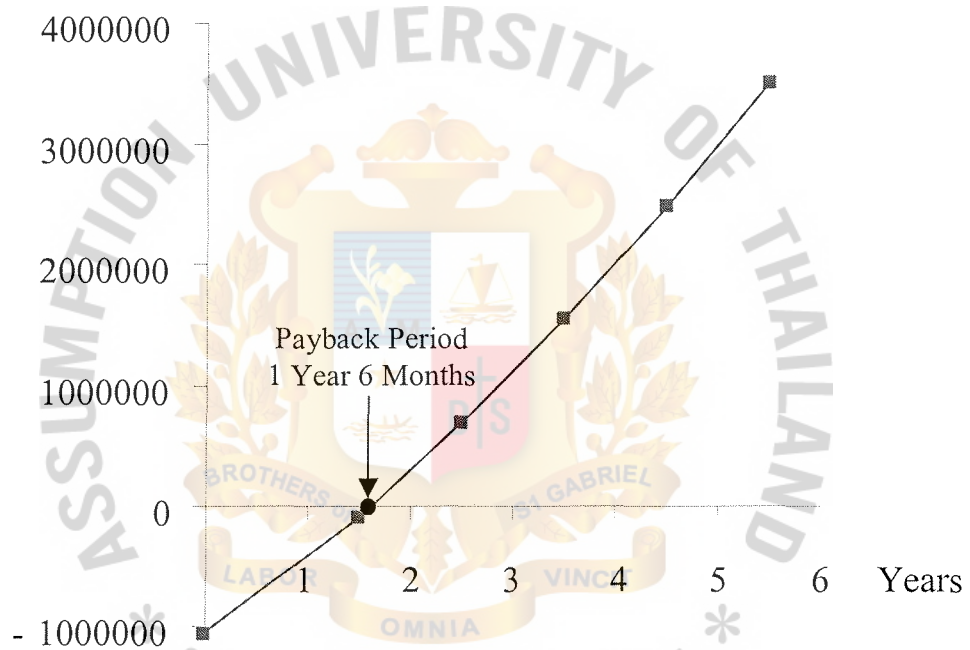


Figure C.1. Payback Period for Candidate 1.

Candidate Solution 2

Cumulative Cost, Baht

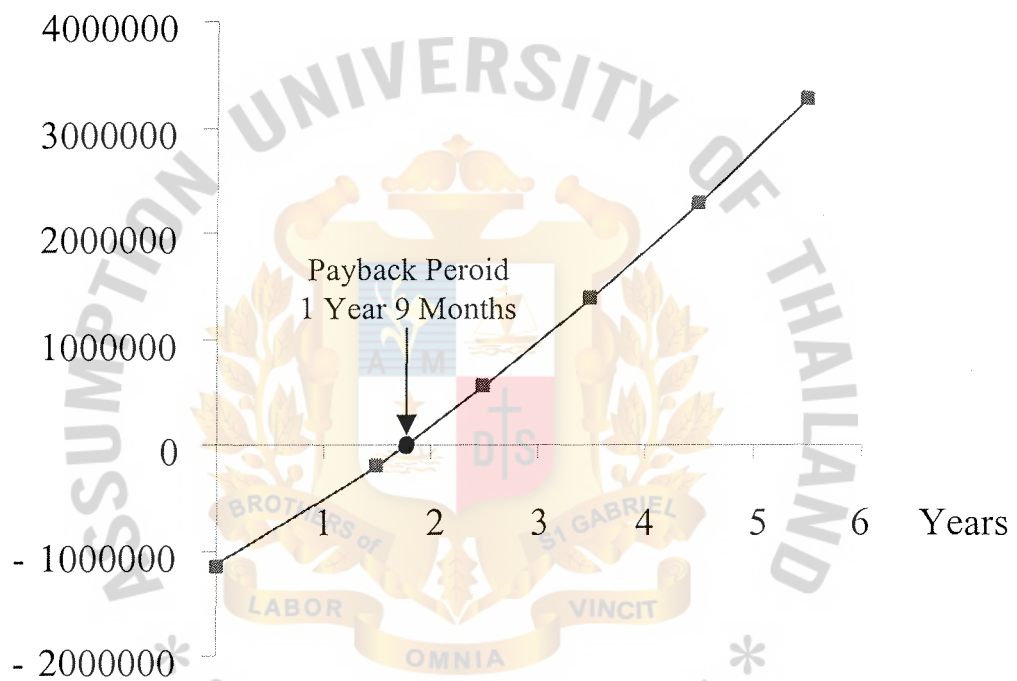


Figure C.2. Payback Period for Candidate 2.

Candidate Solution 3

Cumulative Cost, Baht

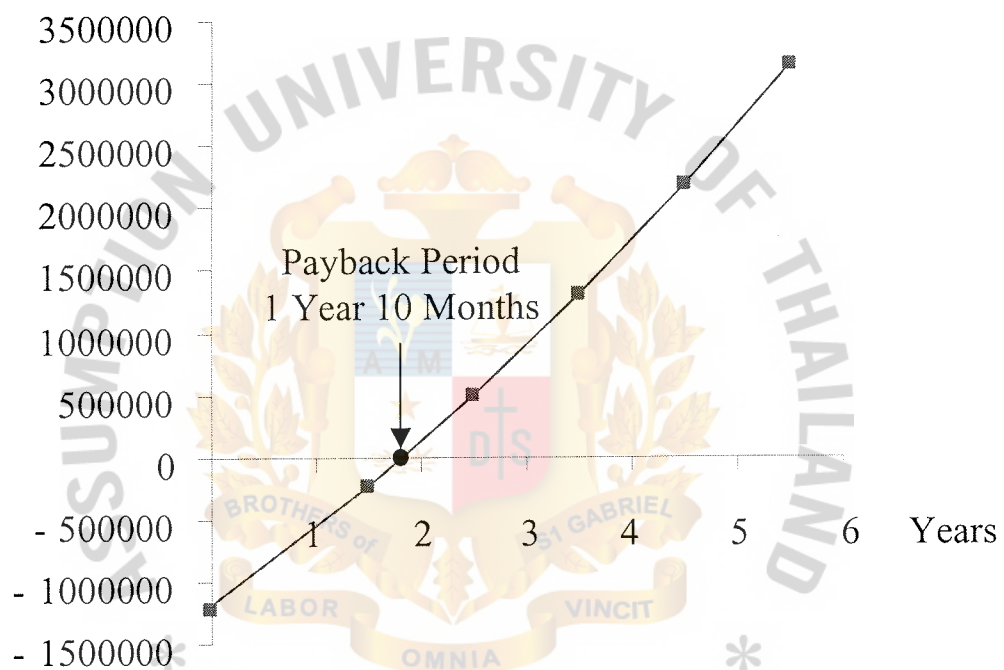


Figure C.3. Payback Period for Candidate 3.



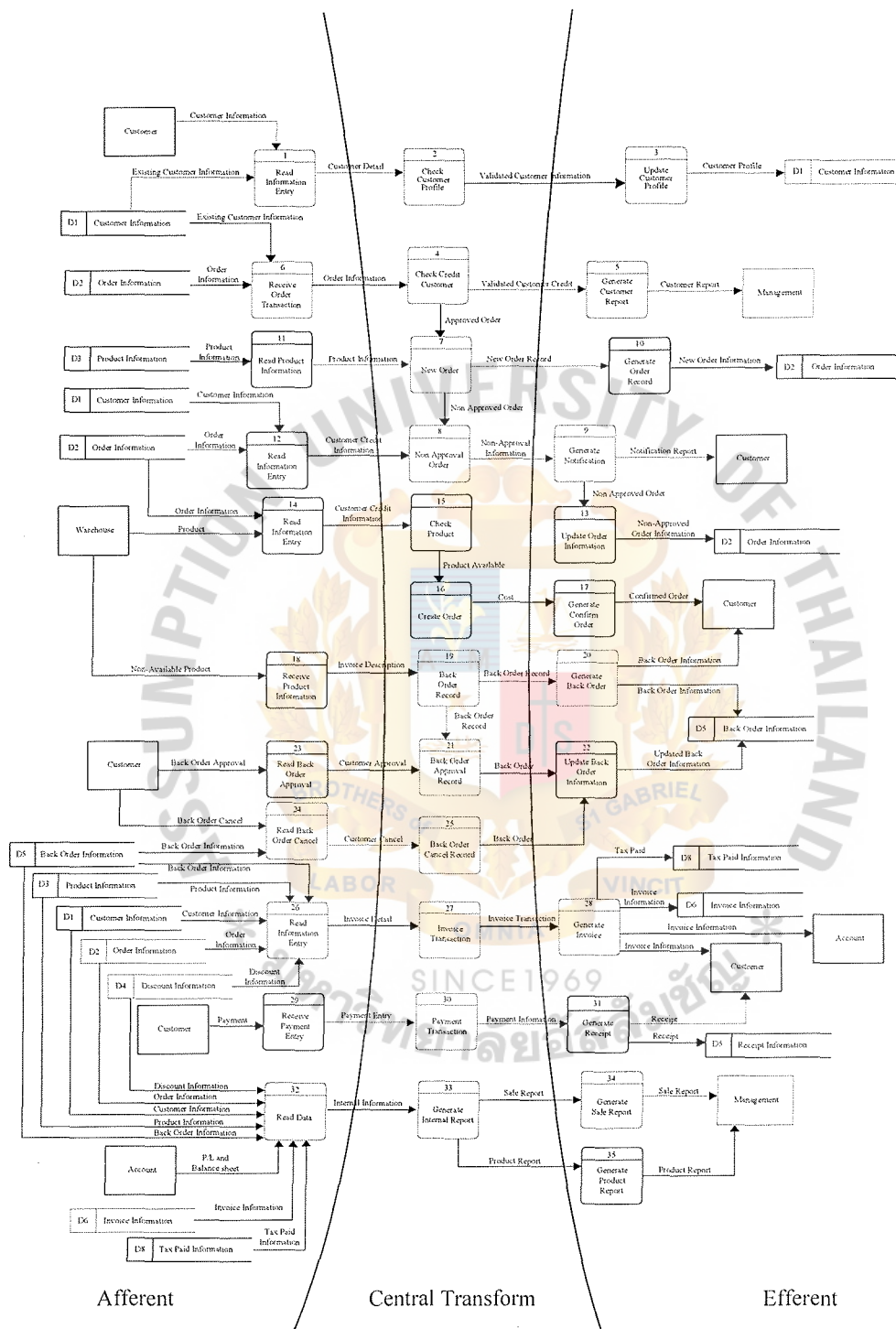


Figure D.1. Partitioned Data Flow Diagram of The Sales Support Information System.

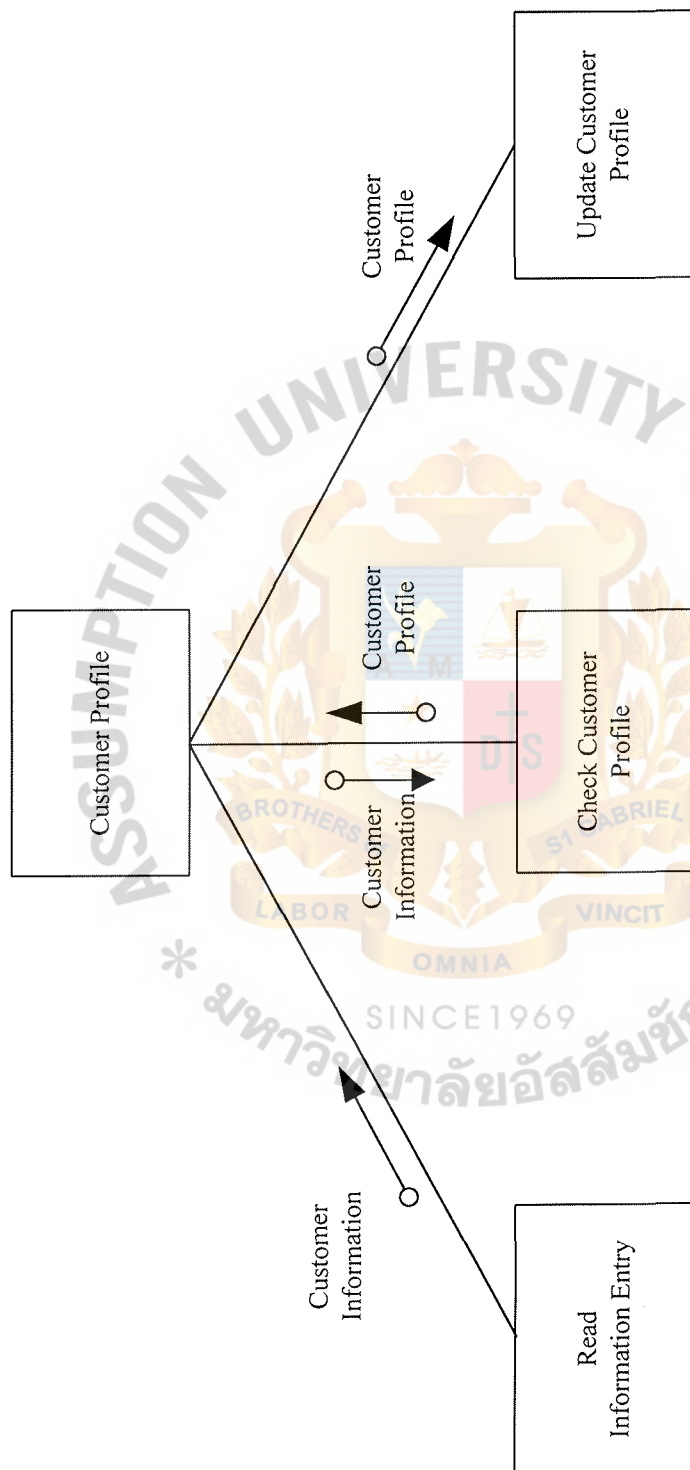


Figure D.2. Structure Chart of Customer Check Profile.

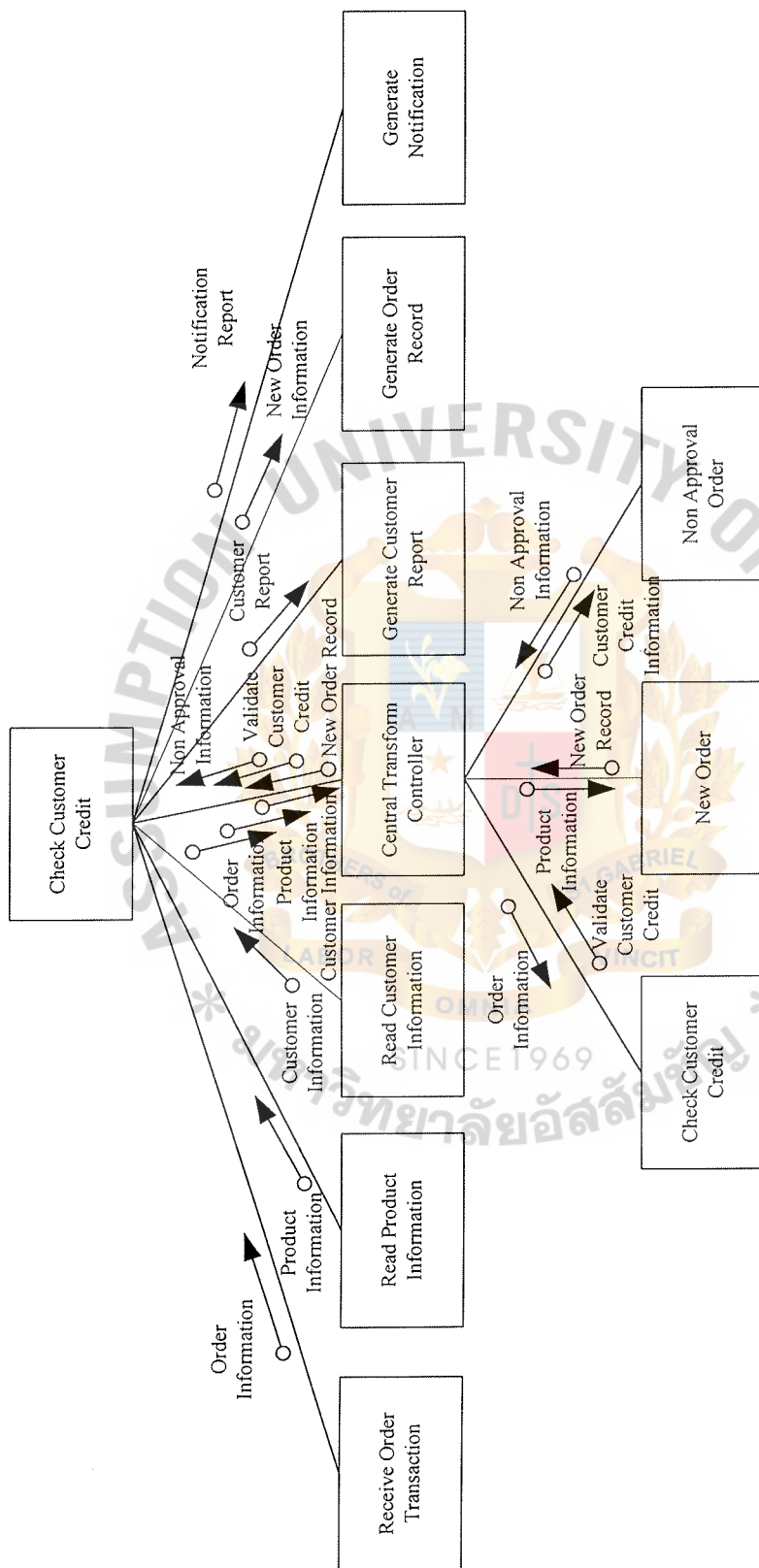


Figure D.3. Structure Chart of Check Customer Credit.

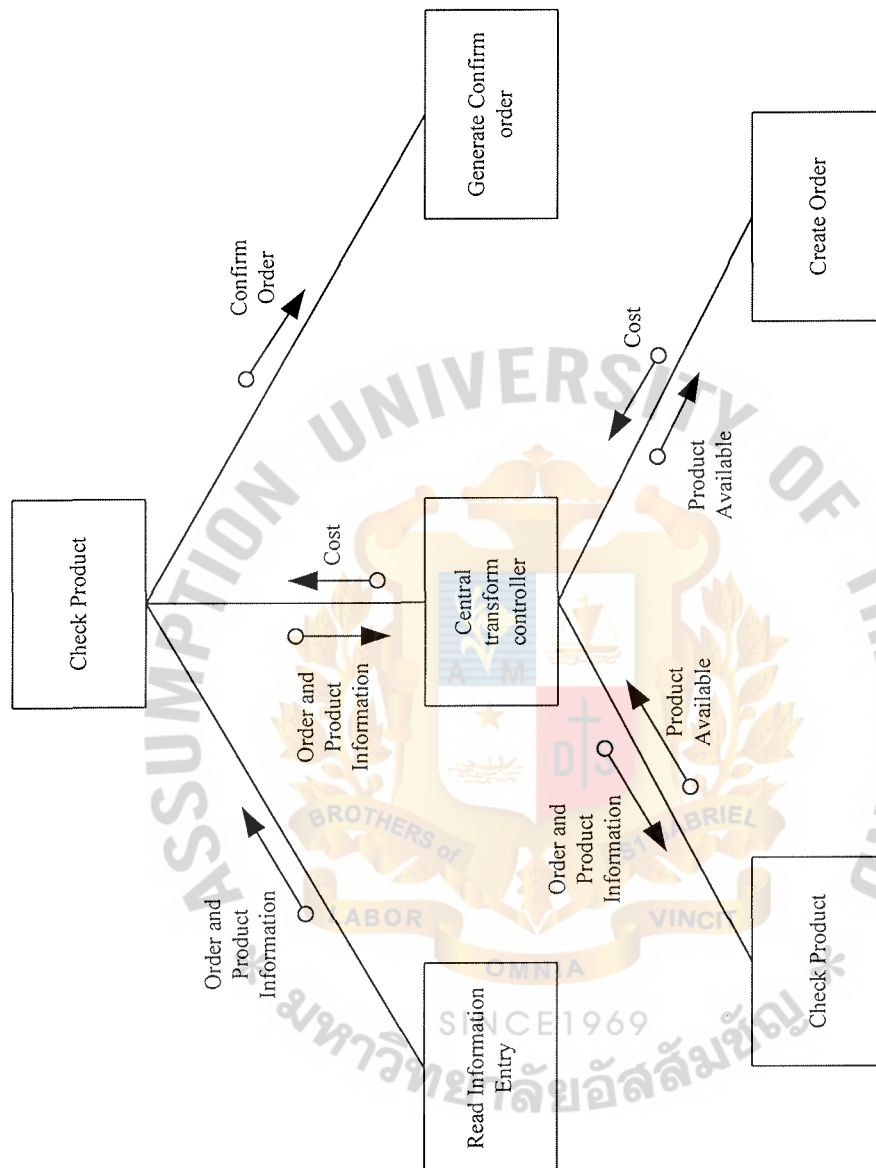


Figure D.4. Structure Chart of Check Product.

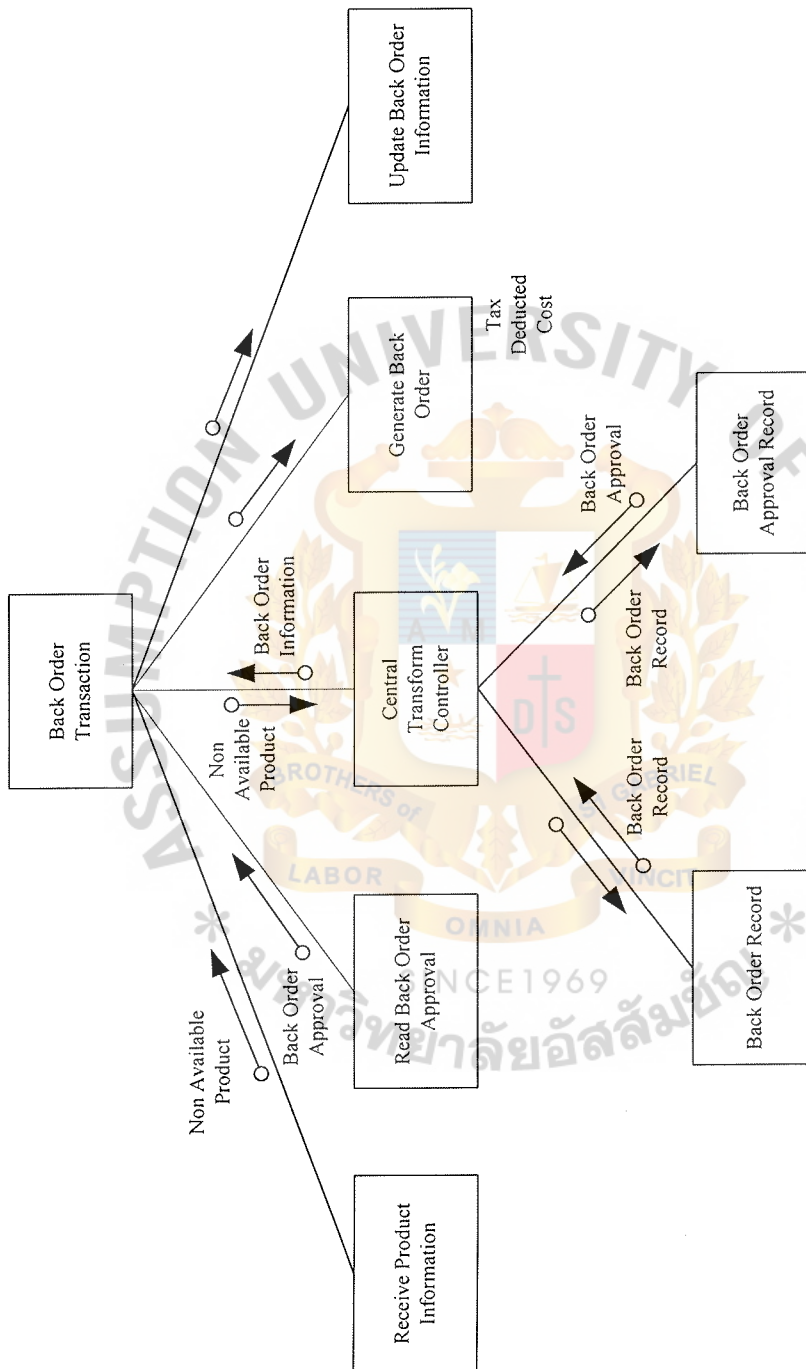


Figure D.5. Structure Chart of Back Order Transaction.

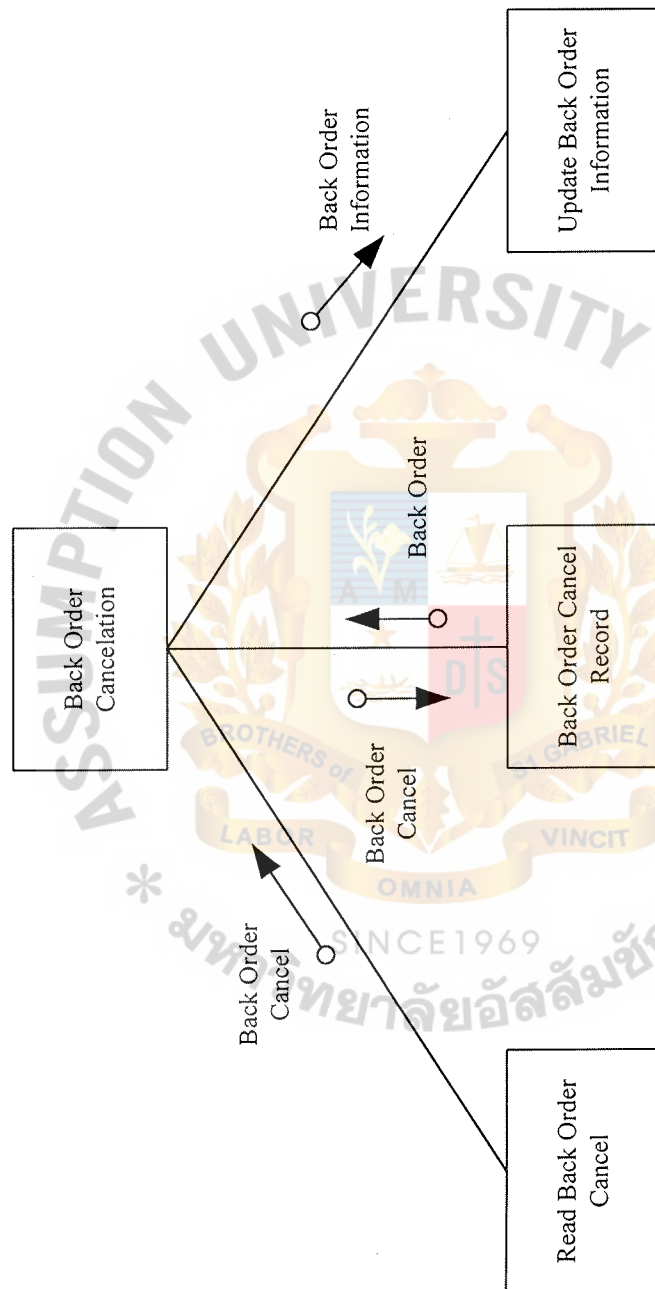


Figure D.6. Structure Chart of Back Order Cancellation .

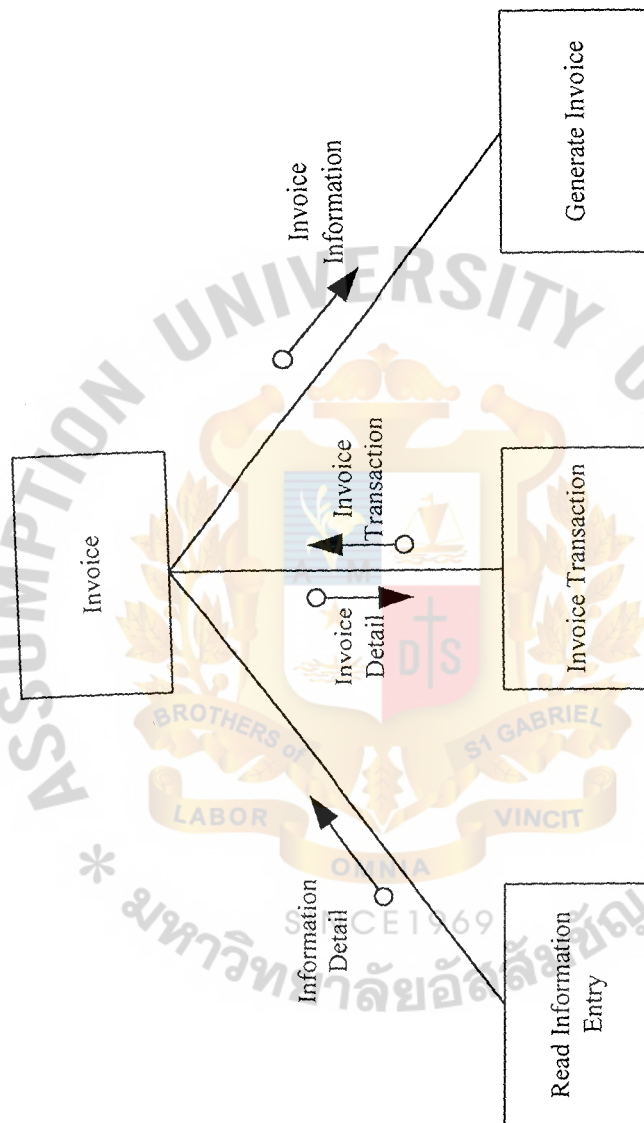


Figure D.7. Structure Chart of Invoice.

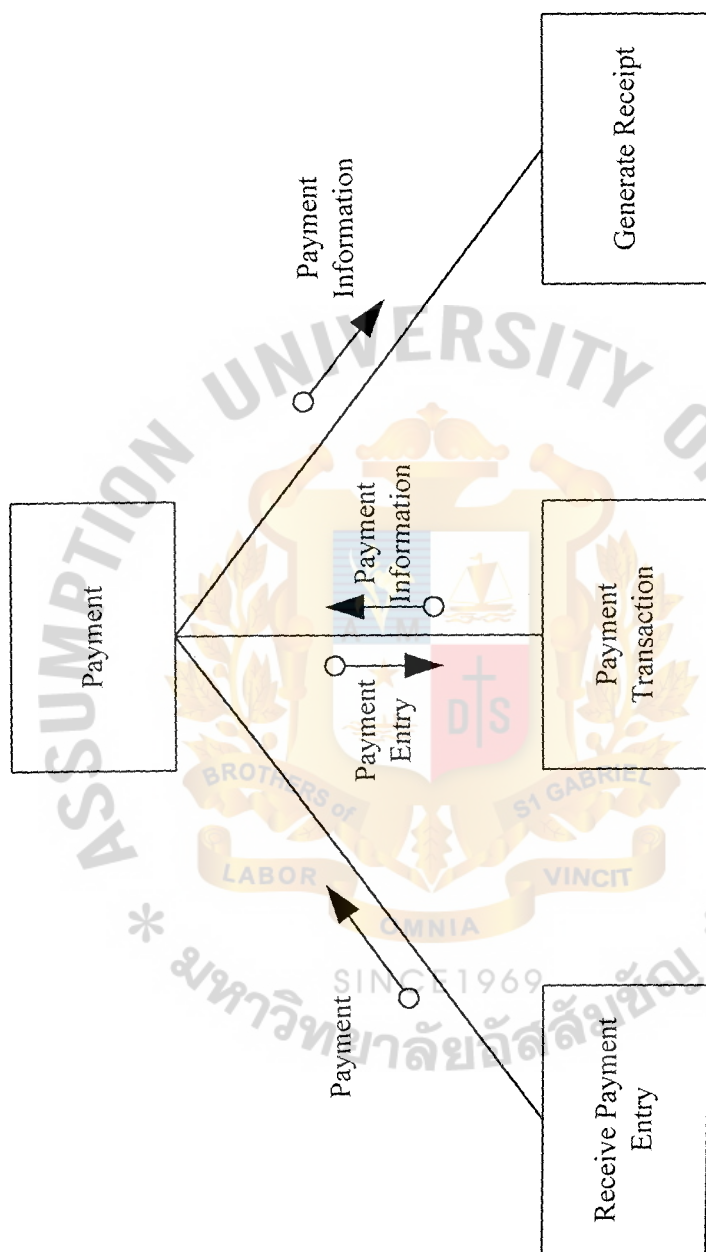


Figure D.8. Structure Chart of Payment.

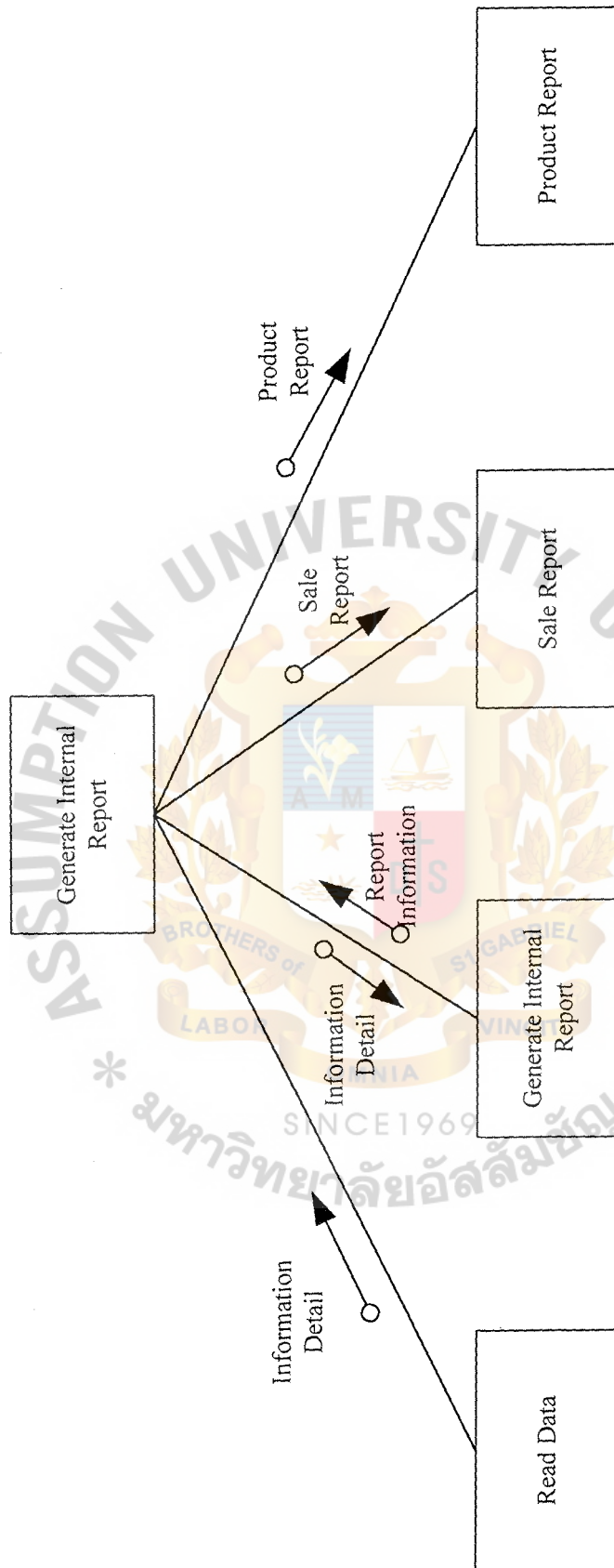


Figure D.9. Structure Chart of Generate Internal Report.



Table E.1. Process Specification of Process 1.1.

Items	Description
Process Name:	Check Customer Profile
Data In:	Customer data from customer Customer Information Database
Data Out:	New customer data is sent to process 1.2
Process:	(1) Officer receives data from customer to verify with the existing customer records
Attachment:	Customer Information database

Table E.2. Process Specification of Process 1.2.

Items	Description
Process Name:	Add New Customer
Data In:	New customer information from process 1.1
Data Out:	New customer record in database
Process:	(1) Classify customer information, then add new record in database
Attachment:	Customer Information database

Table E.3. Process Specification of Process 1.3.

Items	Description
Process Name:	Check Credit Customer
Data In:	Existing Order Information Product Information Customer Information Overdraft Approval Overdraft Non-Approval
Data Out:	Overdraft Non-Approval Notification send to Customer
Process:	(1) Retrieve Existing Order Information from Order Information database (2) Retrieve Product Information from Product Information database to check quantity of order (3) Check Customer Credit from Customer Information database (4) If there is overdraft send overdraft information to Management to make decision (5) Management send either overdraft approval or overdraft non-approval back (6) Send Non-Approval Notification to Customer if Management send overdraft non-approval back
Attachment:	Customer Information database Order Information database Product Information database Customer Management

Table E.4. Process Specification of Process 1.3.1.

Items	Description
Process Name:	Check Customer Credit Record
Data In:	Customer Credit Information Order Information
Data Out:	Overdraft Order
Process:	(1) Receive Customer Credit Information (2) Retrieve Order record to check customer credit balance (3) If the credit balance is in credit line send order to process 1.3.2 (4) If the credit balance is over credit line send overdraft to Management to make decision
Attachment:	Management Customer Information database Order Information database

Table E.5. Process Specification of Process 1.3.2.

Items	Description
Process Name:	New Order
Data In:	Order from process 1.3.1 Overdraft Approval Product Information
Data Out:	New Order record
Process:	(1) Receive Order from process 1.1.1 (2) Retrieve Overdraft Approval if Management decide to allow overdraft for customer (3) Then retrieve Product Information (4) Create new order record
Attachment:	Product Information database Order Information database Management

Table E.6. Process Specification of Process 1.3.3

Items	Description
Process Name:	Non Approve Order
Data In:	Overdraft Non-Approval from Management
Data Out:	Non-approval notification to customer
Process:	(1) Receive Overdraft Non-Approval from Management (2) Generate non-approval notification to customer
Attachment:	Customer Management

Table E.7. Process Specification of Process 1.4.

Items	Description
Process Name:	Generate Report
Data In:	Customer Information
Data Out:	Customer Report
Process:	(1) Retrieve Customer Information (2) Generate New Customer Report
Attachment:	Customer Information database Management

Table E.8. Process Specification of Process 2.1.

Items	Description
Process Name:	Check Product
Data In:	Order Information
Data Out:	Check product available with Warehouse
Process:	(1) Receive order information (2) Request product available from Warehouse
Attachment:	Order Information database Warehouse

Table E.9. Process Specification of Process 2.2.

Items	Description
Process Name:	Confirm Order
Data In:	Available product from Warehouse
Data Out:	Request order confirmation from customer
Process:	(1) Receive available product from Warehouse (2) Request the order confirmation from customer
Attachment:	Customer Warehouse

Table E.10. Process Specification of Process 2.3.

Items	Description
Process Name:	Generate Order
Data In:	Confirm Order from customer
Data Out:	Update order information (confirm)
Process:	(1) Receive confirm order from customer (2) Update order information (confirm)
Attachment:	Customer Order Information database

Table E.11. Process Specification of Process 3.1.

Items	Description
Process Name:	Check Back Order Record
Data In:	Non available product from Warehouse
Data Out:	Create Back order record
Process:	(1) Receive unavailable product from Warehouse (2) Create Back order record
Attachment:	Back Order Information database Warehouse

Table E.12. Process Specification of Process 3.2.

Items	Description
Process Name:	Send Back Order
Data In:	Back Order Record
Data Out:	Back Order Approval Request from customer
Process:	(1) Retrieve Back Order information (2) Generate Back Order approval request to customer (3) Request Back Order Approval from customer
Attachment:	Back Order Information Customer

Table E.13. Process Specification of Process 3.3.

Items	Description
Process Name:	Cancel Back Order
Data In:	Back Order Cancellation from Customer
Data Out:	Update Back Order Information database
Process:	(1) Receive back order cancellation from customer (2) Update cancel status to Back Order Information database
Attachment:	Back Order Information database Customer

Table E.14. Process Specification of Process 3.4.

Items	Description
Process Name:	Confirm Back Order
Data In:	Back Order Confirmation from customer
Data Out:	Update Back Order database Approved Back Order Information to Warehouse
Process:	(1) Receive back order confirmation from customer (2) Update approve status to Back Order Information file (3) Send approve status to Warehouse
Attachment:	Back Order Information Customer Warehouse

Table E.15. Process Specification of Process 4.1.

Items	Description
Process Name:	Generate Invoice
Data In:	Discount Information Back Order Information Order Information Product Information Customer Information
Data Out:	Invoice Information Tax Paid Information Invoice for Customer
Process:	(1) Retrieve Order Information, Back Order Information, Product Information, Discount Information and Customer Information to generate Invoice to customer (2) Store Invoice Information into database
Attachment:	Customer Account Discount Information database Back Order Information database Order Information database Product Information database Customer Information database Invoice Information database Tax Paid Information database

Table E.16. Process Specification of Process 4.2.

Items	Description
Process Name:	Generate Receipt
Data In:	Invoice Information Tax Paid Information Customer Information Payment from customer
Data Out:	Receipt for customer
Process:	(1) Retrieve Invoice Information, Tax Paid Information, Customer Information and Payment from customer to generate receipt for customer
Attachment:	Customer Information database Invoice Information database Tax Paid Information database Customer

Table E.17. Process Specification of Process 5.1.

Items	Description
Process Name:	Generate Sales and Order Report
Data In:	Customer Information Discount Information Product Information Order Information Invoice Information Tax Paid Information
Data Out:	Sales Report to Management Order Report to Management
Process:	(1) Retrieve Customer Information, Discount Information, Product Information, Order Information, Invoice Information and Tax Paid Information to generate Customer report and Sales report that activated by time to management
Attachment:	Customer Information database Discount Information database Product Information database Order Information database Invoice Information database Tax Paid Information database Management

Table E.18. Process Specification of Process 5.2.

Items	Description
Process Name:	Generate Back Order Report
Data In:	Customer Information Discount Information Product Information Order Information Back Order Information P/L and Balance sheet information
Data Out:	Order and Back Order report to Management
Process:	(1) Retrieve Customer Information, Discount Information, Product Information, Order Information and Back Order Information to generate Order and Back Order report that activated by time to management
Attachment:	Customer Information database Discount Information database Product Information database Order Information database Back Order Information database Management Account



DATA DICTIONARY

Project: SALES SUPPORT INFORMATION SYSTEM

Detailed Listing -- Alphabetically
All Entries -- Data Flow Diagrams

Account	External Entity
Location:	
dfd (0)	
Input Flows:	
Invoice information	
Output Flows:	
PL and Balance sheet	
Date Last Altered:11/22/2003	Date Created:11/22/2003

Approve Order	Process
Process #: 8	
Location:	
structure (0)	
Date Last Altered:10/23/2003	Date Created:10/23/2003

Available product	Data Flow
Location:	
dfd (0)	
Source: Warehouse (External Entity)	
Dest: Process Order (Process)	
Date Last Altered:10/25/2003	Date Created:10/13/2003

Available product check	Data Flow
Location:	
dfd (0)	
Source: Process Order (Process)	
Dest: Warehouse (External Entity)	
Date Last Altered:10/25/2003	Date Created:10/13/2003

Back order approval request	Data Flow
Location:	
dfd (0)	
Source: Process Back Order (Process)	
Dest: Customer (External Entity)	
Date Last Altered:10/25/2003	Date Created:10/13/2003

Back order cancellation	Data Flow
Location:	
dfd (0)	
Source: Customer (External Entity)	

Dest: Process Back Order (Process)
Date Last Altered:10/25/2003 Date Created:10/25/2003

Back order confirmation Data Flow

Location:

dfd (0)

Source: Process Back Order (Process)

Dest: Warehouse (External Entity)

Source: Customer (External Entity)

Dest: Process Back Order (Process)

Date Last Altered:10/25/2003 Date Created:10/13/2003

BACK ORDER DATE Data Element

Data element attributes

Storage Type: DateTime

Null Type: NotNull

Location:

Entity --> BACK ORDER

Date Last Altered:10/23/2003 Date Created:10/23/2003

Back Order Information Data Store

Data Store #:D4

Location:

dfd (0)

Output Flows:

Back order information

Input Flows:

Back order information updating

Output Flows:

Back order information

Date Last Altered:10/13/2003 Date Created:10/13/2003

Back order information Data Flow

Location:

dfd (0)

Source: Back Order Information (Data Store)

Dest: Process Report (Process)

Source: Back Order Information (Data Store)

Dest: Process Payment (Process)

Date Last Altered:10/13/2003 Date Created:10/13/2003

Back order information updating Data Flow

Location:

dfd (0)

Source: Process Back Order (Process)

Dest: Back Order Information (Data Store)

Date Last Altered:10/25/2003 Date Created:10/13/2003

BACK ORDER NO Data Element
Data element attributes
Storage Type: Char
Null Type: NotNull
Location:
Entity --> BACK ORDER
Entity --> INVOICE
Date Last Altered:10/23/2003 Date Created:10/23/2003

Back Order report Data Flow
Location:
dfd (0)
Source: Process Report (Process)
Dest: Management (External Entity)
Date Last Altered:10/25/2003 Date Created:10/25/2003

BACK ORDER STATUS Data Element
Data element attributes
Storage Type: Integer 4
Null Type: NotNull
Location:
Entity --> BACK ORDER
Date Last Altered:10/23/2003 Date Created:10/23/2003

Check Credit Customer Process
Process #: 5
Location:
structure (0)
Input Flows:
Existing Information
Date Last Altered:10/23/2003 Date Created:10/23/2003

Check Customer Profile Process
Process #: 2
Location:
structure (0)
Input Flows:
Customer Detail
Output Flows:
Valid Customer Profile
Date Last Altered:10/23/2003 Date Created:10/23/2003

CREDIT BALANCE Data Element
Data element attributes
Storage Type: Money
Null Type: NotNull
Location:
Entity --> CUSTOMER
Date Last Altered:10/23/2003 Date Created:10/23/2003

Data Element

Date Last Altered:10/23/2003 Date Created:10/23/2003

Data Element

Date Last Altered:10/23/2003 Date Created:10/23/2003

Data Element

Date Last Altered:10/23/2003 Date Created:10/23/2003

Data Element

Date Last Altered:10/23/2003 Date Created:10/23/2003

External Entity

Payment

Input Flows:
Back order approval request

Output Flows:
Back order confirmation
Back order cancellation

Date Last Altered:10/23/2003 Date Created:10/23/2003

CUSTOMER ADDRESS Data Element

Data element attributes

Storage Type: Char

Null Type: NotNull

Location:

Entity --> CUSTOMER

Date Last Altered:10/23/2003 Date Created:10/23/2003

Customer Detail Data Flow

Location:

structure (0)

Source: Read Information Entry (Process)

Dest: Check Customer Profile (Process)

Date Last Altered:10/23/2003 Date Created:10/23/2003

CUSTOMER ID Data Element

Data element attributes

Storage Type: Char

Null Type: NotNull

Location:

Entity --> BACK ORDER

Entity --> CUSTOMER

Entity --> ORDER

Entity --> INVOICE

Date Last Altered:10/23/2003 Date Created:10/23/2003

Customer Information Data Store

Data Store #:D1

Location:

structure (0)

Output Flows:

Existing Customer Information

Customer Information

Input Flows:

Update Customer Information

dfd (0)

Input Flows:

New customer profile

Output Flows:

Customer Information

Output Flows:

Customer Information

Customer Information
Date Last Altered:10/23/2003 Date Created:10/23/2003

Customer Information Data Flow

Location:

structure (0)

Source: Customer Information (Data Store)

Dest: Receive Order Information (Process)

dfd (0)

Source: Customer Information (Data Store)

Dest: Process Payment (Process)

Source: Customer Information (Data Store)

Dest: Process Report (Process)

Source: Customer Information (Data Store)

Dest: Process Registration (Process)

Date Last Altered:10/23/2003 Date Created:10/23/2003

CUSTOMER NAME Data Element

Data element attributes

Storage Type: Char

Null Type: NotNull

Location:

Entity --> CUSTOMER

Date Last Altered:10/23/2003 Date Created:10/23/2003

Customer Report Data Flow

Location:

structure (0)

Source: Generate Customer Report (Process)

Dest: Management (External Entity)

dfd (0)

Source: Process Report (Process)

Dest: Management (External Entity)

Date Last Altered:10/23/2003 Date Created:10/23/2003

Discount Information Data Store

Data Store #:D5

Location:

dfd (0)

Output Flows:

Discount information

Discount information

Date Last Altered:10/13/2003 Date Created:10/13/2003

Discount information Data Flow

Location:

dfd (0)

Source: Discount Information (Data Store)

Dest: Process Report (Process)

Source: Discount Information (Data Store)

Dest: Process Payment (Process)
 Source: Product Information (Data Store)
 Dest: Process Registration (Process)
 Source: Product Information (Data Store)
 Dest: Process Payment (Process)
 Source: Product Information (Data Store)
 Dest: Process Report (Process)
 Date Last Altered:10/25/2003 Date Created:10/13/2003

DISCOUNT RATE Data Element
 Data element attributes
 Storage Type: Char
 Null Type: NotNull
 Location:
 Entity --> DISCOUNT
 Date Last Altered:10/23/2003 Date Created:10/23/2003

DISCOUNT TYPE Data Element
 Data element attributes
 Storage Type: Char
 Null Type: NotNull
 Location:
 Entity --> DISCOUNT
 Entity --> CUSTOMER
 Date Last Altered:10/23/2003 Date Created:10/23/2003

Existing Customer Information Data Flow
 Location:
 structure (0)
 Source: Customer Information (Data Store)
 Dest: Read Information Entry (Process)
 Date Last Altered:10/23/2003 Date Created:10/23/2003

Existing Information Data Flow
 Location:
 structure (0)
 Source: Receive Order Information (Process)
 Dest: Check Credit Customer (Process)
 Date Last Altered:10/23/2003 Date Created:10/23/2003

Generate Customer Report Process
 Process #: 6
 Location:
 structure (0)
 Output Flows:
 Customer Report
 Date Last Altered:10/23/2003 Date Created:10/23/2003

Generate Order Process
Process #: 9
Location:
 structure (0)
Date Last Altered:10/23/2003 Date Created:10/23/2003

INVOICE DATE Data Element
Data element attributes
 Storage Type: DateTime
 Null Type: NotNull
Location:
 Entity --> INVOICE
Date Last Altered:10/23/2003 Date Created:10/23/2003

Invoice description Data Flow
Location:
 dfd (0)
 Source: Process Payment (Process)
 Dest: Invoice Information (Data Store)
Date Last Altered:10/25/2003 Date Created:10/25/2003

Invoice Information Data Store
Data Store #:D6
Location:
 dfd (0)
 Input Flows:
 Invoice description
 Output Flows:
 Invoice information
 Invoice information
Date Last Altered:10/13/2003 Date Created:10/13/2003

Invoice information Data Flow
Location:
 dfd (0)
 Source: Invoice Information (Data Store)
 Dest: Process Report (Process)
 Source: Process Payment (Process)
 Dest: Customer (External Entity)
 Source: Invoice Information (Data Store)
 Dest: Process Payment (Process)
 Source: Process Payment (Process)
 Dest: Account (External Entity)
Date Last Altered:10/25/2003 Date Created:10/13/2003

INVOICE NO Data Element
Data element attributes
 Storage Type: Char
 Null Type: NotNull

Location:

Associative Entity -->PRODUCT INVOICE

Entity --> INVOICE

Entity --> RECEIPT

Date Last Altered:10/23/2003

Date Created:10/23/2003

INVOICE_TOTAL_PRICE

Data Element

Data element attributes

Storage Type: Money

Null Type: NotNull

Location:

Entity --> INVOICE

Date Last Altered:10/23/2003

Date Created:10/23/2003

Management

External Entity

Location:

structure (0)

Input Flows:

Customer Report

dfd (0)

Input Flows:

Sale report

Customer Report

Order report

Back Order report

Input Flows:

New Customer Report

Input Flows:

Overdraft

Output Flows:

Overdraft Approval

Overdraft Non-Approval

Date Last Altered:10/23/2003

Date Created:10/23/2003

MANUFACTURE DATE

Data Element

Data element attributes

Storage Type: DateTime

Null Type: NotNull

Location:

Entity --> PRODUCT

Date Last Altered:10/23/2003

Date Created:10/23/2003

New customer profile

Data Flow

Location:

dfd (0)

Source: Process Registration (Process)

Dest: Customer Information (Data Store)

Date Last Altered:10/13/2003

Date Created:10/13/2003

New Customer Report

Data Flow

Location:

dfd (0)

Source: Process Registration (Process)

Dest: Management (External Entity)

Date Last Altered:10/25/2003

Date Created:10/25/2003

New order information

Data Flow

Location:

dfd (0)

Source: Process Registration (Process)

Dest: Order Information (Data Store)

Date Last Altered:10/13/2003

Date Created:10/13/2003

Non available product

Data Flow

Location:

dfd (0)

Source: Warehouse (External Entity)

Dest: Process Back Order (Process)

Date Last Altered:10/13/2003

Date Created:10/13/2003

Order

Data Flow

Location:

dfd (0)

Source: Customer (External Entity)

Dest: Process Registration (Process)

Date Last Altered:10/25/2003

Date Created:10/13/2003

ORDER DATE

Data Element

Data element attributes

Storage Type: DateTime

Null Type: NotNull

Location:

Entity --> ORDER

Date Last Altered:10/23/2003

Date Created:10/23/2003

Order Information

Data Store

Data Store #:D2

Location:

structure (0)

Output Flows:

Order information

dfd (0)

Input Flows:

New order information

Output Flows:

Order information

Order information

Input Flows:

Update Order Information

Output Flows:

Order information

Order information

Date Last Altered:10/23/2003

Date Created:10/23/2003

Order information

Data Flow

Location:

structure (0)

Source: Order Information (Data Store)

Dest: Receive Order Information (Process)

dfd (0)

Source: Order Information (Data Store)

Dest: Process Registration (Process)

Source: Order Information (Data Store)

Dest: Process Order (Process)

Source: Order Information (Data Store)

Dest: Process Payment (Process)

Source: Order Information (Data Store)

Dest: Process Report (Process)

Date Last Altered:10/25/2003

Date Created:10/23/2003

Order Information Confirmation

Data Flow

Location:

dfd (0)

Source: Customer (External Entity)

Dest: Process Order (Process)

Date Last Altered:10/25/2003

Date Created:10/25/2003

ORDER NO

Data Element

Data element attributes

Storage Type: Char

Null Type: NotNull

Location:

Associative Entity -->ORDER PRODUCT

Entity --> ORDER

Entity --> INVOICE

Date Last Altered:10/23/2003

Date Created:10/23/2003

Order report

Data Flow

Location:

dfd (0)

Source: Process Report (Process)

Dest: Management (External Entity)

Date Last Altered:10/25/2003

Date Created:10/13/2003

ORDER STATUS

Data Element

Data element attributes

Storage Type: Integer 4

Null Type: NotNull
Location:
Entity --> ORDER
Date Last Altered:10/23/2003 Date Created:10/23/2003

ORDER_PRODUCT_PRICE Data Element
Data element attributes
Storage Type: Money
Null Type: NotNull
Location:
Associative Entity -->ORDER PRODUCT
Date Last Altered:10/23/2003 Date Created:10/23/2003

ORDER_PRODUCT_QUANTITY Data Element
Data element attributes
Storage Type: Integer 4
Null Type: NotNull
Location:
Associative Entity -->ORDER PRODUCT
Date Last Altered:10/23/2003 Date Created:10/23/2003

Overdraft Data Flow
Location:
dfd (0)
Source: Process Order (Process)
Dest: Management (External Entity)
Date Last Altered:10/25/2003 Date Created:10/25/2003
Overdraft Approval Data Flow
Location:
dfd (0)
Source: Management (External Entity)
Dest: Process Order (Process)
Date Last Altered:10/25/2003 Date Created:10/25/2003

Overdraft Non-Approval Data Flow
Location:
dfd (0)
Source: Management (External Entity)
Dest: Process Order (Process)
Date Last Altered:10/25/2003 Date Created:10/25/2003

Payment Data Flow
Location:
dfd (0)
Source: Customer (External Entity)
Dest: Process Payment (Process)
Date Last Altered:10/13/2003 Date Created:10/13/2003

PL and Balance sheet

Data Flow

Location:

dfd (0)

Source: Account (External Entity)

Dest: Process Report (Process)

Date Last Altered:11/22/2003 Date Created:11/22/2003

PRO_INV_PRICE

Data Element

Data element attributes

Storage Type: Money

Null Type: NotNull

Location:

Associative Entity -->PRODUCT INVOICE

Date Last Altered:10/23/2003 Date Created:10/23/2003

PRO_INV_QUANTITY

Data Element

Data element attributes

Storage Type: Integer 4

Null Type: NotNull

Location:

Associative Entity -->PRODUCT INVOICE

Date Last Altered:10/23/2003 Date Created:10/23/2003

PRO_QUANTITY

Data Element

Data element attributes

Storage Type: Integer 4

Null Type: NotNull

Location:

Entity --> PRODUCT

Date Last Altered:10/23/2003 Date Created:10/23/2003

PRO_UNIT_PRICE

Data Element

Data element attributes

Storage Type: Money

Null Type: NotNull

Location:

Entity --> PRODUCT

Date Last Altered:10/23/2003 Date Created:10/23/2003

Process Back Order

Process

Process #: 3

Location:

dfd (0)

Input Flows:

Non available product

Back order confirmation

Back order cancellation

Output Flows:

Back order confirmation

Order information
Discount information
Output Flows:
New customer profile
New order information
New Customer Report
Date Last Altered:10/13/2003 Date Created:10/13/2003

Process Report	Process
Process #: 5	
Location:	
dfd (0)	
Input Flows:	
Back order information	
Invoice information	
Discount information	
Discount information	
Customer Information	
Order information	
Tax Paid Information	
PL and Balance sheet	
Output Flows:	
Sale report	
Customer Report	
Order report	
Back Order report	
Date Last Altered:10/13/2003	Date Created:10/13/2003

PRODUCT ID	Data Element
Data element attributes	
Storage Type: Char	
Null Type: NotNull	
Location:	
Entity --> PRODUCT	
Associative Entity -->PRODUCT INVOICE	
Associative Entity -->ORDER PRODUCT	
Date Last Altered:10/23/2003	Date Created:10/23/2003

Product Information	Data Store
Data Store #:D3	
Location:	
structure (0)	
dfd (0)	
Output Flows:	
Discount information	
Discount information	
Output Flows:	
Discount information	
Date Last Altered:10/23/2003	Date Created:10/23/2003

PRODUCT NAME	Data Element
Data element attributes	
Storage Type: Char	
Null Type: NotNull	
Location:	
Entity --> PRODUCT	
Date Last Altered:10/23/2003	Date Created:10/23/2003

Read Product Information	Process
Process #: 7	
Location: structure (0)	
Date Last Altered:10/23/2003	Date Created:10/23/2003

RECEIPT DATE Data Element
Data element attributes
Storage Type: DateTime
Null Type: NotNull
Location:
Entity --> RECEIPT
Date Last Altered:10/23/2003 Date Created:10/23/2003

RECEIPT STATUS	Data Element
Data element attributes	
Storage Type: Integer 4	
Null Type: NotNull	
Location:	
Entity --> RECEIPT	
Date Last Altered:10/23/2003	Date Created:10/23/2003

RECEIPT TOTAL	Data Element
Data element attributes	
Storage Type: Money	
Null Type: NotNull	
Location:	
Entity --> RECEIPT	
Date Last Altered:10/24/2003	Date Created:10/24/2003

Receive Order Information	Process
Process #: 4	
Location:	
structure (0)	
Input Flows:	
Customer Information	
Order information	
Output Flows:	
Existing Information	
Date Last Altered:10/23/2003	Date Created:10/23/2003

Register New Record	Data Flow
Location:	
structure (0)	
Source: Customer (External Entity)	
Dest: Read Information Entry (Process)	
Date Last Altered:10/23/2003	Date Created:10/23/2003

Request order confirmation	Data Flow
Location:	
dfd (0)	
Source: Process Order (Process)	
Dest: Customer (External Entity)	
Date Last Altered:10/13/2003	Date Created:10/13/2003

Sale report	Data Flow
Location:	
dfd (0)	
Source: Process Report (Process)	
Dest: Management (External Entity)	
Date Last Altered:10/13/2003	Date Created:10/13/2003

Tax Paid Data Flow
Location:
 dfd (0)
 Source: Process Payment (Process)
 Dest: Tax Paid Information (Data Store)
Date Last Altered:10/25/2003 Date Created:10/25/2003

Tax Paid Information Data Store
Data Store #:D7
Location:
 dfd (0)
 Input Flows:
 Tax Paid
 Output Flows:
 Tax Paid Information
 Tax Paid Information
Date Last Altered:10/25/2003 Date Created:10/25/2003

Tax Paid Information Data Flow
Location:
 dfd (0)
 Source: Tax Paid Information (Data Store)
 Dest: Process Payment (Process)
 Source: Tax Paid Information (Data Store)
 Dest: Process Report (Process)
Date Last Altered:10/25/2003 Date Created:10/25/2003

TAX RATE Data Element
Data element attributes
 Storage Type: Money
 Null Type: NotNull
Location:
 Entity --> RECEIPT
Date Last Altered:10/24/2003 Date Created:10/24/2003

Update Customer Information Data Flow
Location:
 structure (0)
 Source: Update Customer Profile (Process)
 Dest: Customer Information (Data Store)
Date Last Altered:10/23/2003 Date Created:10/23/2003

Update Customer Profile Process
Process #: 3
Location:
 structure (0)
 Input Flows:
 Valid Customer Profile
 Output Flows:

Update Customer Information
Date Last Altered:10/23/2003 Date Created:10/23/2003

Update Order Information Data Flow
Location:
 dfd (0)
 Source: Process Order (Process)
 Dest: Order Information (Data Store)
Date Last Altered:10/25/2003 Date Created:10/13/2003

Valid Customer Profile Data Flow
Location:
 structure (0)
 Source: Check Customer Profile (Process)
 Dest: Update Customer Profile (Process)
Date Last Altered:10/23/2003 Date Created:10/23/2003

Warehouse External Entity
Location:
 dfd (0)
 Input Flows:
 Available product check
 Back order confirmation
 Output Flows:
 Available product
 Non available product
Date Last Altered:10/13/2003 Date Created:10/13/2003

DATA DICTIONARY

Project: SALES SUPPORT INFORMATION SYSTEM

Detailed Listing -- Alphabetically
All Entries -- Entity Relationship

BACK ORDER

Entity

Composition:

ORDER NO : Char

BACK ORDER NO : Char

BACK ORDER DATE : DateTime

BACK ORDER STATUS : Integer 4

Primary Key:

Index Name: Generated by VAW

Column(s): BACK ORDER NO [ASC]

Foreign Key(s):

CUSTOMER 'confirms' BACK ORDER

On Delete Restrict

On Update Restrict

On Insert of Child Row Restrict

ORDER 'has' BACK ORDER

ORDER NO -> ORDER NO

On Delete Restrict

On Update Restrict

On Insert of Child Row Restrict

Location:

context erd

Attached relationships on context erd:

[confirms] MIN: 1 MAX: 1

CUSTOMER

generates

MIN: 0 MAX: many

INVOICE

keybased and attribute

Attached relationships on keybased and attribute:

[has] MIN: 1 MAX: 1

ORDER

Date Last Altered:11/22/2003

Date Created:10/23/2003

BACK ORDER DATE

Data Element

Data element attributes

Storage Type: DateTime

Null Type: NotNull

Location:

Entity --> BACK ORDER

Date Last Altered:10/23/2003

Date Created:10/23/2003

BACK ORDER NO Data Element

Data element attributes

Storage Type: Char

Null Type: NotNull

Location:

Entity --> INVOICE

Entity --> BACK ORDER

Date Last Altered:10/23/2003 Date Created:10/23/2003

BACK ORDER STATUS Data Element

Data element attributes

Storage Type: Integer 4

Null Type: NotNull

Location:

Entity --> BACK ORDER

Date Last Altered:10/23/2003 Date Created:10/23/2003

confirms Relationship

Attached Objects:

CUSTOMER

confirms MIN: 0 MAX: many

BACK ORDER

[confirms] MIN: 1 MAX: 1

Foreign Key(s):

CUSTOMER 'confirms' BACK ORDER

On Delete Restrict

On Update Restrict

On Insert of Child Row Restrict

Location:

context erd

Date Last Altered:10/23/2003 Date Created:10/23/2003

CREDIT BALANCE Data Element

Data element attributes

Storage Type: Money

Null Type: NotNull

Date Last Altered:10/23/2003 Date Created:10/23/2003

CREDIT BALANCE1 Data Element

Data element attributes

Storage Type: Money

Null Type: NotNull

Location:

Entity --> CUSTOMER

Date Last Altered:11/22/2003 Date Created:11/22/2003

CREDIT BALANCE2 Data Element

Data element attributes

Storage Type: Money
Null Type: NotNull
Location:
Entity --> CUSTOMER
Date Last Altered:11/22/2003 Date Created:11/22/2003

CREDIT LINE Data Element
Data element attributes
Storage Type: Money
Null Type: NotNull
Date Last Altered:10/23/2003 Date Created:10/23/2003

CREDIT LINE1 Data Element
Data element attributes
Storage Type: Money
Null Type: NotNull
Location:
Entity --> CUSTOMER
Date Last Altered:11/22/2003 Date Created:11/22/2003

CREDIT LINE2 Data Element
Data element attributes
Storage Type: Money
Null Type: NotNull
Location:
Entity --> CUSTOMER
Date Last Altered:11/22/2003 Date Created:11/22/2003

CUST FAX NO Data Element
Data element attributes
Storage Type: Integer 4
Null Type: NotNull
Location:
Entity --> CUSTOMER
Date Last Altered:10/23/2003 Date Created:10/23/2003

CUST TEL1 Data Element
Data element attributes
Storage Type: Char
Null Type: NotNull
Location:
Entity --> CUSTOMER
Date Last Altered:10/23/2003 Date Created:10/23/2003

CUST TEL2 Data Element
Data element attributes
Storage Type: Char
Null Type: NotNull
Location:

Entity --> CUSTOMER
Date Last Altered:10/23/2003 Date Created:10/23/2003

CUSTOMER Entity

Composition:

DISCOUNT TYPE : Char
CUSTOMER ID : Char
CUSTOMER NAME : Char
CUSTOMER ADDRESS : Char
CUST TEL1 : Char
CUST TEL2 : Char
CUST FAX NO : Integer 4
CREDIT LINE1 : Money
CREDIT BALANCE1 : Money
DATE_CHANGE1 : DateTime
CREDIT LINE2 : Money
CREDIT BALANCE2 : Money
DATE_CHANGE2 : DateTime

Primary Key:

Index Name: Generated by VAW
Column(s): CUSTOMER ID [ASC]

Foreign Key(s):

DISCOUNT 'has' CUSTOMER
DISCOUNT TYPE -> DISCOUNT TYPE
On Delete Restrict
On Update Restrict
On Insert of Child Row Restrict

Location:

context erd

Attached relationships on context erd:

[has]	MIN: 0 MAX: 1
DISCOUNT	
places	MIN: 1 MAX: many
ORDER	
receive	MIN: 1 MAX: many
INVOICE	
confirms	MIN: 0 MAX: many
BACK ORDER	

keybased and attribute

Attached relationships on keybased and attribute:

[has]	MIN: 0 MAX: 1
DISCOUNT	
places	MIN: 1 MAX: many
ORDER	
receive	MIN: 1 MAX: many
INVOICE	

Date Last Altered:11/22/2003 Date Created:10/23/2003

CUSTOMER ADDRESS

Data Element

Data element attributes

Storage Type: Char

Null Type: NotNull

Location:

Entity --> CUSTOMER

Date Last Altered:10/23/2003

Date Created:10/23/2003

CUSTOMER ID

Data Element

Data element attributes

Storage Type: Char

Null Type: NotNull

Location:

Entity --> ORDER

Entity --> INVOICE

Entity --> CUSTOMER

Date Last Altered:10/23/2003

Date Created:10/23/2003

CUSTOMER NAME

Data Element

Data element attributes

Storage Type: Char

Null Type: NotNull

Location:

Entity --> CUSTOMER

Date Last Altered:10/23/2003

Date Created:10/23/2003

DATE_CHANGE1

Data Element

Data element attributes

Storage Type: DateTime

Null Type: NotNull

Location:

Entity --> CUSTOMER

Date Last Altered:11/22/2003

Date Created:11/22/2003

DATE_CHANGE2

Data Element

Data element attributes

Storage Type: DateTime

Null Type: NotNull

Location:

Entity --> CUSTOMER

Date Last Altered:11/22/2003

Date Created:11/22/2003

DISCOUNT

Entity

Composition:

DISCOUNT TYPE : Char

DISCOUNT RATE : Char

Primary Key:

Index Name: Generated by VAW

Column(s): DISCOUNT TYPE [ASC]

Location:

context erd

Attached relationships on context erd:

has MIN: 1 MAX: many

CUSTOMER

keybased and attribute

Attached relationships on keybased and attribute:

has MIN: 1 MAX: many

CUSTOMER

Date Last Altered:10/23/2003

Date Created:10/23/2003

DISCOUNT RATE

Data Element

Data element attributes

Storage Type: Char

Null Type: NotNull

Location:

Entity --> DISCOUNT

Date Last Altered:10/23/2003

Date Created:10/23/2003

DISCOUNT TYPE

Data Element

Data element attributes

Storage Type: Char

Null Type: NotNull

Location:

Entity --> DISCOUNT

Entity --> CUSTOMER

Date Last Altered:10/23/2003

Date Created:10/23/2003

generates

Relationship

Attached Objects:

INVOICE

generates

MIN: 1 MAX: many

ORDER

[generates]

MIN: 1 MAX: 1

Foreign Key(s):

INVOICE 'generates' ORDER

On Delete Restrict

On Update Restrict

On Insert of Child Row Restrict

Location:

context erd

keybased and attribute

Date Last Altered:10/23/2003

Date Created:10/23/2003

generates

Relationship

Attached Objects:

BACK ORDER

generates

MIN: 0 MAX: many

INVOICE

[generates]

MIN: 1 MAX: 1

Foreign Key(s):

BACK ORDER 'generates' INVOICE
BACK ORDER NO -> BACK ORDER NO
On Delete Restrict
On Update Restrict
On Insert of Child Row Restrict

Location:

context erd

Date Last Altered:10/23/2003

Date Created:10/23/2003

generates

Relationship

Attached Objects:

INVOICE

generates

MIN: 1 MAX: 1

RECEIPT

[generates]

MIN: 1 MAX: 1

Foreign Key(s):

INVOICE 'generates' RECEIPT

INVOICE NO -> INVOICE NO

On Delete Restrict

On Update Restrict

On Insert of Child Row Restrict

Location:

context erd

keybased and attribute

Date Last Altered:10/23/2003

Date Created:10/23/2003

has

Relationship

Attached Objects:

DISCOUNT

has

MIN: 1 MAX: many

CUSTOMER

[has]

MIN: 0 MAX: 1

Foreign Key(s):

DISCOUNT 'has' CUSTOMER

DISCOUNT TYPE -> DISCOUNT TYPE

On Delete Restrict

On Update Restrict

On Insert of Child Row Restrict

Location:

context erd

keybased and attribute

Date Last Altered:10/23/2003

Date Created:10/23/2003

has

Relationship

Attached Objects:

ORDER

has

MIN: 0 MAX: many

PRODUCT

[has] MIN: 1 MAX: many
Foreign Key(s):
ORDER 'has' PRODUCT
On Delete Restrict
On Update Restrict
On Insert of Child Row Restrict
Location:
context erd
Date Last Altered:10/23/2003 Date Created:10/23/2003

has Relationship
Attached Objects:
INVOICE
has MIN: 1 MAX: many
PRODUCT
[has] MIN: 1 MAX: 1
Foreign Key(s):
INVOICE 'has' PRODUCT
On Delete Restrict
On Update Restrict
On Insert of Child Row Restrict
Location:
context erd
Date Last Altered:10/23/2003 Date Created:10/23/2003

has Relationship
Attached Objects:
ORDER
has MIN: 0 MAX: 1
BACK ORDER
[has] MIN: 1 MAX: 1
Foreign Key(s):
ORDER 'has' BACK ORDER
ORDER NO -> ORDER NO
On Delete Restrict
On Update Restrict
On Insert of Child Row Restrict
Location:
keybased and attribute
Date Last Altered:11/22/2003 Date Created:11/22/2003

has Relationship
Attached Objects:
ORDER
has MIN: 1 MAX: many
ORDER PRODUCT
[has] MIN: 1 MAX: 1
Foreign Key(s):
ORDER 'has' ORDER PRODUCT

has MIN: 1 MAX: many
 PRODUCT
 generates MIN: 1 MAX: many
 ORDER
 [receive] MIN: 1 MAX: 1
 CUSTOMER
 [generates] MIN: 1 MAX: 1
 BACK ORDER
 generates MIN: 1 MAX: 1
 RECEIPT

keybased and attribute

Attached relationships on keybased and attribute:

generates MIN: 1 MAX: many
 ORDER
 generates MIN: 1 MAX: 1
 RECEIPT
 is a MIN: 1 MAX: many
 PRODUCT INVOICE
 [receive] MIN: 1 MAX: 1
 CUSTOMER

Date Last Altered:10/23/2003 Date Created:10/23/2003

INVOICE DATE Data Element

Data element attributes

Storage Type: DateTime

Null Type: NotNull

Location:

Entity --> INVOICE

Date Last Altered:10/23/2003 Date Created:10/23/2003

INVOICE NO Data Element

Data element attributes

Storage Type: Char

Null Type: NotNull

Location:

Associative Entity -->PRODUCT INVOICE

Entity --> INVOICE

Entity --> RECEIPT

Date Last Altered:10/23/2003 Date Created:10/23/2003

INVOICE_TOTAL_PRICE Data Element

Data element attributes

Storage Type: Money

Null Type: NotNull

Location:

Entity --> INVOICE

Date Last Altered:10/23/2003 Date Created:10/23/2003

is a Relationship

Attached Objects:

PRODUCT

is a

MIN: 0 MAX: many

PRODUCT INVOICE

[is a]

MIN: 1 MAX: 1

Foreign Key(s):

PRODUCT 'is a' PRODUCT INVOICE

PRODUCT ID -> PRODUCT ID

On Delete Restrict

On Update Restrict

On Insert of Child Row Restrict

Location:

keybased and attribute

Date Last Altered:10/23/2003

Date Created:10/23/2003

Attached Objects:

INVOICE

is a

MIN: 1 MAX: many

PRODUCT INVOICE

[is a]

MIN: 1 MAX: 1

Foreign Key(s):

INVOICE 'is a' PRODUCT INVOICE

INVOICE NO -> INVOICE NO

On Delete Restrict

On Update Restrict

On Insert of Child Row Restrict

Location:

keybased and attribute

Date Last Altered:10/23/2003

Date Created:10/23/2003

MANUFACTURE DATE

Data Element

Data element attributes

Storage Type: DateTime

Null Type: NotNull

Location:

Entity --> PRODUCT

Date Last Altered:10/23/2003

Date Created:10/23/2003

ORDER

Entity

Composition:

CUSTOMER ID : Char

ORDER NO : Char

ORDER DATE : DateTime

ORDER STATUS : Integer 4

Primary Key:

Index Name: Generated by VAW

Column(s): ORDER NO [ASC]

Foreign Key(s):

CUSTOMER 'places' ORDER

CUSTOMER ID -> CUSTOMER ID
 On Delete Restrict
 On Update Restrict
 On Insert of Child Row Restrict
 INVOICE 'generates' ORDER
 On Delete Restrict
 On Update Restrict
 On Insert of Child Row Restrict
 Location:
 context erd
 Attached relationships on context erd:
 [places] MIN: 1 MAX: 1
 CUSTOMER
 has MIN: 0 MAX: many
 PRODUCT
 [generates] MIN: 1 MAX: 1
 INVOICE
 keybased and attribute
 Attached relationships on keybased and attribute:
 [places] MIN: 1 MAX: 1
 CUSTOMER
 [generates] MIN: 1 MAX: 1
 INVOICE
 has MIN: 1 MAX: many
 ORDER PRODUCT
 has MIN: 0 MAX: 1
 BACK ORDER
 Date Last Altered:10/23/2003 Date Created:10/23/2003

ORDER DATE Data Element
 Data element attributes
 Storage Type: DateTime
 Null Type: NotNull
 Location:
 Entity --> ORDER
 Date Last Altered:10/23/2003 Date Created:10/23/2003

ORDER NO Data Element
 Data element attributes
 Storage Type: Char
 Null Type: NotNull
 Location:
 Associative Entity -->ORDER PRODUCT
 Entity --> ORDER
 Entity --> INVOICE
 Entity --> BACK ORDER
 Date Last Altered:10/23/2003 Date Created:10/23/2003

ORDER PRODUCT

Associative Entity

Composition:

ORDER NO : Char

PRODUCT ID : Char

ORDER_PRODUCT_QUANTITY : Integer 4

ORDER_PRODUCT_PRICE : Money

Primary Key:

Index Name: Generated by VAW

Column(s): ORDER NO [ASC]

PRODUCT ID [ASC]

Foreign Key(s):

PRODUCT 'has' ORDER PRODUCT

PRODUCT ID -> PRODUCT ID

On Delete Restrict

On Update Restrict

On Insert of Child Row Restrict

ORDER 'has' ORDER PRODUCT

ORDER NO -> ORDER NO

On Delete Restrict

On Update Restrict

On Insert of Child Row Restrict

Location:

keybased and attribute

Attached relationships on keybased and attribute:

[has] MIN: 1 MAX: 1

ORDER

[has] MIN: 1 MAX: 1

PRODUCT

Date Last Altered:10/23/2003

Date Created:10/23/2003

ORDER STATUS

Data Element

Data element attributes

Storage Type: Integer 4

Null Type: NotNull

Location:

Entity --> ORDER

Date Last Altered:10/23/2003

Date Created:10/23/2003

ORDER_PRODUCT_PRICE

Data Element

Data element attributes

Storage Type: Money

Null Type: NotNull

Location:

Associative Entity -->ORDER PRODUCT

Date Last Altered:10/23/2003

Date Created:10/23/2003

ORDER_PRODUCT_QUANTITY

Data Element

Data element attributes

Storage Type: Integer 4

Null Type: NotNull
Location:
Associative Entity -->ORDER PRODUCT
Date Last Altered:10/23/2003 Date Created:10/23/2003

places Relationship
Attached Objects:
CUSTOMER
places MIN: 1 MAX: many
ORDER
[places] MIN: 1 MAX: 1
Foreign Key(s):
CUSTOMER 'places' ORDER
CUSTOMER ID -> CUSTOMER ID
On Delete Restrict
On Update Restrict
On Insert of Child Row Restrict
Location:
context erd
keybased and attribute
Date Last Altered:10/23/2003 Date Created:10/23/2003

PRO_INV_PRICE Data Element
Data element attributes
Storage Type: Money
Null Type: NotNull
Location:
Associative Entity -->PRODUCT INVOICE
Date Last Altered:10/23/2003 Date Created:10/23/2003

PRO_INV_QUANTITY Data Element
Data element attributes
Storage Type: Integer 4
Null Type: NotNull
Location:
Associative Entity -->PRODUCT INVOICE
Date Last Altered:10/23/2003 Date Created:10/23/2003

PRO_QUANTITY Data Element
Data element attributes
Storage Type: Integer 4
Null Type: NotNull
Location:
Entity --> PRODUCT
Date Last Altered:10/23/2003 Date Created:10/23/2003

PRO_UNIT_PRICE Data Element
Data element attributes
Storage Type: Money

Null Type: NotNull
Location:
Entity --> PRODUCT
Date Last Altered:10/23/2003 Date Created:10/23/2003

PRODUCT Entity
Composition:
PRODUCT ID : Char
PRODUCT NAME : Char
PRO_QUANTITY : Integer 4
PRO_UNIT_PRICE : Money
MANUFACTURE DATE : DateTime

Primary Key:
Index Name: Generated by VAW
Column(s): PRODUCT ID [ASC]

Foreign Key(s):
ORDER 'has' PRODUCT
On Delete Restrict
On Update Restrict
On Insert of Child Row Restrict
INVOICE 'has' PRODUCT
On Delete Restrict
On Update Restrict
On Insert of Child Row Restrict

Location:
context erd
Attached relationships on context erd:
[has] MIN: 1 MAX: many
ORDER
[has] MIN: 1 MAX: 1
INVOICE

keybased and attribute
Attached relationships on keybased and attribute:
has MIN: 0 MAX: many
ORDER PRODUCT
is a MIN: 0 MAX: many
PRODUCT INVOICE

Date Last Altered:10/23/2003 Date Created:10/23/2003

PRODUCT ID Data Element

Data element attributes
Storage Type: Char
Null Type: NotNull
Location:

Entity --> PRODUCT
Associative Entity -->PRODUCT INVOICE
Associative Entity -->ORDER PRODUCT
Date Last Altered:10/23/2003 Date Created:10/23/2003

PRODUCT INVOICE

Associative Entity

Composition:

INVOICE NO : Char
 PRODUCT ID : Char
 PRO_INV_QUANTITY : Integer 4
 PRO_INV_PRICE : Money

Primary Key:

Index Name: Generated by VAW
 Column(s): PRODUCT ID [ASC]
 INVOICE NO [ASC]

Foreign Key(s):

INVOICE 'is a' PRODUCT INVOICE
 INVOICE NO -> INVOICE NO

On Delete Restrict

On Update Restrict

On Insert of Child Row Restrict

PRODUCT 'is a' PRODUCT INVOICE

PRODUCT ID -> PRODUCT ID

On Delete Restrict

On Update Restrict

On Insert of Child Row Restrict

Location:

keybased and attribute

Attached relationships on keybased and attribute:

[is a] MIN: 1 MAX: 1

PRODUCT

[is a] MIN: 1 MAX: 1

INVOICE

Date Last Altered:10/23/2003

Date Created:10/23/2003

PRODUCT NAME

Data Element

Data element attributes

Storage Type: Char

Null Type: NotNull

Location:

Entity --> PRODUCT

Date Last Altered:10/23/2003

Date Created:10/23/2003

RECEIPT

Entity

Composition:

INVOICE NO : Char
 RECEIPT NO : Char
 RECEIPT DATE : DateTime
 RECEIPT STATUS : Integer 4
 TAX RATE : Money
 RECEIPT TOTAL : Money

Primary Key:

Index Name: Generated by VAW
 Column(s): RECEIPT NO [ASC]

Foreign Key(s):
INVOICE 'generates' RECEIPT
INVOICE NO -> INVOICE NO
On Delete Restrict
On Update Restrict
On Insert of Child Row Restrict

Location:

context erd

Attached relationships on context erd:

[generates] MIN: 1 MAX: 1

INVOICE

keybased and attribute

Attached relationships on keybased and attribute:

[generates] MIN: 1 MAX: 1

INVOICE

Date Last Altered:10/24/2003 Date Created:10/23/2003

RECEIPT DATE Data Element

Data element attributes

Storage Type: DateTime

Null Type: NotNull

Location:

Entity --> RECEIPT

Date Last Altered:10/23/2003 Date Created:10/23/2003

RECEIPT NO Data Element

Data element attributes

Storage Type: Char

Null Type: NotNull

Location:

Entity --> RECEIPT

Date Last Altered:10/23/2003 Date Created:10/23/2003

RECEIPT STATUS Data Element

Data element attributes

Storage Type: Integer 4

Null Type: NotNull

Location:

Entity --> RECEIPT

Date Last Altered:10/23/2003 Date Created:10/23/2003

RECEIPT TOTAL Data Element

Data element attributes

Storage Type: Money

Null Type: NotNull

Location:

Entity --> RECEIPT

Date Last Altered:10/24/2003 Date Created:10/24/2003



APPENDIX G

DATABASE DESIGN

Table G.1. Structure of Customer Table.

Name	Type	Length	Key Type	Foreign Key to	Check
Customer_id	Text	6	Primary Key	Order Table Back Order Table Invoice Table	-
Customer_name	Text	30	Attribute	-	-
Customer_address	Text	50	Attribute	-	-
Contact person	Text	30	Attribute	-	-
Cust tel no1	Number	9	Attribute	-	9 Digits
Cust tel no2	Number	9	Attribute	-	9 Digits
Cust fax no	Number	9	Attribute	-	9 Digits
Credit line1	Money	10	Attribute	-	-
Credit balance1	Money	10	Attribute	-	-
Date_change1	Date/Time	10	Attribute	-	-
Credit line2	Money	10	Attribute	-	-
Credit balance2	Money	10	Attribute	-	-
Date_change2	Date/Time	10	Attribute	-	-

Table G.2. Structure of Discount Table.

Name	Type	Length	Key Type	Foreign Key to	Check
Discount type	Text	6	Primary Key	Customer Table	-
Discount rate	Number	4	Attribute	-	-

Table G.3. Structure of Order Table.

Name	Type	Length	Key Type	Foreign Key to	Check
Order no	Text	6	Primary Key	Order Product Table Invoice Table	-
Order date	Date/Time	10	Attribute	-	-
Order status	Boolean	1	Attribute	-	-

Table G.4. Structure of Order Product Table.

Name	Type	Length	Key Type	Foreign Key to	Check
Order no	Text	6	Primary Key	Back Order Table	-
Product no	Text	6	Primary Key	-	-
Order_product_quantity	Number	20	Attribute	-	-
Order_product_price	Number	20	Attribute	-	-

Table G.5. Structure of Product Table.

Name	Type	Length	Key Type	Foreign Key to	Check
Product id	Text	6	Primary Key	Order Product Table Product Invoice Table	-
Product name	Text	30	Attribute	-	-
Pro_quantity	Number	20	Attribute	-	-
Pro_unit_price	Money	20	Attribute	-	-
Manufacture date	Date/Time	10	Attribute	-	-

Table G.6. Structure of Product Invoice Table.

Name	Type	Length	Key Type	Foreign Key to	Check
Product id	Text	6	Primary Key	-	-
Invoice no	Text	6	Primary Key	-	-
Pro_inv_quantity	Number	20	Attribute	-	-
Pro_inv_price	Money	20	Attribute	-	-

Table G.7. Structure of Invoice Table.

Name	Type	Length	Key Type	Foreign Key to	Check
Invoice no	Text	6	Primary Key	Product Invoice Table Receipt Table	-
Invoice date	Date/Time	10	Attribute	-	-
Invoice_total_price	Money	22	Attribute	-	-

Table G.8. Structure Back Order Table.

Name	Type	Length	Key Type	Foreign Key to	Check
Back order no	Text	6	Primary Key	-	-
Back order date	Date/Time	10	Attribute	-	-
Back order status	Boolean	1	Attribute	-	-

Table G.9. Structure of Receipt Table.

Name	Type	Length	Key Type	Foreign Key to	Check
Receipt no	Text	6	Primary Key	-	-
Receipt date	Date/Time	10	Attribute	-	-
Receipt status	Boolean	1	Attribute	-	-
Tax rate	Number	4	Attribute	-	-
Receipt_total	Money	22	Attribute	-	-



APPENDIX H

USER INTERFACE DESIGN

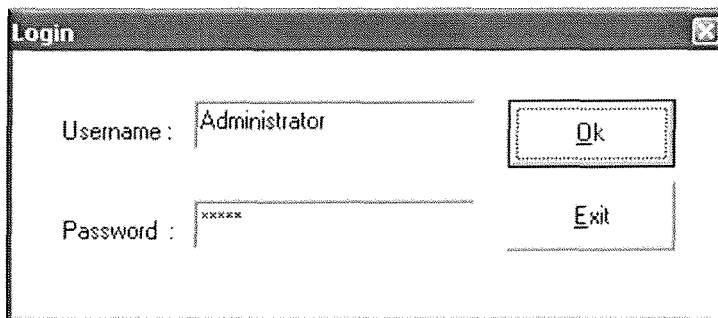


Figure H.1. Interface Design of Login Screen.

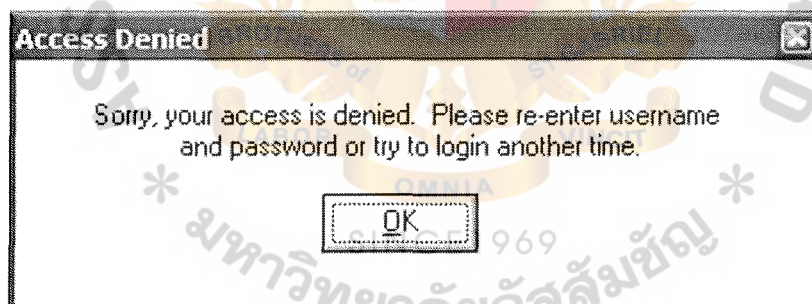


Figure H.2. Interface Design of Invalid User Login.

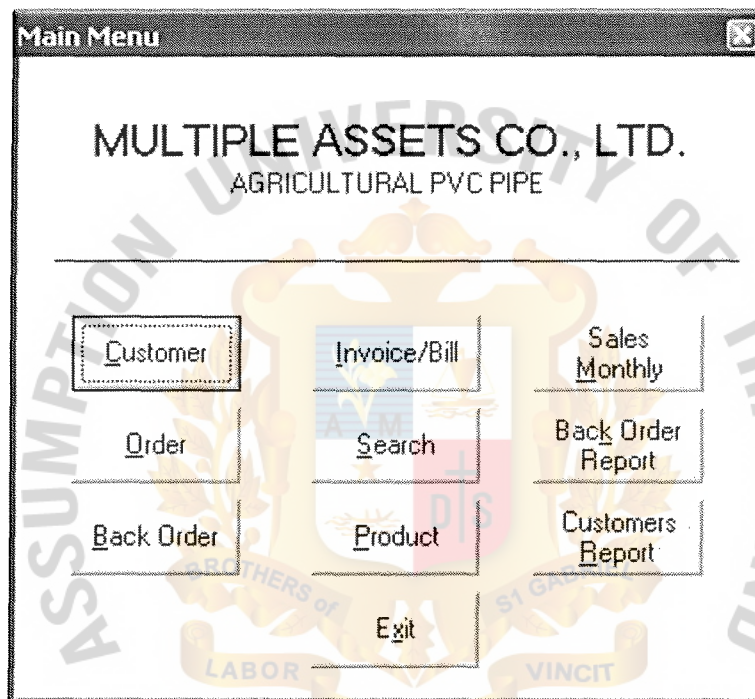


Figure H.3. Interface Design of Main Menu.

New Register

Customer ID : C200318101 Register Date : 17 October 2003

Customer Name : บริษัท โซคไพศาล การเกษตร จำกัด

Contact Person : คุณธงชัย สืบสุนทร

Address : 15/2 หมู่ 3 ตำบลตึกชัย อำเภอโคกพระ
จังหวัดสระแก้ว

Telephone No. : 037 221456 Terms of Payment

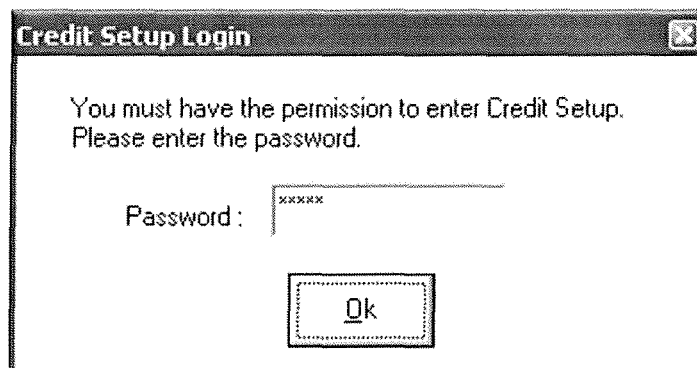
Mobile Phone No. : 01 9301143 ☒ Cash ☐ 30 Days

Fax No. : 037 221431 ☐ 10 Days ☐ 45 Days

☐ 15 Days ☐ 60 Days

Set Credit **Add** Save Print Exit

Figure H.4. Interface Design of New Registration Screen.

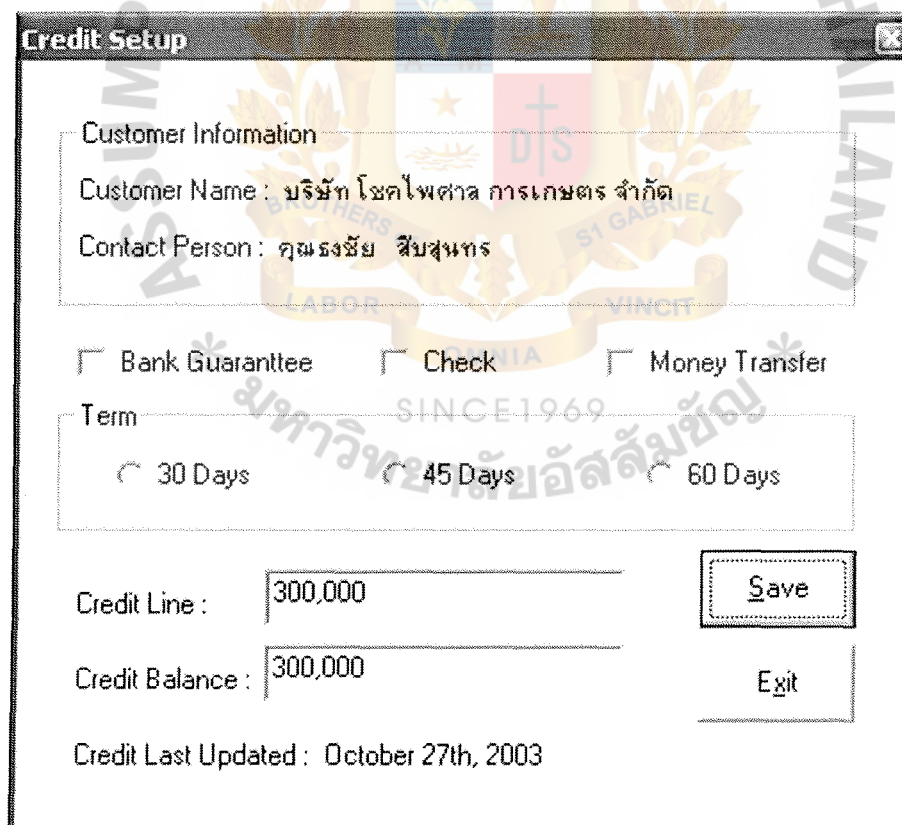


Credit Setup Login

You must have the permission to enter Credit Setup.
Please enter the password.

Password :

Figure H.5. Interface Design of Credit Setup Login.



Credit Setup

Customer Information

Customer Name : บริษัท โซคไฟศาล การเกษตร จำกัด

Contact Person : คุณธงชัย ชินสุนทร

☐ Bank Guarantee ☐ Check ☐ Money Transfer

Term

☐ 30 Days ☐ 45 Days ☐ 60 Days

Credit Line :

Credit Balance :

Credit Last Updated : October 27th, 2003

Figure H.6. Interface Design of Credit Setup.

Order

Customer ID : C2003181001
Delivery Date : 21 October 2003

Customer Information
Customer Name : บริษัท โซลโฟศาล การเกษตร จำกัด
Contact Person : คุณธงชัย ชื่นสุนทร
Address : 15/2 หมู่ 3 ตำบลตึกชัย อำเภอโคกพระโค่น จังหวัดสระแก้ว
Telephone No : 037 - 221456
Mobile Phone No. : 01 - 9301143
Fax No. : 037 - 221431

Customer Credit Record
Credit Line : 500,000 Baht
Credit Used : 354,500 Baht
Credit Balance : 145,500 Baht
Discount : 5%

Order Description
Order No : 154/2003
P/O No. : 564/03
Invoice No : C81001/23
Billing No : CB81001/12

Products
Size : 3/4"
Quantity : 100
Add Entry
Overdraft

Inventory

Size : 3/8"	Qty. : 350
Size : 1/2"	Qty. : 630
Size : 3/4"	Qty. : 450
Size : 1"	Qty. : 350
Size : 1 1/2"	Qty. : 350
Size : 2"	Qty. : 560
Size : 2 1/2"	Qty. : 890
Size : 3"	Qty. : 300
Size : 4"	Qty. : 210

1/2"	Qty. 50
3/4"	Qty. 70
1 1/2"	Qty. 130
3"	Qty. 20
4"	Qty. 30

Print
New Order
Save
Exit

Order must be printed out before you can exit

Figure H.7. Interface Design of Order Screen.

Back Order

Customer ID : C2003181001 Delivery Date : 21 October 2003

Customer Information

Customer Name : บริษัท โชคไพศาล การเกษตร จำกัด
Contact Person : คุณธงชัย สืบสุนทร
Address : 15/2 หมู่ 3 ตำบลตึกชัย อำเภอโคกพระ จังหวัดสระแก้ว
Telephone No : 037 - 221456 Mobile Phone No. : 01 - 9301143
Fax No. : 037 - 221431

Customer Credit Record

Credit Line : 500,000 Baht Credit Used : 354,500 Baht
Credit Balance : 145,500 Baht Discount : 5%

Order Description

Back Order No : 154/2003
P/O No. : 564/03
Invoice No : C81001/23
Billing No : CB81001/12

Products

Size : 3/4"
Quantity : 100
Add Entry Overdraft

Inventory

Size : 3/8"	Qty. : 350
Size : 1/2"	Qty. :
Size : 3/4"	Qty. :
Size : 1"	Qty. : 350
Size : 1 1/2"	Qty. :
Size : 2"	Qty. :
Size : 2 1/2"	Qty. : 890
Size : 3"	Qty. : 300
Size : 4"	Qty. : 210

1/2" Qty. 50

3/4" Qty. 70

1 1/2" Qty. 130

2" Qty. 20

Print

Save

Add Back Order

Exit

Back Order must be printed out before you can exit

Figure H.8. Interface Design of Back Order Screen.

Invoice & Billing

Invoice No. :

Start From : C80521/60 To : C80521/65

Billig No. :

Start From : CB1001/12 To : CB1001/12

Print Exit

Figure H.9. Interface Design of Generate Invoice & Billing Screen.

Search

Search by :

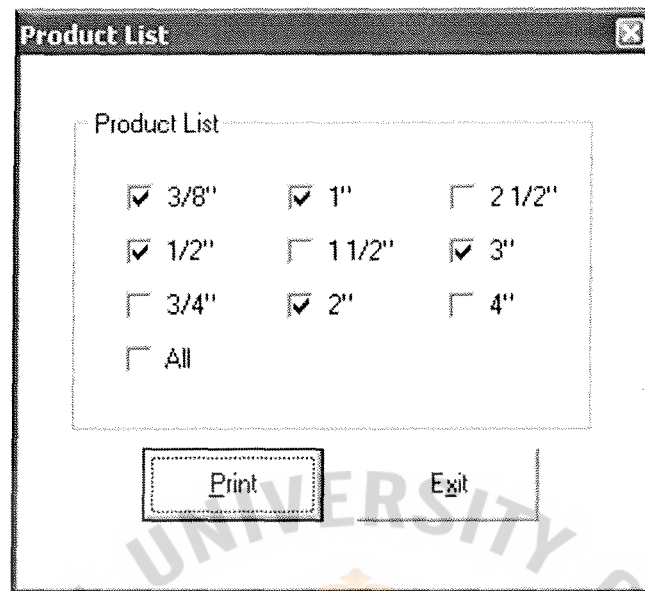
Customer ID : C2003181023

Order No :

Back Order No. :

Ok

Figure H.10. Interface Design of Search Screen.



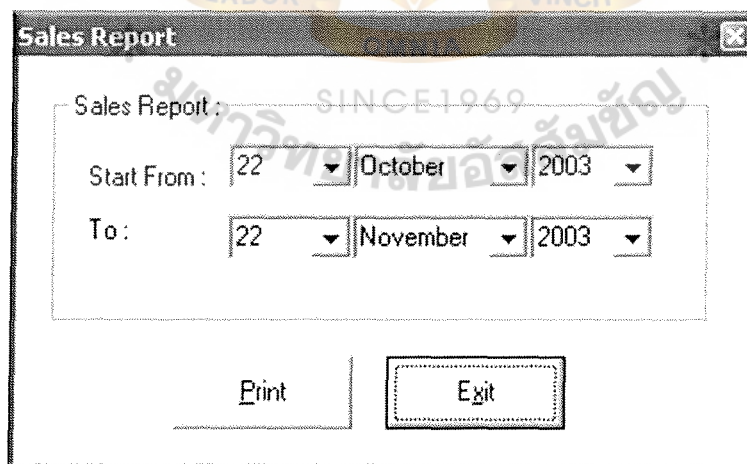
Product List

Product List

<input checked="" type="checkbox"/> 3/8"	<input checked="" type="checkbox"/> 1"	<input type="checkbox"/> 2 1/2"
<input checked="" type="checkbox"/> 1/2"	<input type="checkbox"/> 1 1/2"	<input checked="" type="checkbox"/> 3"
<input type="checkbox"/> 3/4"	<input checked="" type="checkbox"/> 2"	<input type="checkbox"/> 4"
<input type="checkbox"/> All		

Print Exit

Figure H.11. Interface Design of Product List Screen.



Sales Report

Sales Report :

Start From : 22 October 2003

To : 22 November 2003

Print Exit

Figure H.12. Interface Design of Product List Screen.

The screenshot shows a window titled "Back Order" with a close button in the top right corner. Inside the window, there is a section labeled "Back Order Report :". Below this label, there are two rows of date selection controls. The first row is labeled "Start From :" and contains three dropdown menus with values "15", "October", and "2003". The second row is labeled "To:" and contains three dropdown menus with values "17", "October", and "2003". At the bottom of the window, there are two buttons: "Print" and "Exit".

Figure H.13. Interface Design of Back Order Screen.

The screenshot shows a window titled "Customer Profile" with a close button in the top right corner. Inside the window, there is a section labeled "Customer ID". Below this label, there are two rows of text input fields. The first row is labeled "From :" and contains the text "A2003251202". The second row is labeled "To:" and contains the text "A2003251255". Below these input fields, there are four checkboxes with labels: "A - Class" (checked), "B - Class", "C - Class", and "All". At the bottom of the window, there are two buttons: "Print" and "Exit".

Figure H.14. Interface Design of Customer Report.

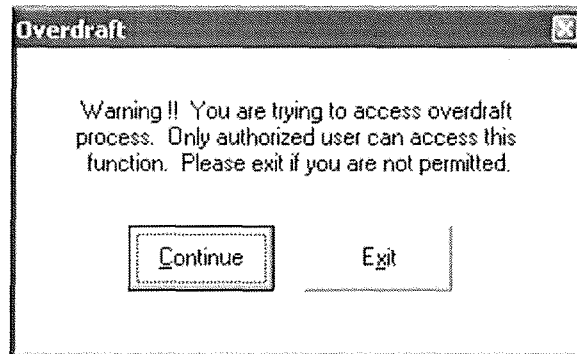


Figure H.15. Interface Design of Overdraft Screen.



Figure H.16. Interface Design of Overdraft Login Screen.



APPENDIX I

REPORT DESIGN

CUSTOMER PROFILE

Customer ID	Name	Contact Person	Address	Tel. No.	Mobile No.	Fax. No.	TOTAL : 6
C2003181001	บริษัท ไซเคไฟศาล การเกษตร จำกัด	นายธงชัย สืบสมุทร	15/2 หมู่ 2 ตำบลดักชัย อำเภอโคกโพธิ์ไชย จังหวัด สระแก้ว	037 - 221 - 456	01 - 863 - 4741	037 - 221 - 431	
	Credit Line : 500,000	Credit Used : 345,500	Credit Balance : 145,500	Total Sales : 250,300			
C200315052	บริษัท ไชยราชา พืชผล จำกัด	นายไพฑูรย์ ยะปะดัง	37/7 ต. เขาสอยดาว อ.เขาสอยดาว จ.สระบุรี จังหวัด จันทบุรี	039 - 456 - 477	01 - 844 - 3674	039 - 456 - 479	
	Credit Line : 500,000	Credit Used : 40,500	Credit Balance : 459,500	Total Sales : 782,300			
A199924111	บริษัท กลุ่มงาน ลอ พาณิชย์ จำกัด	นายสมศักดิ์ วิศรวงศ์	1751 พหลโยธิน 25 ถนนพหลโยธิน ลาดยาว จตุจักร กรุงเทพฯ	02 - 930 - 1143	01 - 322 - 8989	02 - 511 - 1030	
	Credit Line : 1500,000	Credit Used : 645,500	Credit Balance : 854,500	Total Sales : 22,250,300			
B200116132	บริษัท บางกอกเจริญ พืชไร่ จำกัด	นายพิเชษฐ์ สิงห์วัฒนากุล	23/9 ตำบล ท่าเรือ อำเภอท่าแ อยุธยา	033 - 651 - 752	01 - 485 - 5564	033 - 651 - 750	
	Credit Line : 1,000,000	Credit Used : 755,500	Credit Balance : 244,500	Total Sales : 12,890,300			

Figure I.1. Customer Report.

PRODUCT REPORT

Product Code	Description	Quantity	Product Details	
			Weight	Price
4380	4 Meters of PVC pipe with 3/8" Diameter	1550	0.45 * 50	400.00
4120	4 Meters of PVC pipe with 1/2" Diameter	1450	0.55 * 50	488.00
4340	4 Meters of PVC pipe with 3/4" Diameter	2450	0.62 * 50	552.00
4100	4 Meters of PVC pipe with 1" Diameter	2150	0.75 * 50	670.00
4112	4 Meters of PVC pipe with 1 1/2" Diameter	2450	1.15 * 50	1,025.00
4200	4 Meters of PVC pipe with 2" Diameter	2350	1.50 * 50	1,350.00
4212	4 Meters of PVC pipe with 2 1/2" Diameter	1950	1.80 * 50	1,600.00
4300	4 Meters of PVC pipe with 3" Diameter	450	2.10 * 50	1,870.00
4400	4 Meters of PVC pipe with 4" Diameter	600	2.75 * 50	2,450.00
Total		15400		

TOTAL : 09

Figure I.2. Product Report.

SALES REPORT

FROM : May 1, 2003 TO : May 31, 2003

Invoice No.	Customer ID	Name	Net Amount
C81001/23	C200318101	บริษัท ไชยไพศาล การเกษตร จำกัด	68,500.00
C81002/23	C200315052	บริษัท ไชยราชา พืชผล จำกัด	48,200.00
C81003/23	B200214132	ห้างหุ้นส่วน สหพัฒน์ การเกษตร	195,650.00
C81004/23	A200019052	ห้างหุ้นส่วน ขลาลัย	567,000.00
C81005/23	A199924111	บริษัท กลุ่มงาน ลอ พณิชย์ จำกัด	760,000.00
C81006/23	B200116132	บริษัท บางกอกเจริญ พืชไร่ จำกัด	87,500.00
C81007/23	B200218122	บริษัท ทศภาค การเกษตร จำกัด	64,870.00
C81008/23	B200260832	ห้างหุ้นส่วน เกียจัน จำกัด	98,450.00
C81009/23	A199812051	บริษัท น.มาดี จำกัด	384,500.00
C81010/23	C200301042	ร้าน ก.เจริญ ค้าพืช	22,450.00
TOTAL : 10			2,297,120.00

Figure I.3. Sales Report.

ORDER REPORT

FROM : October 1, 2003 TO : October 10, 2003

Customer ID	Name	Contact	Order Date & Order No.	Delivery Date	Product ID	Qty.	Total Charge
C200315052	บริษัท ไทยราชา ฟิล์ม จำกัด	นายไพฑูรย์ ยะประดัง	2-ค.ค.-2003 Order No. : 171/03	8-ค.ค.-2003	4112 4200 4212 4300	500 400 450 300	27,500.00
A199924111	บริษัท กลุ่มงาน ลอ	นายสมศักดิ์ วิศรวงศ์	5-ค.ค.-2003 Order No. : 172/03	11-ค.ค.-2003	4380 4120 4120 4340	1550 1200 450 1650	52,400.00
B200116132	บริษัท บางกอกเจริญ	นายพิเชษฐ์ สิงห์วัฒนา	7-ค.ค.-2003 Order No. : 173/03	11-ค.ค.-2003	4100 4212 4380 4200	100 650 900 550	34,500.00
C2003181001	บริษัท โชคดีไพศาล	นายธงชัย สิมสุนทร	9-ค.ค.-2003 Order No. : 174/03	16-ค.ค.-2003	4200 4212 4300 4400	200 300 450 650	36,400.00
A199924111	บริษัท กลุ่มงาน ลอ	นายสมศักดิ์ วิศรวงศ์	10-ค.ค.-2003 Order No. : 175/03	15-ค.ค.-2003	4380 4400 4200 4212	350 850 900 400	36,740.00
						12800	187,540.00

Figure I.4. Order Report.

ORDER REPORT

FROM : October 1, 2003 TO : October 10, 2003

Customer ID	Name	Contact	Back Order Date & Order No.	Delivery Date	Product ID	Qty.	Total Charge
C200315052	บริษัท ไทยราชา พืชผล จำกัด	นายไพฑูรย์ ยะประดัง	2-ค.ค.-2003 Back Order No. : B16/03 Order No. : 171/03	15-ค.ค.-2003 4112 4200	750 500		
A199924111	บริษัท กลุ่มงาน ลอ	นายสมศักดิ์ วิศรวงศ์	5-ค.ค.-2003 Back Order No. : B17/03 Order No. : 172/03	20-ค.ค.-2003 4380 4120	2000 950		43,500.00
B200116132	บริษัท บางกอกเจริญ	นายพิเชษฐ์ สิงห์วัฒนา	7-ค.ค.-2003 Back Order No. : B18/03 Order No. : 173/03	23-ค.ค.-2003 4100 4212	1400 650		86,470.00
C2003181001	บริษัท ไชยไพศาล	นายธงชัย สืบสุนทร	9-ค.ค.-2003 Back Order No. : B19/03 Order No. : 174/03	24-ค.ค.-2003 4200	2050 750		83,050.00
A199924111	บริษัท กลุ่มงาน ลอ	นายสมศักดิ์ วิศรวงศ์	10-ค.ค.-2003 Back Order No. : B20/03 Order No. : 175/03	25-ค.ค.-2003 4380 4400	6100		48,000.00
					6100		81,500.00
					13100		342,520.00

Figure I.5. Back Order Report.

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