MEDICINE STOCK MANAGEMENT SYSTEM IN COMMUNITY HOSPITAL

by

Ms. Chintana Laopaisanwanitsiri

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

Submitted in Partial Fulfillment
of the Requirements for the Degree of
Master of Science
in Computer Information Systems
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Project Title   Medicine Stock Management System in Community Hospital

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Project Advisor   Asst.Prof. Ouen Pin-Ngern

Academic Year   November 2000

The Graduate School of Assumption University has approved this final report of the three-credit course, CS 6998 System Development Project, submitted in partial fulfillment of the requirements for the degree of Master of Science in Computer Information System.

Approval Committee:

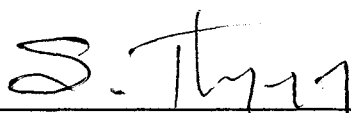_____   _____
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November 2000

ABSTRACT

This project presents the Medicine Stock Management in Ban-Sang Community Hospital. It includes analysis and design of medicine stock management system, Cost/Benefit Analysis and Benefit of a new system.
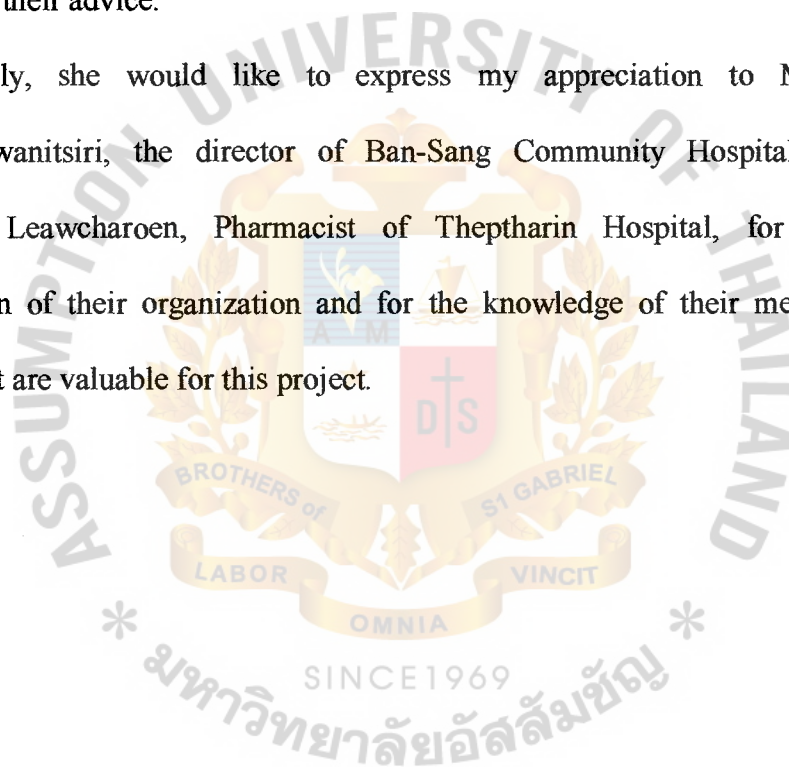
After dispensation, the pharmacist staff checks the medicine availability to ensure that it will be enough for the next dispensation. In addition, The medicine will be dispensed as FIFO (first in first out) to prevent the out dated medicine. Most of medicine stock data is stored on paper. It is time consuming to search the medicine information and balance the stock. To control an accurate medicine stock is extremely difficult; therefore, the new purposed Medicine Stock Management System will be designed to handle a massive amount of paperwork, performing repetitive and tedious tasks.

ACKNOWLEDGEMENTS

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I. INTRODUCTION

1.1 Background of the Project

The community hospital is a governmental hospital under the control of Ministry of Public Heath. It was established in Amphures around the country. It provides the health services to the people and also promote the health activities such as elderly health promotion and malarial fever protection. The capacity of the community hospital depends on the amount of people in this area. Generally, it has a 30 – 60 beds capacity.

Traditionally, the pharmacist staff in the hospital makes a medicine inventory list. This list consists of the names of medicines, batch numbers, strength, expiry date, quantity and price. As a daily work, the pharmacist staff calculates medicine fee and prepares the medicine according to the prescription. To balance the stock, the pharmacist staff will cut the stock from the prescriptions and she/he will fill the stock from observing the amount of medicine remainder in the stock and then make orders. Besides, at the end of each year, the pharmacist staff checks the stock by counting the medicine remainder and then compares with the medicine list in prescriptions.

To control an accurate dispensing medicine record, calculating medicine fees and reducing paperwork is extremely difficult. It is necessary to automate the dispensation process, so that the medicine stock can be managed and controlled effectively. The automated system will ensure that all the important information is not missing. Also, a high level of accuracy of medicine availability is maintained. By making use of computer-based information system, the difficulty of controlling and operating those tasks can be greatly reduced. In stead of having to handle massive paperwork, performing repetitive and tedious tasks, a well–designed computer information system can handle it all.

The system presented in this project is not designed for a specific organization or Ban-Sang Hospital. Rather, it aims to serve the common functions of hospital activities of medicine stock. The information processed in those activities tends to be almost the same for most small to medium size hospitals.

1.2 Objectives of the Project

Following are the broad objectives of the Medicine Stock Management System in a Community Hospital:

(1) Study the existing system of medicine stock in Ban-Sang Community hospital.

(2) Identify the problems and determine the user's requirement in managing the stock.

(3) Design the medicine stock system to assist the pharmacist in managing and controlling the medicine availability.

(4) Design the automate system to assist the pharmacist in calculating medicine fees and averaging costs.

1.3 Scope of the Project

(1) Analyze and design the computerized system to manage the medicine stock.

(2) Create the database to support the dispensation and stock management.

(3) Collect the information of the medicine details such as batch number, strength, expiry date, quantity and price.

(4) Design and build the screen layout that is easy for the user to type in data.

(5) Design and build the screen layout for calculating medicine fees.

(6) Check the medicines remainder to be able to notify in case of low stock.

1.4 Deliverables

The deliverables of the project can be identified as follows:

(1) Screen layout for entering the medicine information.

    (A) Medicine Name/Commercial Name, Batch number, Date delivered of medicine, Expired date, Price, Quantity.

(2) Screen layout for entering the dispensation and automatically calculate medicine fees and average costs.

(3) Screen layout for entering the delivery medicine in order to update the stock.

(4) Medicine Purchase Order issuance.

(5) Display screen for viewing any medicine which is below the safety stock value.

(6) Display screen of dosage information.

(7) Stock transaction report.

II. EXISTING SYSTEM

2.1 Background of Ban-Sang Community Hospital

Ban-Sang Hospital is a community hospital in Prachinburi province. It is public hospital which provides public health services to the people in Prachinburi and some Nakhonnayok areas. It has been expanded to 30 beds in order to serve the rapidly increasing amount of patients.

There are seven departments in Ban-Sang Hospital in accordance with the standards of the community hospitals in Thailand. Figure 2.1 represents the organization chart of Ban-Sang Community Hospital.

Administration Department: Collect the documents and receipts for all hospital purchasing. Administer the budget, staff salary and patient payments.

Community Pharmacy Department: Dispensing drugs according to the doctors' prescription and provide counseling drug about how to use for in-patients.

Dental Public Health Department: Cure the dental problem and provide the basic knowledge about how to take care of the tooth, give correct instructions to brush the teeth.

Medical Technique Department: Examine the patients ' urine and feces. Investigate blood composition.

Nursing Care Department: Provide the initial cure or emergency cases instead of doctor. To assist the doctors work. Take care of patients such as give drug, normal saline and other solutions.

Public Heath Department: Provide training and educate people in heath, correct living life in order to improve the quality of life.

Heath Promotion Department: Promote the elders' health and educate new mothers' nursing. Provide contagious disease protection such as Malarial diseases, respiratory diseases and gastrointestinal diseases.

Figure 2.1. Organization Chart of Ban-Sang Community Hospital.

2.2 Current Problems and Areas for Improvement

The pharmacist staff that performs the medicine stock handles a number of tasks that are important to the orderly accumulation and dissemination of dispensing to appropriate patients. In managing stock process, the following difficulties arise:

(1) Balancing stock is time consuming and prone to error.

(2) Difficult to control accuracy of medicine fee calculation and cost average.

(3) Difficult to handle the medicine remainder above a safety stock limit.

(4) A lot of paper work is involved.

Although, the most highly visible duty of the pharmacist staff is to dispense medicines and to provide counseling drugs the pharmacist also maintain the medicine stock. Keeping a medicine stock procedures consists of several steps, each of which is important to efficient inventory management and the maintenance of medicine stocks. The following are the problems normally found;

(1) Balancing stock is time consuming

(2) Preparing stock report is very time consuming

(3) Error in calculation medicine fees.

(4) Error in average medicine costs.

(5) Error in handling the medicine remainder above a safety stock limit

(6) Lost of prescriptions.

To reduce the difficult tasks and problems as mentioned above, the medicine stock management is designed. It will cover the major part of dispensation, stock management and operation. The following areas will be improved;

(1) Medicine information will be kept in database, which consisted of the name, batch number, strength, expiry date, selling price, quantity and cost.

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(2) Dispensing records and Delivery Order records will be collected as database in order to balance stock and generate reports.

(3) Medicine fee will be calculated automatically to help to reduce time consumption in searching for medicine prices.

(4) A safety stock limit will be initially set in order to display a notification message.

(5) Facilitate annual medicine stock report.

2.3 Existing System

Generally, the patients are divided into 2 categories; Out-patient (OPD) and In-patient (IPD). Health care of those are slightly different. The followings are steps of both drug's health care process as day to day work.

Dispensation for Out-patient

(1) Start with a doctor issuing a prescriptions to the patient. Then, the patient will produce that prescription at Dispensary Counter.

(2) At the Dispensary Counter, the pharmacist staff will separate the copy of prescription. Send one copy to calculate medicine fees and the other to prepare the medicine.

(3) To calculate medicine fees, the pharmacist staff will look up the prices from the book and then multiply its price by its quantities. Finally summarize the total money and write down the prescription and then passes it to the Payment Counter.

(4) To dispense the medicine, the pharmacist staff dispenses according to the prescription list. If there is not enough medicine available at the counter, it can be ordered from the stock. If there is no available stock, it will be

borrowed from the nearest hospital and then make an order for that medicine later.

(5) The pharmacist staff will pass a prescription, which completely calculates medicine fees to the Payment Counter. The officer at the Payment counter will add other fees such as doctors' fees and medical equipment fees. Then the officer will call the patient to pay the money. After receiving the money, the officer will issue the receipt to the patient.

(6) The patients' name will be called from Dispensary Counter. The patient name called will have to show the receipt before getting medicines.

(7) At the end of each period, the pharmacist staff will collect the prescription and balance the stock

Dispensation for Out-patient is represented by the work flow in Figure 2.2.
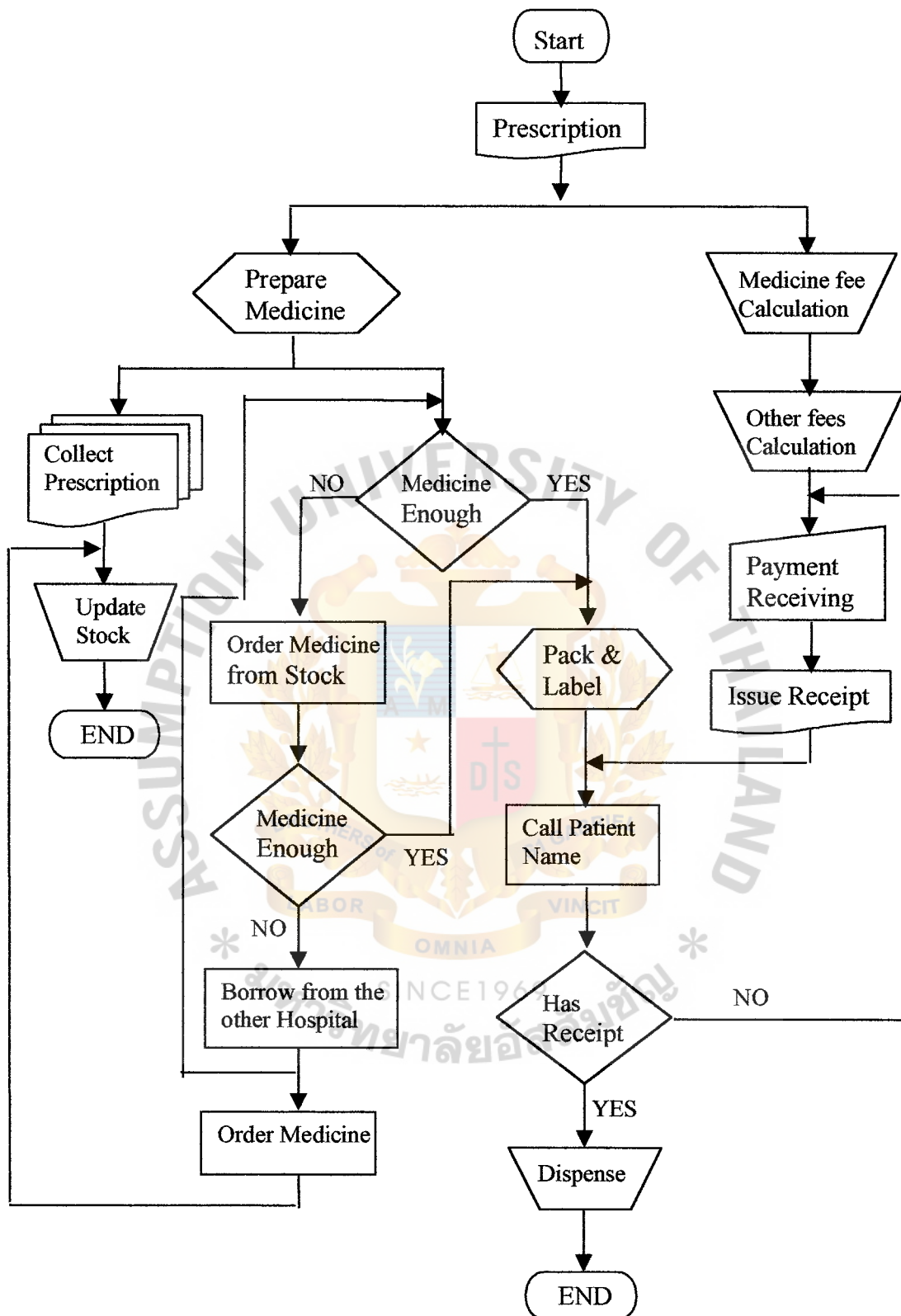
Figure 2.2. Dispensation Flowchart for Out-patient.

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Dispensation for In-patient.

(1)   A nurse will look at the patient 's chart and note the medicines that will be taken each day and then pass the note to Dispensation Counter.

(2)   At dispensary counter, the pharmacist staff dispenses the medicines and keeps one copy and sends the other back to the nurse.

(3)   If there is not enough medicine in the stock, it will be borrowed from the nearest hospital and then make an order later.

(4)   The medicine will be dispensed daily. There is no stock in the ward.

(5)   In-patients do not pay immediately but they are given credits term to pay at any given period. Therefore, pharmacist staff will collect bills till the due date.

Dispensation for Out-patient is represented by the work flow in Figure 2.3.
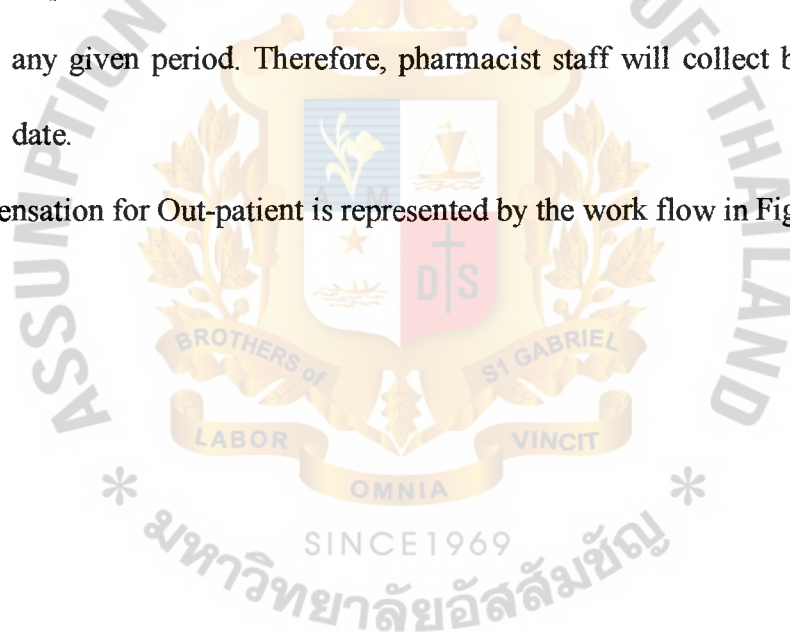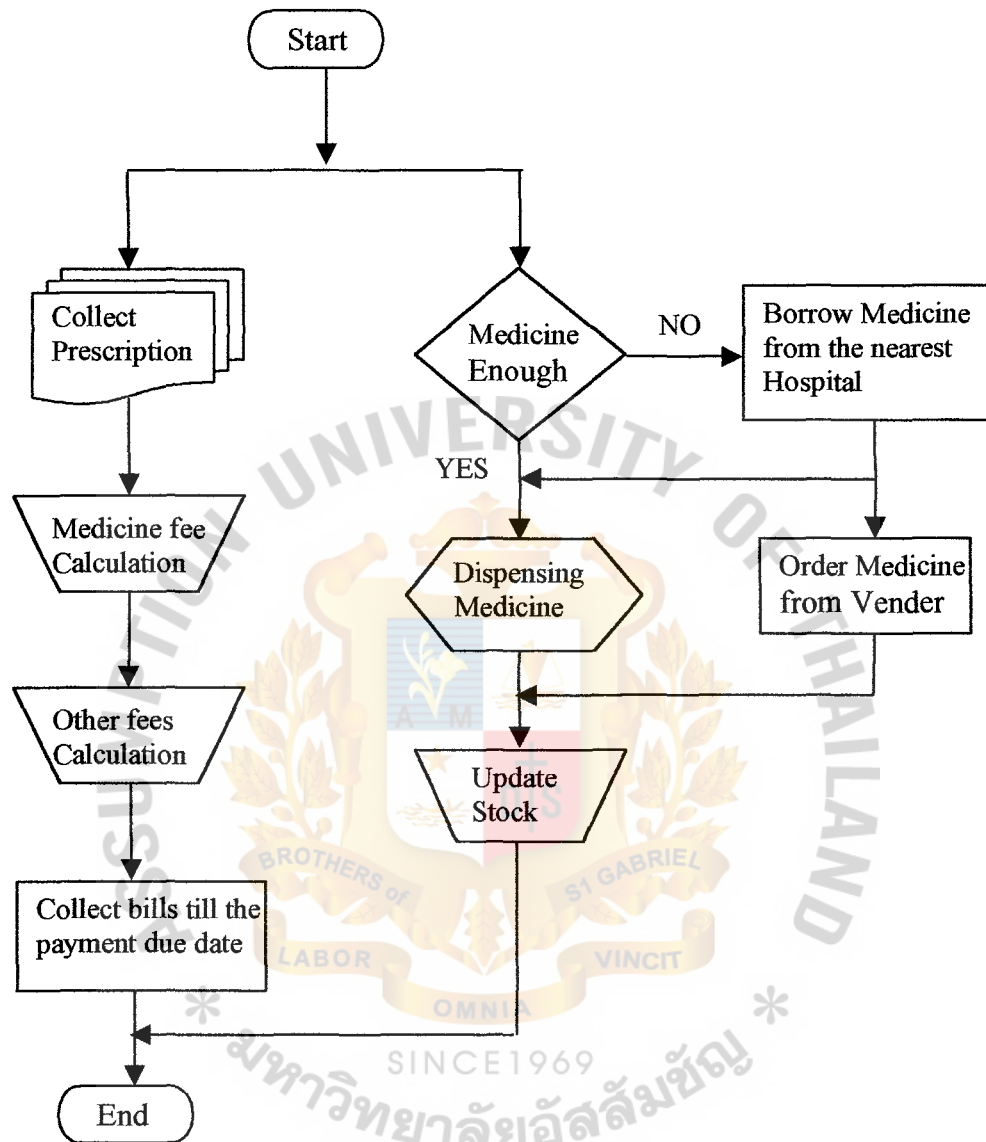
Figure 2.3.   Dispensation Flowchart for In-Patient.

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There is only one computer in Community Pharmacy Department. It is used to calculate medicine availability in the stock. It is not a real time calculation. Pharmacist staff will add the stock with the amount of delivered medicine and he will deduct the stock with the collected dispensing record. Figure 2.4 represents the whole network configuration of the hospital. Only those computers in Public Health Department and Health Promoting Department are connected with each other. The rest stand alone in computers.
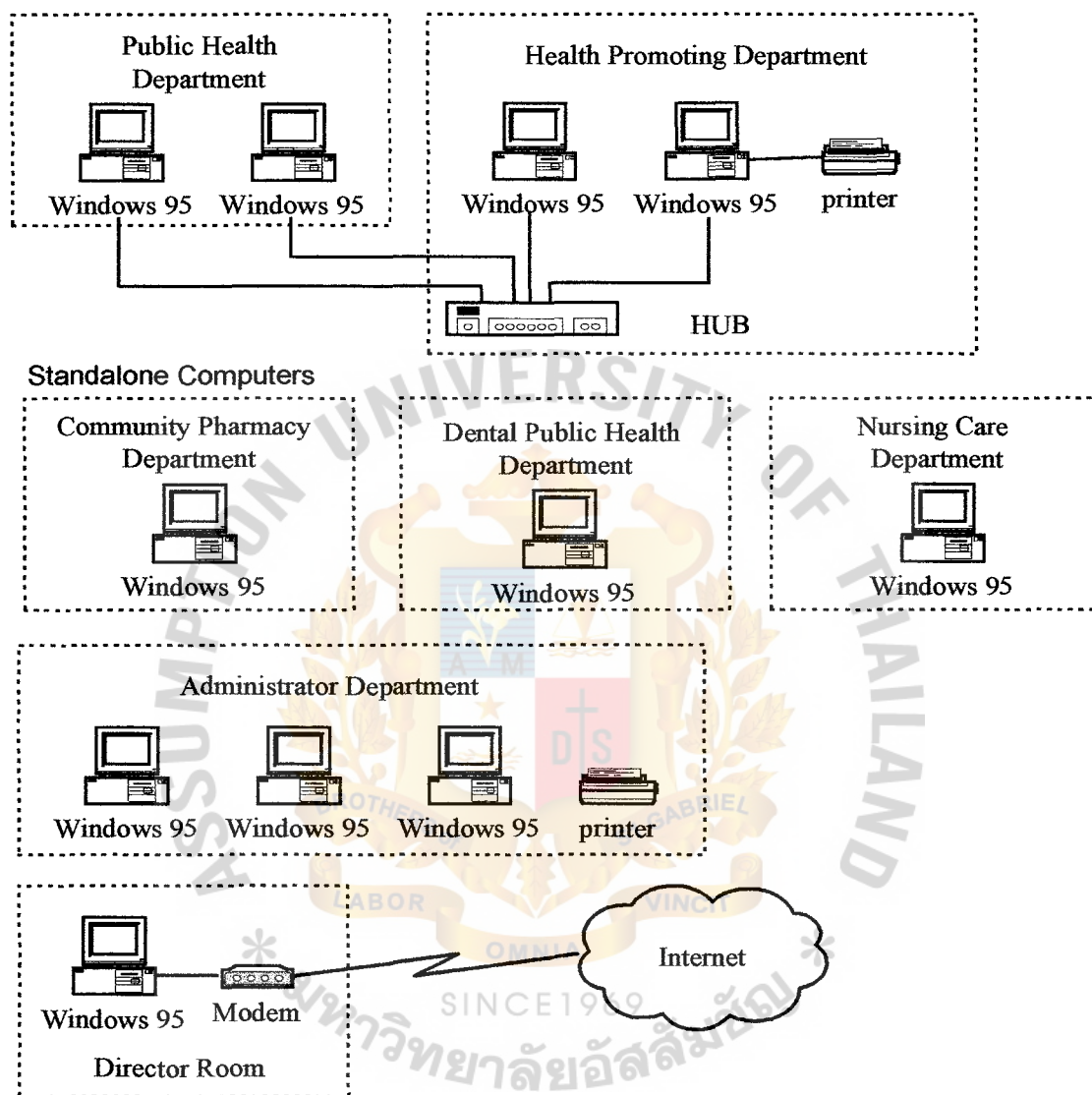
Figure 2.4.   Existing Computer System of Ban Sang Hospital.

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III. PROPOSED SYSTEM

3.1 User Requirements

The purpose of Medicine Stock Management System is to computerize medicine availability in the stock and to maintain information needed for the pharmacist supervisor and director. This includes dispensing record, medicine fee calculation, medicine stock and generating report. The following are the basic requirements for the stock management;

(1) Be able to store dispensing records, information and stock inventory list.

(2) Can calculate the medicine fee and its average cost, correctly.

(3) Increase the efficiency of medicine availability management.

(4) Reduce the time consumed to balance the stock and generate report.

(5) Reduce the documentation and paper works.

(6) Enhance the dispensation services to the patients.

(7) Provide the medicine information look up and stock status review.

Given the users' requirements, we have to identify the alternative solutions. There are three candidate solutions; Candidate1, Candidate2 and Candidiate3. A matrix is able to help capture, organize and compare the characteristics for candidate solutions. Table 3.1 represents Partially Completed Candidate Matrix.

Candidate 1: Purchase ABX Software package, which is generally used in big hospitals. It is so complex and has many features. It can serve almost all users' requirements.

Candidate 2: Purchase the package software from the Software house. This package software will not cover users' requirements. However, we can ask Software House to additionally design beyond its existing functions.

Candidate3: Design the new system that will cover all users' requirements, it will

have We can customize the functions and can build a needed report.

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Table 3.1. Partially Completed Candidate Matrix.

Characteristic	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	Medicine availability in the stock and medicine fee calculation. Dispensation report and stock report.	Medicine availability in the stock and medicine fee calculation.	Same as candidate 1.
Benefits: Brief description of the business benefits that would be realized for this candidate	This solution can implemented quickly because it is a purchased solution.	This solution can implement quite quickly.	Fully support users required business processes.
Servers and Workstation: Software tools needed to design and build the candidate. Not generally applicable if applications software packages are to be purchased.	Technically architecture dictates Pentium III, MS Windows NT, and MS Windows NT workstation or MS Windows 98.	Technically architecture dictates Pentium III but the capacity is less than Candidate 1, MS Windows NT, and MS Windows NT workstation or MS Windows 98.	Same as Candidate 2.
Application Software: A description of the software to be purchased, build, accessed, or some combination of these techniques.	Page Solution.	Custom Solution.	Same as Candidate 2.
Method of Data Processing: Generally some combination of online, batch, deferred batch, remote batch and real - time	Client/Server.	Same as Candidate 1.	Same as Candidate 1.
Output Devices and Implications: A description of output devices that would be used, special output requirements.	Laser Printer, and Dot matrix Printer.	Same as Candidate 1.	Same as Candidate 1.

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Table 3.1. Partially Completed Candidate Matrix (Continue).

Characteristic	Candidate 1	Candidate 2	Candidate 3
Input Devices and Implications: A description of input methods to be used, input devices, special input requirement and input considerations	Key Board and Mouse.	Same as Candidate 1.	Same as Candidate 1.
Storage Devices and Implications: Brief description of data would be stored, what data would be accessed from existing stores, what storage media would be used.	MS SQL Server DBMS with 100GB arrayed capability.	Same as Candidate 1.	MS SQL Server DBMS with capability less than candidate 1.

Once alternative candidate solutions are defined, each candidate must be analyzed for feasibility according to their economic, operational, technical and schedule. Table 3.2 represents Partially Completed Feasibility Matrix.

The development cost, payback period and net present value of each candidate will be calculated and shown as follows:

Table 3.3, 3.4 and 3.5 represent the estimated cost, payback period and net present worth of candidate 1, respectively. Figure 3.1 represents payback period graph.

Table 3.6, 3.7 and 3.8 represent the estimated cost, payback period and net present worth of candidate 2, respectively. Figure 3.2 represents payback period graph.

Table 3.9, 3.10 and 3.11 represent the estimated cost, payback period and net present worth of candidate 3, respectively. Figure 3.3 represents payback period graph.

Partially Completed Feasibility Matrix in Table 3.2, candidate 3 will be the selected solution for new medicine stock system, because Candidate 3 has the best overall combination of operational, technical, economic, and schedule feasibility.

Table 3.2. Partially Completed Feasibility Matrix.

Feasibility Criteria	Weight	Candidate 1	Candidate 2	Candidate 3
Operation 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 user management, user and organization perspective.	30%	Fully supports user required functionality. Score : 100	Only supports medicine stock availability. The dispensation report would have to be modified to take advantage of software functionality. Score: 60	Same as Candidate 1. Score: 100
Technical Feasibility Technology. An assessment of the maturity, availability (or ability to acquire), and desirability if 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%	Company charges for installation fee and additional annual fee for technical support. Required hiring or training expertise to perform and maintain database. Score: 50	Company charges for modify some part of program and additional charge per call for technical support. Need initial training for operating users and advance training for super user. Score: 60	MS Access program is already existing. However, MS Visual Basic is additional needed. Need initial MS Access training for operating users. MS VB training is a must for system admin. Score: 70

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Table 3.2.   Partially Completed Feasibility Matrix (Continue).

Feasibility Criteria	Weight	Candidate 1	Candidate 2	Candidate 3
Economic Feasibility Cost to Develop: Payback period (discounted): Net Present value: Detailed Calculations:	30%	1,265,000 Baht more than 7 years -1,041,017.00 Baht See Table 3.3, 3.4 and 3.5 Figure 3.1 Score: 20	225,000 Baht Approximately 4.15 years 8,983 Baht See Table 3.6,3.7 and 3.8 Figure 3.2 Score: 60	236,500 Baht Approximately 3.13 years 71,483.00 Baht See Table 3.9,3.10 and 3.11 Figure 3.3 Score: 90
Schedule Feasibility An assessment of how long the solution will take to design and implement.	10%	Less than 30 days. Score: 90	Less than 40 days. Score: 80	Less than 90 days Score: 60
Ranking	100%	60	62	84

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Table 3.3. Estimate Costs for Client/Server of Candidate 1.

Cost Items	Description	Amount	Unit Price (Baht/Hr.)	Price (Baht)
1. Development Cost				
	1.1 Personal Cost: Consultant(160 hrs./ea)	1	2,000.00	320,000.00
	Subtotal 1:			320,000.00
	1.2 New Hardware:			
	Database Server(Pentium II Class)	1	70,000.00	70,000.00
	Subtotal 2:			70,000.00
	1.3 New Software: DBMS Server Software (less than 10 users)	1	700,000.00	700,000.00
	Package Software	1	120,000.00	120,000.00
	Operating System Software	1	20,000.00	20,000.00
	Subtotal 3:			840,000.00
	1.4 Other Cost: Installation Charge	1	35,000.00	35,000.00
	Subtotal 4:			35,000.00
	Total Development Cost			1,265,000.00
2. Operating Cost:				
	2.1 Personal Cost: Technical Support	1	54,000.00	54,000.00
	Subtotal 1:			54,000.00
	2.2 Maintenance: Maintenance Agreement for Package Software		30,000.00	30,000.00
	Subtotal 2:			30,000.00
	Total Operating Cost			84,000.00
	Total Projected Annual Cost			1,349,000.00

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Table 3.4. Payback Analysis for Client/Server of Candidate 1.

Cost Items	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Development cost	1349000.00					
Operation & Maintain cost		30000.00	30000.00	35000.00	40500.00	45000.00
Discount factor 10%	1.00	0.909	0.826	0.751	0.683	0.621
Time-Adjusted costs	1349000.00	27270.00	24780.00	26285.00	27661.50	27945.00
Cumulative Time-Adjust cost	1349000.00	1376270.00	1401050.00	1427335.00	1454996.50	1482941.50
Benefits derived from operating new system	0.00	63000.00	128500.00	130500.00	137000.00	140000.00
Discount Factor 12%	1.00	0.909	0.826	0.751	0.683	0.621
Time-Adjusted Benefits	0.00	57267.00	106141.00	98005.50	93571.00	86940.00
Cumulative Time-Adjust Benefit		57267.00	163408.00	261413.50	354984.50	441924.50
Cumulative Lifetime-adjusted (Costs + Benefits)	-1349000.00	-1319003.00	-1237642.00	-1165921.50	-1100012.00	-1041017.00

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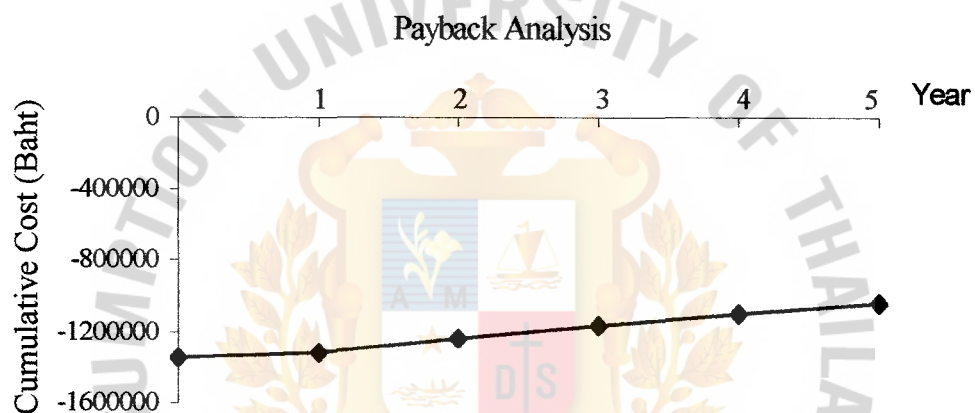
Figure 3.1.   Payback Analysis of Candidate 1.

Table 3.5. Net Present Value Analysis Client/Server of Candidate 1.

Cost Items	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Development cost (Baht)	1349000.00						
Operation & Maintain cost		30000.00	30000.00	35000.00	40500.00	45000.00	
Discount factor 10%	1.00	0.909	0.826	0.751	0.683	0.621	
Present Value of annual costs	1349000.00	27270.00	24780.00	26285.00	27661.50	27945.00	
Total present value of lifetime costs							1482941.50
Benefits derived from operating new system	0.00	63000.00	128500.00	130500.00	137000.00	140000.00	
Discount Factor 10%	1.00	0.909	0.826	0.751	0.683	0.621	
Present Value of annual Benefits	0.00	57267.00	106141.00	98005.50	93571.00	86940.00	
Total present value of lifetime benefit		57267.00	163408.00	261413.50	354984.50	441924.50	
Net Present Value of Candidate 1							-1041017.00

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Table 3.6. Estimate Costs for Client/Server of Candidate 2.

Cost Items	Description	Amount	Unit Price (Baht/Hr.)	Price (Baht)
1. Development Cost				
	1.1 Personal Cost:			
	System Analyst (100 hrs./ea)	1	400.00	40,000.00
	Programmer (100 hrs./ea)	1	200.00	20,000.00
	Subtotal 1:			60,000.00
	1.2 New Hardware:			
	Database Server(Pentium II Class)	1	70,000.00	70,000.00
	Subtotal 2:			70,000.00
	1.3 New Software:			
	Informic database Software (5 uers)	1	20,000.00	20,000.00
	Package Software	1	50,000.00	50,000.00
	Operating System Software	1	20,000.00	20,000.00
	Subtotal 3:			90,000.00
	1.4 Other Cost:			
	Installation Charge	1	5,000.00	5,000.00
	Subtotal 4:			5,000.00
	Total Development Cost			225,000.00
3. Operating Cost:				
	2.1 Personal Cost:			
	Technical Support	1	54,000.00	54,000.00
	Subtotal 1:			54,000.00
	2.2 Maintenance:			
	Maintenance Agreement for Package Software		20,000.00	20,000.00
	Subtotal 2:			20,000.00
	Total Operating Cost			74,000.00
	Total Projected Annual Cost			229,000.00

Table 3.7.   Payback Analysis for Client/Server of Candidate 2.

Cost Items	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Development cost(Baht)	299000.00					
Operation & Maintain cost		30000.00	30000.00	35000.00	40500.00	45000.00
Discount factor 10%	1.00	0.909	0.826	0.751	0.683	0.621
Time-Adjusted costs	299000.00	27270.00	24780.00	26285.00	27661.50	27945.00
Commutative Time-Adjust cost	299000.00	326270.00	351050.00	377335.00	404996.50	432941.50
Benefits derived from operating new system	0.00	63000.00	128500.00	130500.00	137000.00	140000.00
Discount Factor 12%	1.00	0.909	0.826	0.751	0.683	0.621
Time-Adjusted Benefits	0.00	57267.00	106141.00	98005.50	93571.00	86940.00
Commutative Time-Adjust Benefit		57267.00	163408.00	261413.50	354984.50	441924.50
Commutative Lifetime-adjusted (Costs + Benefits)	-299000.00	-269003.00	-187642.00	-115921.50	-50012.00	8983.00

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Payback Analysis

Figure 3.2.   Payback Analysis of Candidate 2.

Table 3.8.   Net Present Value Analysis Client/Server of Candidate 2.

Cash Flow Description	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Development cost (Baht)	299000.00						
Operation & Maintain cost		30000.00	30000.00	35000.00	40500.00	45000.00	
Discount factor 10%	1.00	0.909	0.826	0.751	0.683	0.621	
Present Value of annual costs	299000.00	27270.00	24780.00	26285.00	27661.50	27945.00	
Total present value of lifetime costs							432941.50
Benefits derived from operating new system	0.00	63000.00	128500.00	130500.00	137000.00	140000.00	
Discount Factor 10%	1.00	0.909	0.826	0.751	0.683	0.621	
Present Value of annual Benefits	0.00	57267.00	106141.00	98005.50	93571.00	86940.00	
Total present value of lifetime benefit		57267.00	163408.00	261413.50	354984.50	441924.50	
Net Present Value of Candidate 2							8983.00

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Table 3.9.   Estimate Costs for Client/Server of Candidate 3.

Cost Items	Description		Amount	Unit Price (Baht/Hr.)	Price (Baht)
1. Development Cost					
	1.1	Personal Cost: System Analyst (100 hrs./ea)	1	400.00	40,000.00
		Programmer (100 hrs./ea)	1	200.00	20,000.00
		Subtotal 1:			60,000.00
	1.2	New Hardware:			
		Database Server(Pentium II Class)	1	70,000.00	70,000.00
		Subtotal 2:			70,000.00
	1.3	New Software:			
		MS Access Software	1	4,500.00	4,500.00
		Operating System Software	1	20,000.00	20,000.00
		Subtotal 3:			94,500.00
	1.4	Other Cost:			
		MS Visual Basic Training	1	5,000.00	5,000.00
		MS Access Training	2	5,000.00	10,000.00
		Subtotal 4:			15,000.00
	Total Development Cost				180,500.00
4. Operating Cost:					
	2.1	Personal Cost: Technical Support	1	54,000.00	54,000.00
		Subtotal 1:			54,000.00
	2.2	Maintenance: Database Server Maintenance		2,000.00	2,000.00
		Subtotal 2:			2,000.00
	Total Operating Cost				56,000.00
	Total Projected Annual Cost				236,500.00

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Table 3.10 Payback Analysis for Client/Server of Candidate 3.

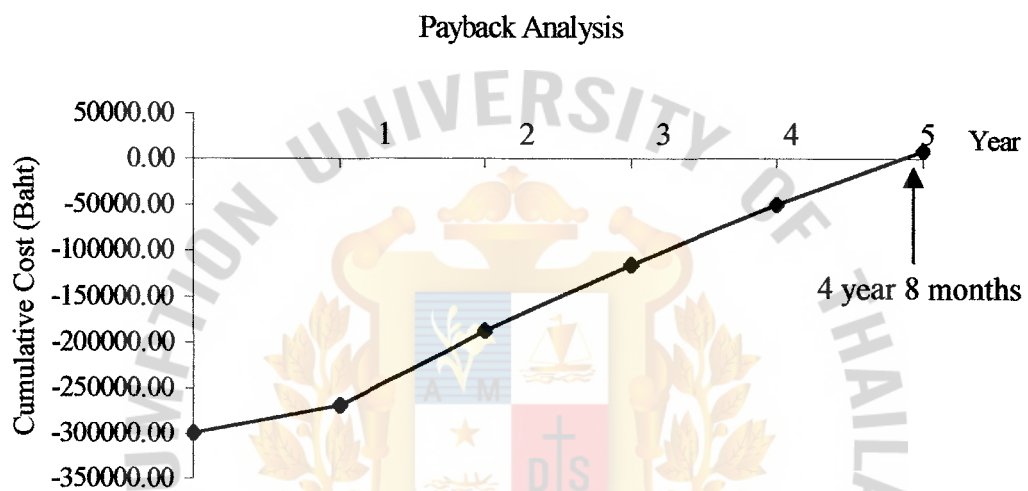| Cash Flow Description	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Development cost	236500.00					
Operation & Maintain cost		30000.00	30000.00	35000.00	40500.00	45000.00
Discount factor 10%	1.00	0.909	0.826	0.751	0.683	0.621
Time-Adjusted costs	236500.00	27270.00	24780.00	26285.00	27661.50	27945.00
Commutative Time-Adjust cost	236500.00	263770.00	288550.00	314835.00	42496.50	370441.50
Benefits derived from operating new system	0.00	63000.00	128500.00	130500.00	137000.00	140000.00
Discount Factor 12%	1.00	0.909	0.826	0.751	0.683	0.621
Time-Adjusted Benefits	0.00	57267.00	106141.00	98005.50	93571.00	86940.00
Commutative Time-Adjust Benefit		57267.00	163408.00	261413.50	354984.50	441924.50
Commutative Lifetime-adjusted (Costs + Benefits)	-271000.00	-206503.00	-125142.00	-53421.50	12488.00	71483.00

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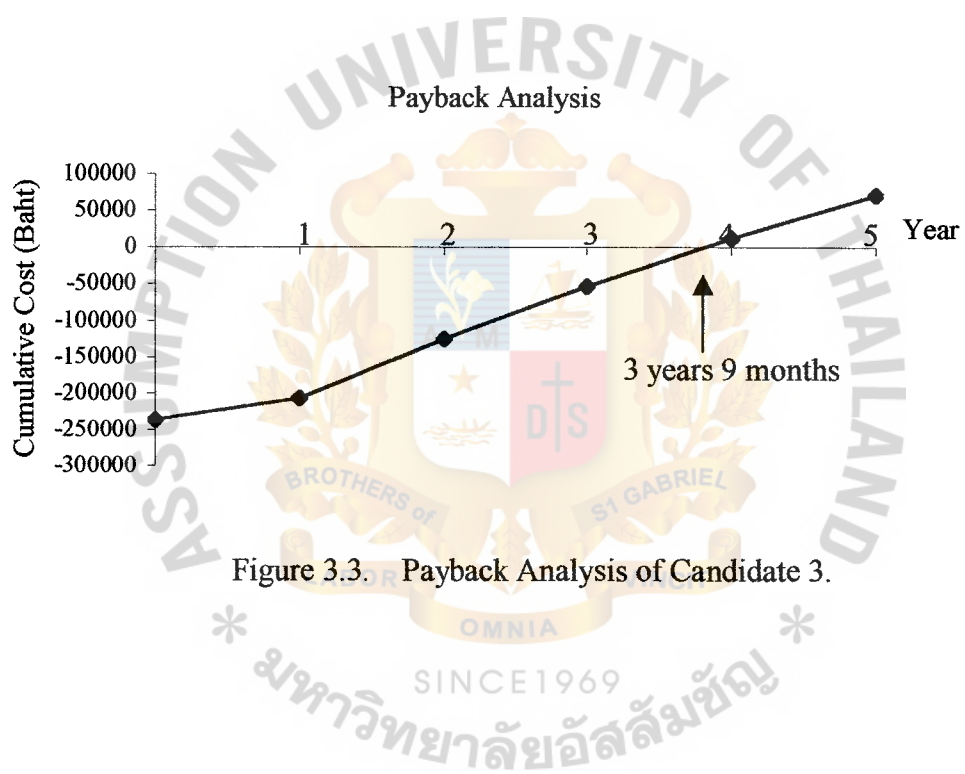
Figure 3.3.   Payback Analysis of Candidate 3.

Table 3.11. Net Present Value Analysis Client/Server of Candidate 3.

Cash Flow Description	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Development cost	236500.00						
Operation & Maintain cost		30000.00	30000.00	35000.00	40500.00	45000.00	
Discount factor 10%	1.00	0.909	0.826	0.751	0.683	0.621	
Present Value of annual costs	236500.00	27270.00	24780.00	26285.00	27661.50	27945.00	
Total present value of lifetime costs							370441.50
Benefits derived from operating new system	0.00	63000.00	128500.00	130500.00	137000.00	140000.00	
Discount Factor 10%	1.00	0.909	0.826	0.751	0.683	0.621	
Present Value of annual Benefits	0.00	57267.00	106141.00	98005.50	93571.00	86940.00	
Total present value of lifetime benefit		57267.00	163408.00	261413.50	354984.50	441924.50	
Net Present Value of Candidate 3							71483.00

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3.2 System Design

System design for this proposed Medicine Stock Management will be selected appropriately according to each criteria; Process Architecture, Network Architecture, Data Architecture and Interface Architecture.

Network Architecture: is a Two – Tiered Client/Server computing system. The system information data is stored in the server and the business logic and user interfaces are stored on client.

Data and DB Process on Server   Logic and User Interface on PC
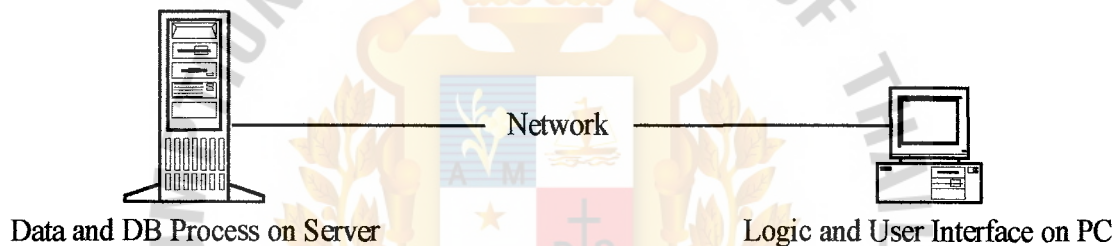
Figure 3.4.   Two-Tiered Client/Server Computing.

Data Architecture: is a relational database in which the data is stored in a tabular form. Each file is implemented as a table. Each field is a column in the table. Each record in the field is a row in the table.

Interface Architecture: is On-line processing and GUI (Graphical User Interfaces). On-line system provides for a conversational dialogue between the user and computer.

Process Architecture: is Microsoft Access program that will be used to develop the Medicine Stock Database.

We use the DFD (Data Flow Diagram) as a tool for modeling the essential or logical business requirement. It depicts the flow of data through a system and the work

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or processing performed by that system. Figure 3.5 represents the context of data flow of the designed system. It depicts the view as a whole. Then, it is decomposed into the sub-systems as shown in Figure 3.6. Each sub-systems will display the flow of data within itself by the merging related event diagrams in Figure 3.7 to Figure 3.11. Finally, we show all the elementary processes, data stores, and data flow for single events in Figure 3.21 and Figure 3.22.

Project Name:	Medicine Inventory Management
Project Path:	c:\ban-sang\
Chart File:	dfd00001.dfd
Chart Name:	Context Data Flow Diagram
Created On:	Feb-14-2000
Created By:	Chintana L.
Modified On:	Jun-19-2000
Modified By:	Chintana L.
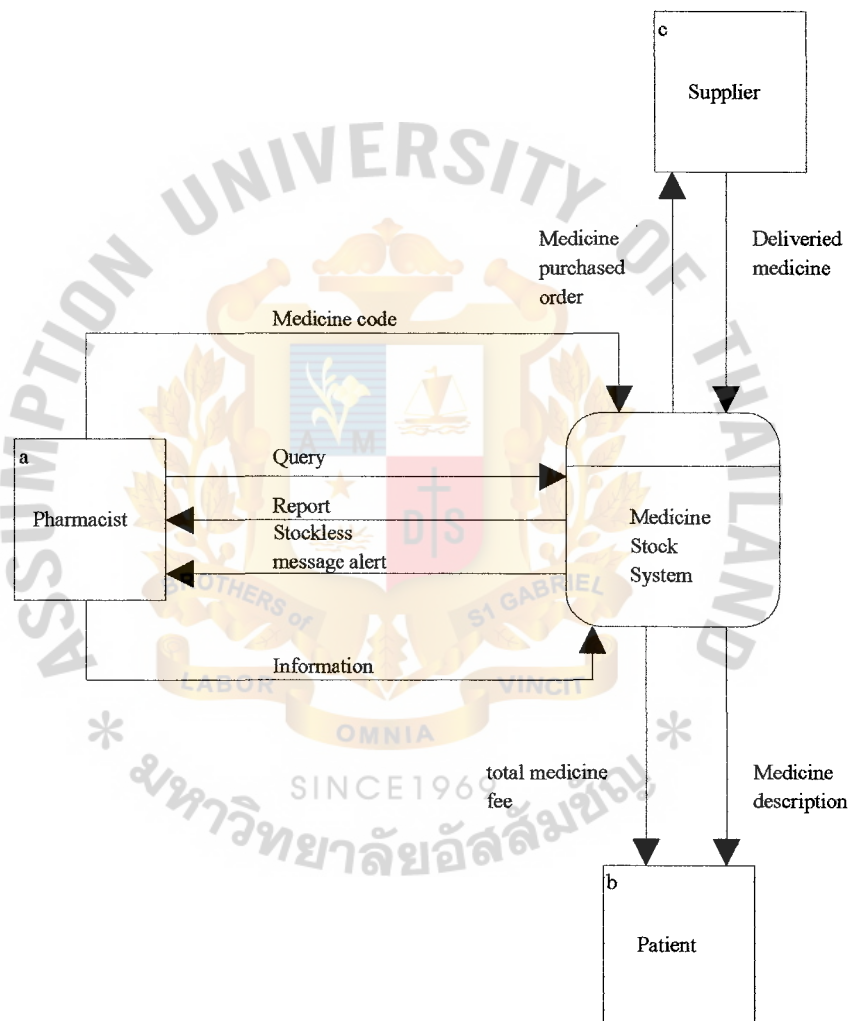
Figure 3.5. Level 0 Context DFD of Medicine Stock Management System.
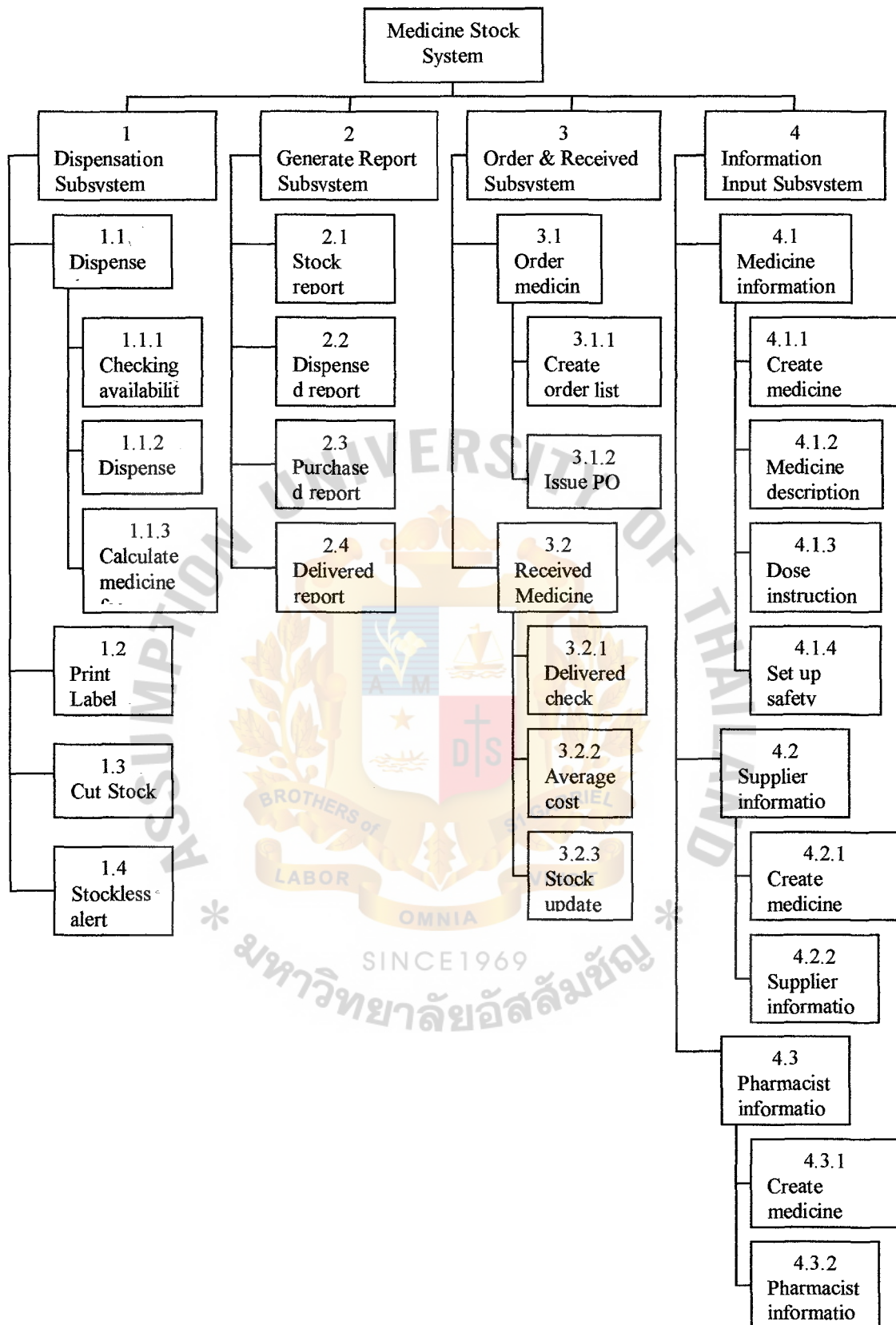
Figure 3.6.   Decomposition DFD of Medicine Stock Management System.

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```
Project Name:   Medicine Inventory Management
Project Path:   c:\ban-sang\
Chart File:     dfd00024.dfd
Chart Name:     Level 1
Created On:     Jul-20-2000
Created By:     Chintana L.
Modified On:    Jul-20-2000
Modified By:    Chintana L.
```

Figure 3.7.   Level 1 DFD of Medicine Stock Management System.
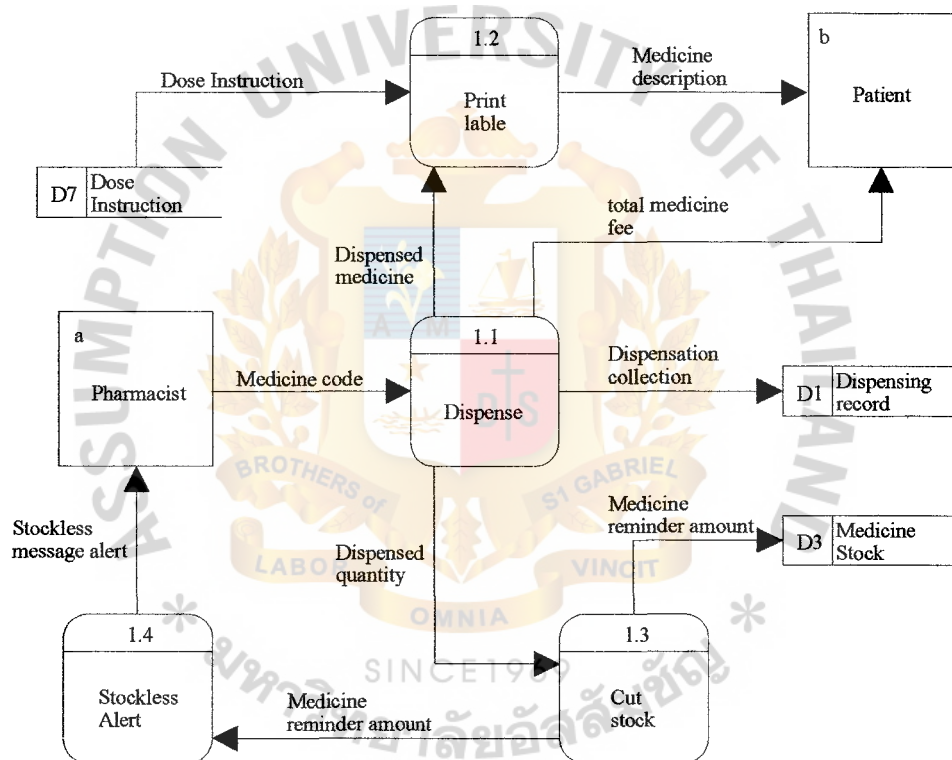
Figure 3.8.   Level 2 DFD of Dispensation Subsystem.

Figure 3.9.   Level 2 DFD of Generate Report Subsystem.

Project Name:	Medicine Inventory
Project Path:	c:\ban-sang\
Chart File:	dfd00028.dfd
Chart Name:	level 2 Order & Receive
Created On:	Jul-20-2000
Created By:	Chintana L.
Modified On:	Jul-20-2000
Modified By:	Chintana L.
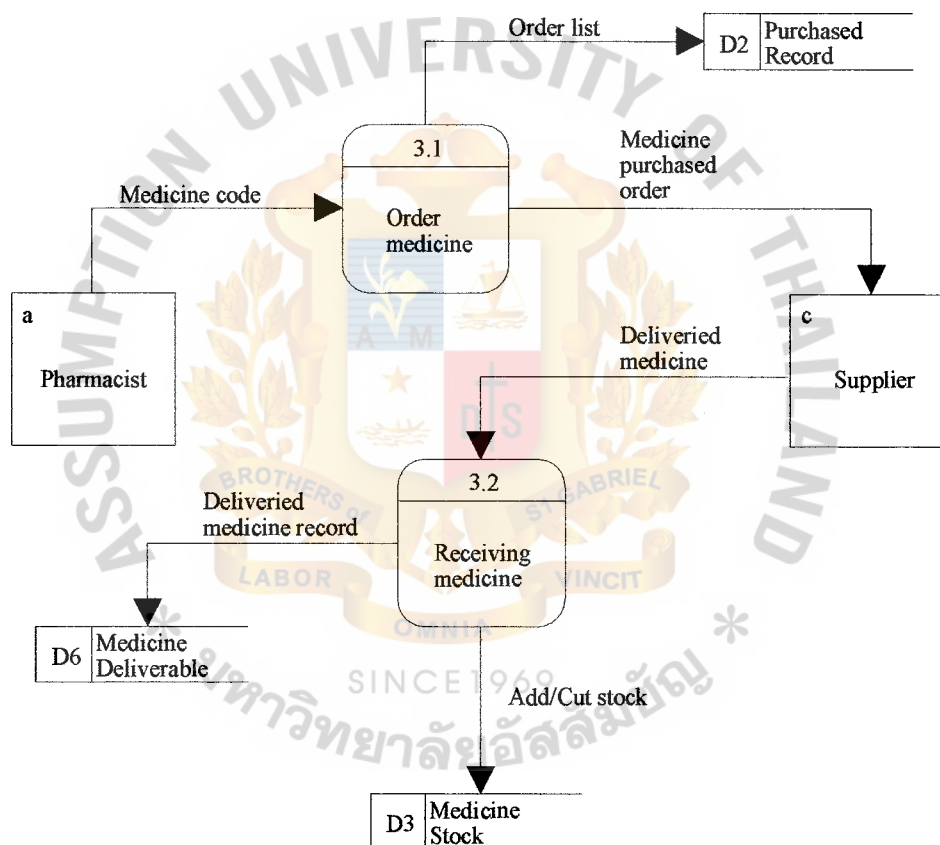
Figure 3.10.   Level 2 DFD of Order & Receive Subsystem.

Project Name: Medicine Inventory Management
Project Path: c:\ban-sang\
Chart File: dfd00029.dfd
Chart Name: Level 2 Information Input
Created On: Jul-20-2000
Created By: Chintana L.
Modified On:
Modified By:
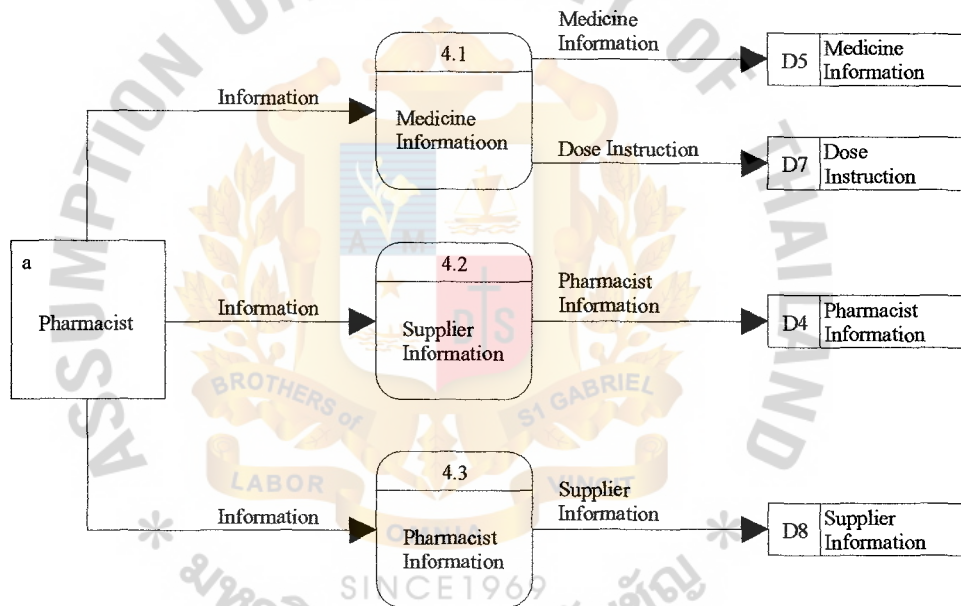
Figure 3.11. Level 2 DFD of Information Input Subsystem.

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```
Project Name:    Medicine Inventory Management
Project Path:    c:\ban-sang\
Chart File:      dfd00030.dfd
Chart Name:      Level 3 Dispensed Medicine
Created On:      Jul-21-2000
Created By:      Chintana L.
Modified On:
Modified By:
```
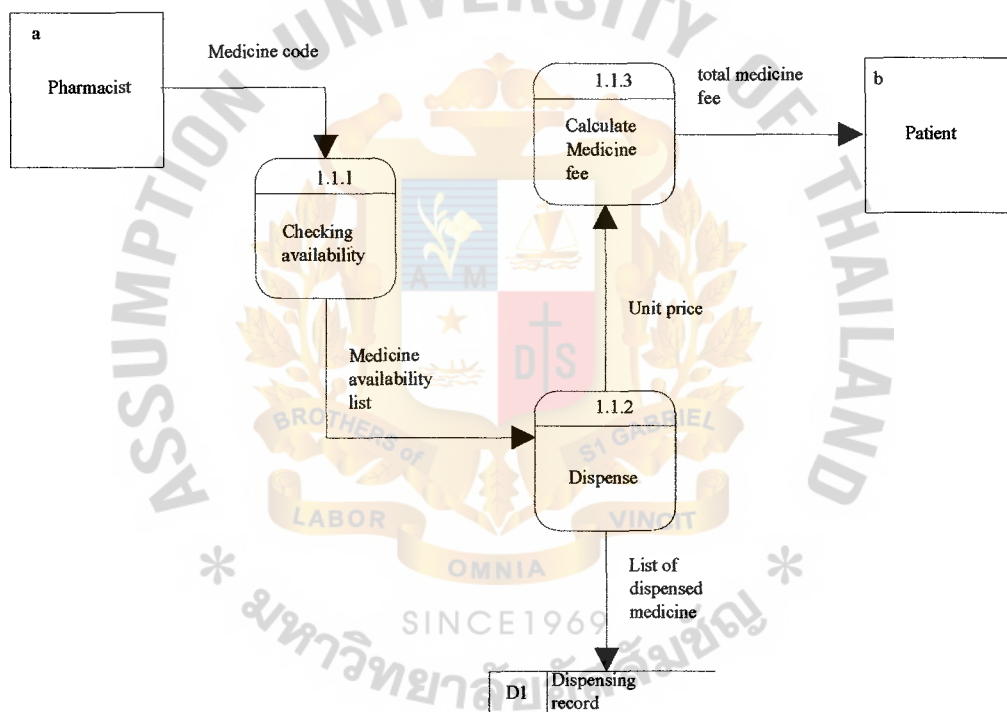

Figure 3.12.   Level 3 DFD of Dispensed Process.

Project Name:	Medicine Inventory Management
Project Path:	c:\ban-sang\
Chart File:	dfd00031.dfd
Chart Name:	Level 3 Order
Created On:	Jul-21-2000
Created By:	Chintana L.
Modified On:	Jul-21-2000
Modified By:	Chintana L.
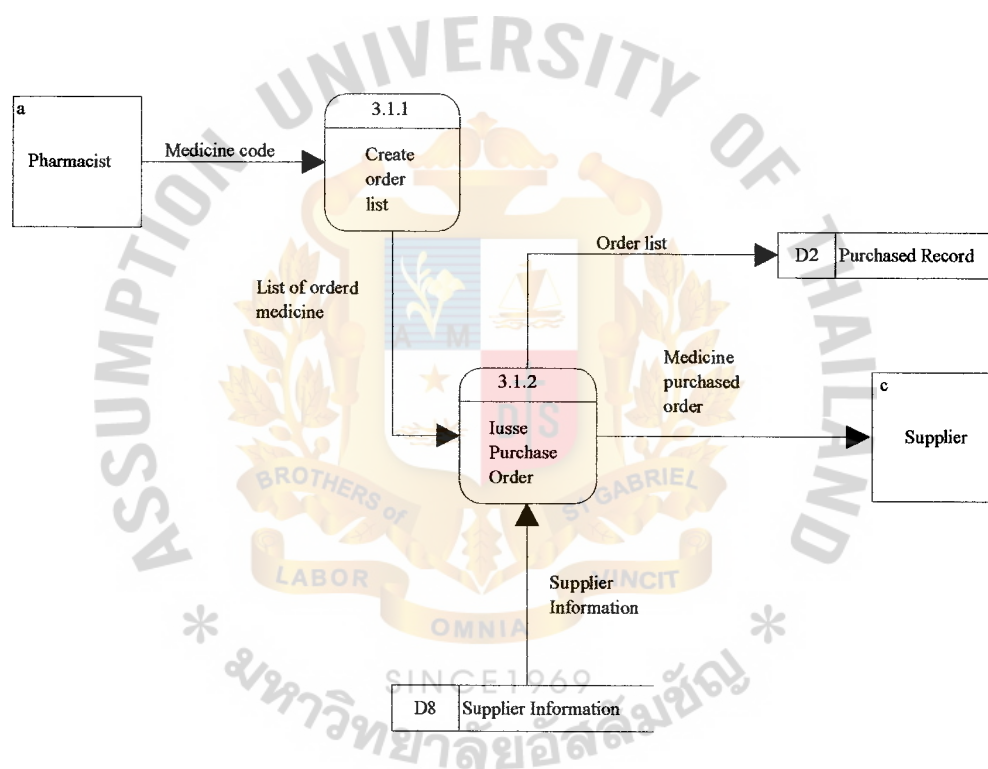
Figure 3.13.   Level 3 DFD of Order Process.

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```
Project Name:  Medicine Inventory Management
Project Path:  c:\ban-sang\
Chart File:    dfd00032.dfd
Chart Name:    Level 3 Delivered
Created On:    Jul-21-2000
Created By:    Chintana L.
Modified On:   Jul-21-2000
Modified By:   Chintana L.
```
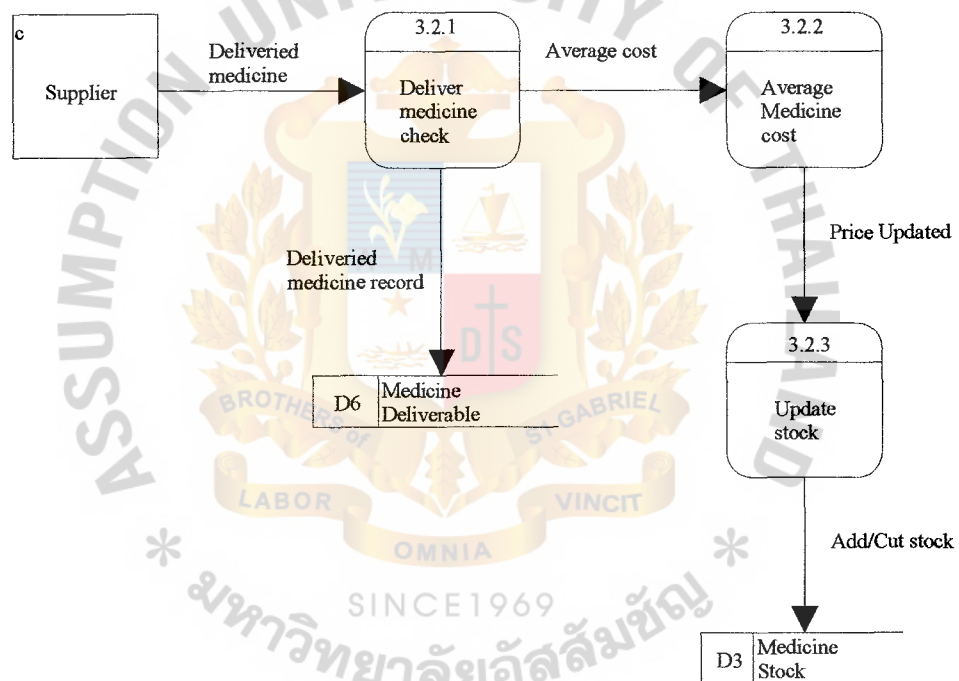

Figure 3.14.   Level 3 DFD of Received Process.

44

```
Project Name:    Medicine Inventory
Project Path:    c:\ban-sang\
Chart File:      dfd00033.dfd
Chart Name:      Level 3 Med
Created On:      Jul-21-2000
Created By:      Chintana L.
Modified On:     Jul-21-2000
Modified By:     Chintana L.
```
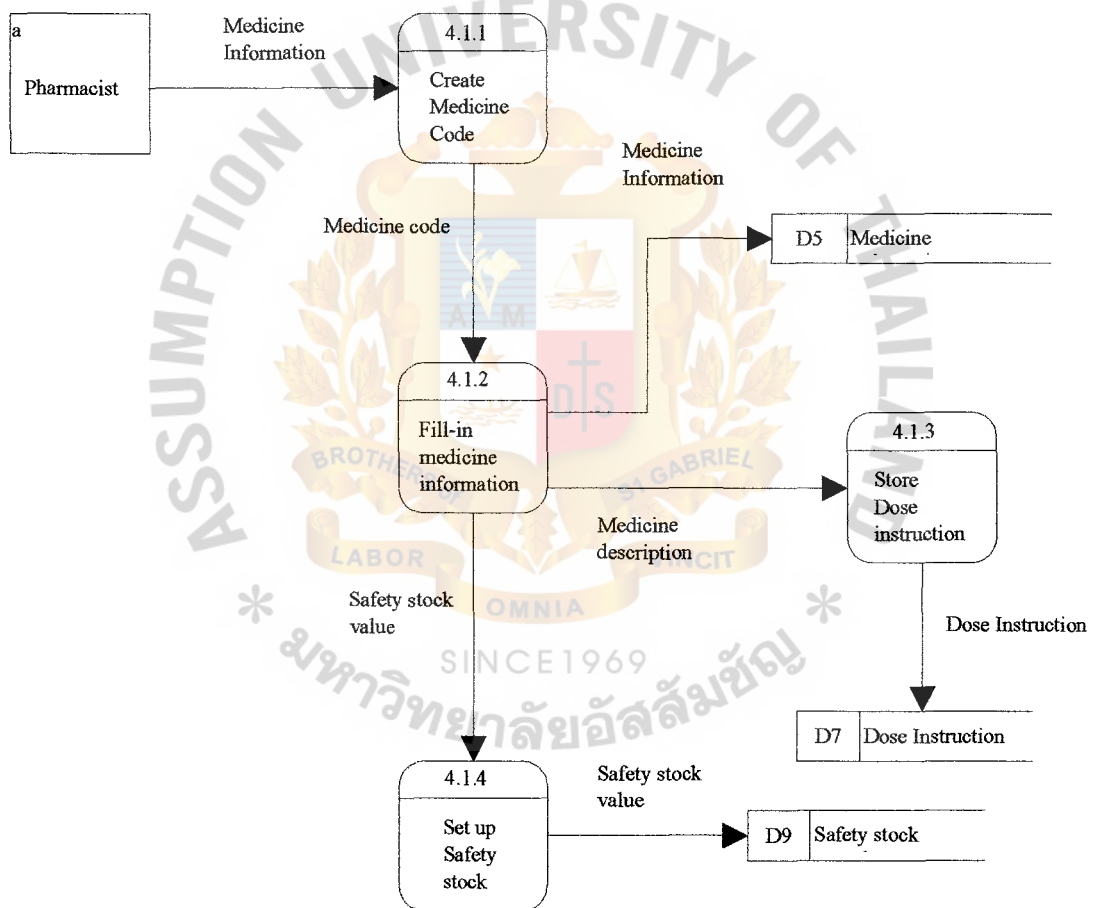

Figure 3.15.   Level 3 DFD of Medicine Information Input Process.

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Figure 3.16. Level 3 DFD of Supplier Information Input.

Project Name:	Medicine Inventory
Project Path:	c:\ban-sang\
Chart File:	dfd00035.df
Chart Name:	Level 3 Pharmacist
Created On:	Jul-21-2000
Created By:	Chintana L.
Modified On:	
Modified By:	
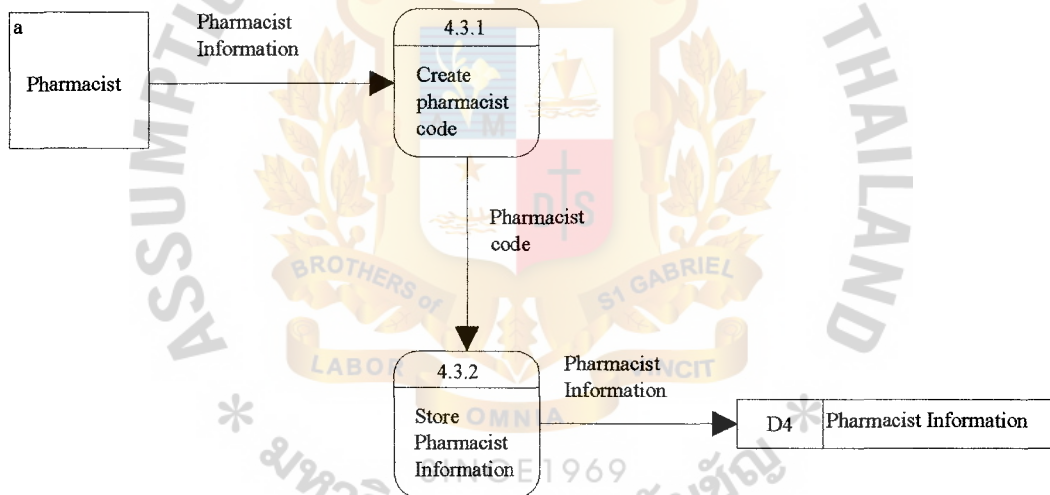
Figure 3.17.   Level 3 DFD of Pharmacist Information Input.

Figure 3.18. Level 4 DFD of Dispensation Subsystem.

```
Project Name:     Medicine Inventory Management
Project Path:     c:\ban-sang\
Chart File:       dfd00008.dfd
Chart Name:       Balance Stock Subsystem
Created On:       Apr-13-2000
Created By:       Chintana L.
Modified On:      Jul-11-2000
Modified By:      Chintana L.
```
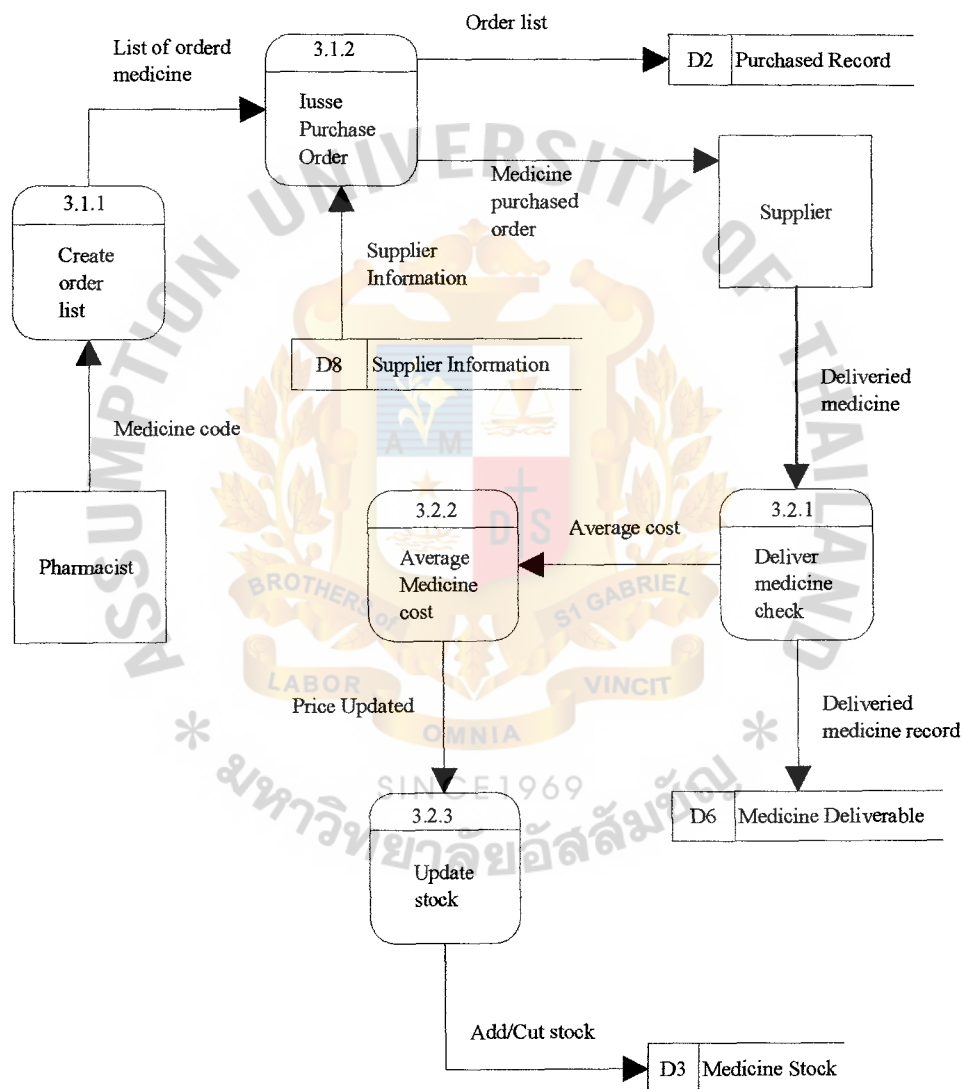

Figure 3.19.   Level 4 DFD of Order & Received Subsystem.

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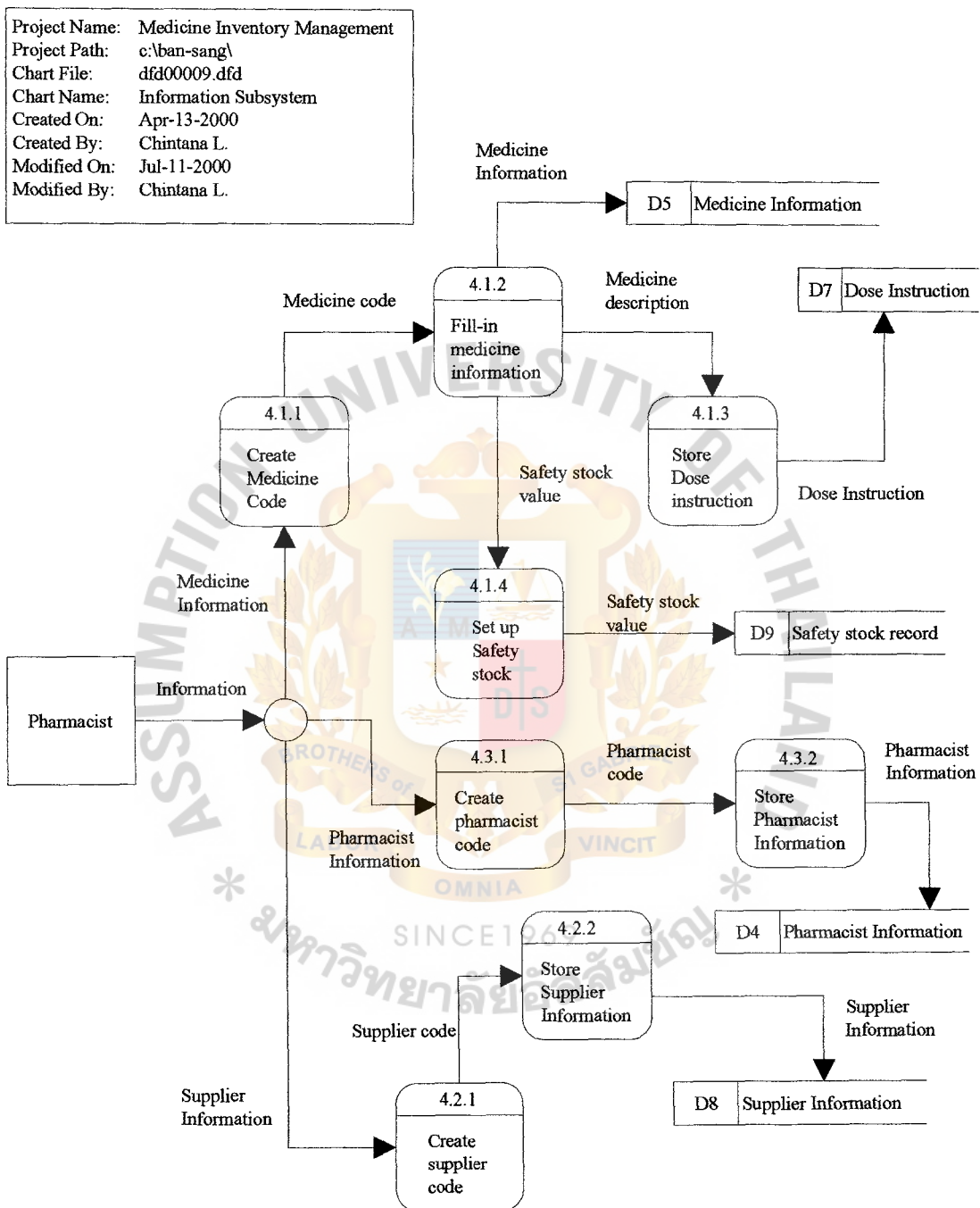
Figure 3.20.   Level 4 DFD of Information Input Subsystem.
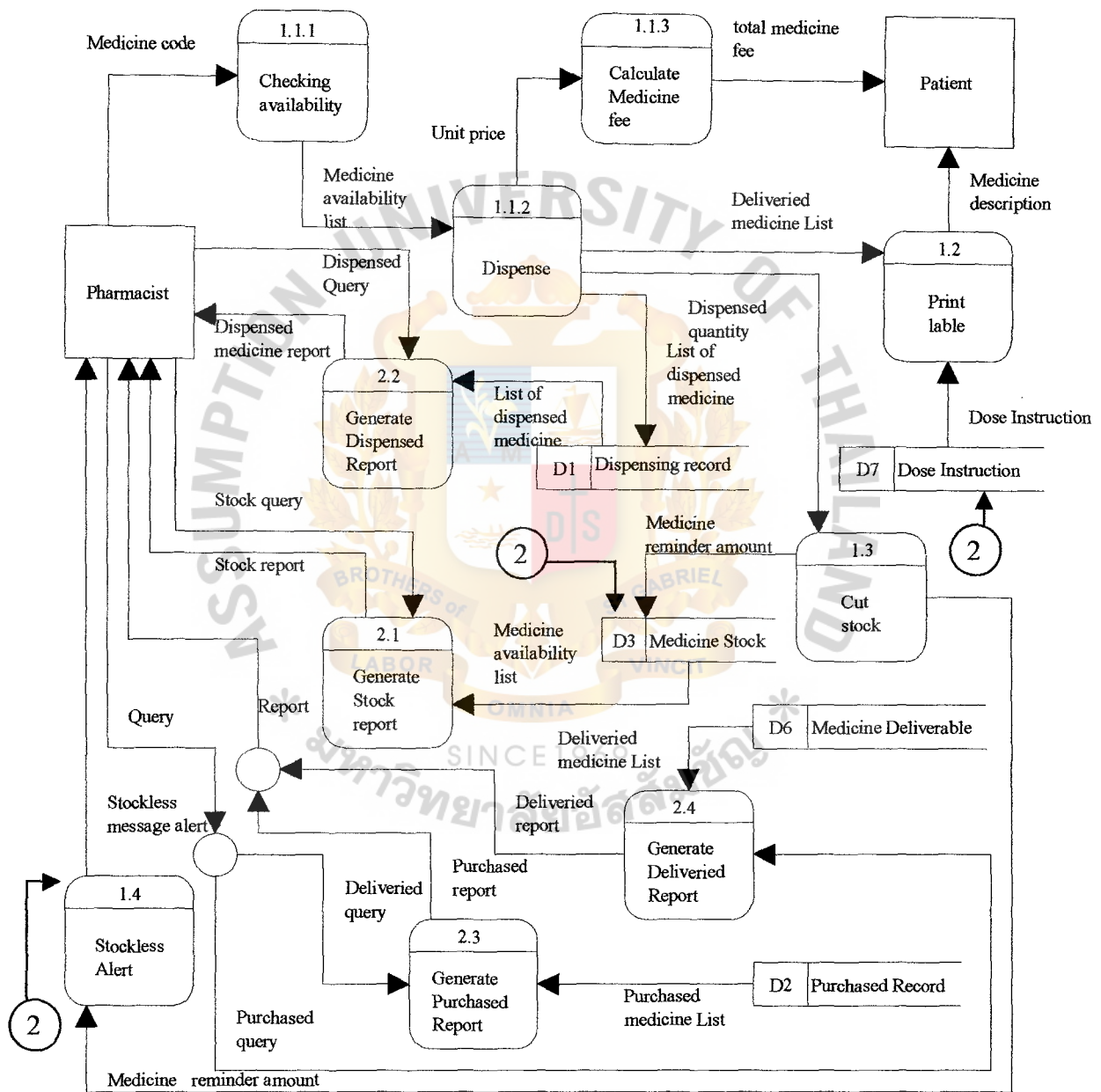
Figure 3.21. Primitive DFD of Medicine Stock Management System.
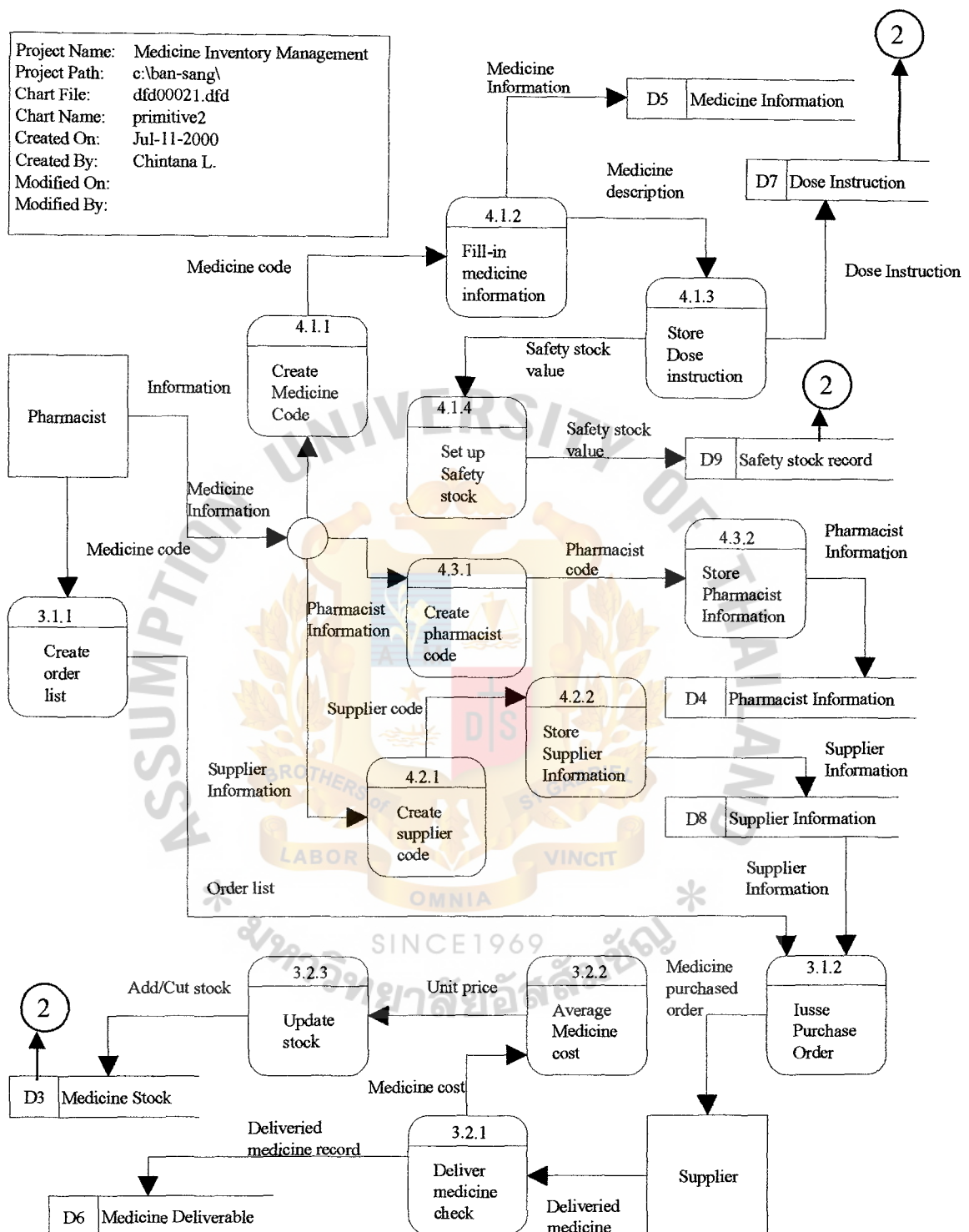
Figure 3.22. Primitive DFD of Medicine Stock Management System (Continue).

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Database Design

ERD (Entity Relationship Diagram) is a tool for data modeling in which we are interested. Entity will become as a table and any attributes belong to. It will be the fields in that table. We have to identify the Primary Keys; are fields whose values identify one and only one record in a file, and Foreign Keys; are pointer to the records of a different file in a database, of each table. Then, we can be able to normalize them from the first normal form (1NF) till the third normal form (3NF), finally.

Figure 3.23 represents the context ERD that will depict the view of new system as a whole. Figure 3.24 is shown the primary keys and foreign keys and Figure 3.25 represents the fully attributes of the designed system.

Figure 3.26 is the first normal form of the designed system. It will be the second normal form, if its an attribute whose value is determined by only part of the primary key. Figure 3.27 represents 2NF.

Figure 3.28 represents 3 NF of the designed system by each non-primary key attribute is dependent on the primary key, the whole primary key, and nothing but the primary key.

Figure 3.23.   Context ERD of Medicine Stock Management System.

Figure 3.24. Key-Based ERD of Medicine Stock Management System.

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Project Name: Medicine Inventory Management
Project Path: c:\ban-sang\
Chart File: erd00005.erd
Chart Name: Fully Attri
Created On: May-12-2000
Created By: Chintana L.
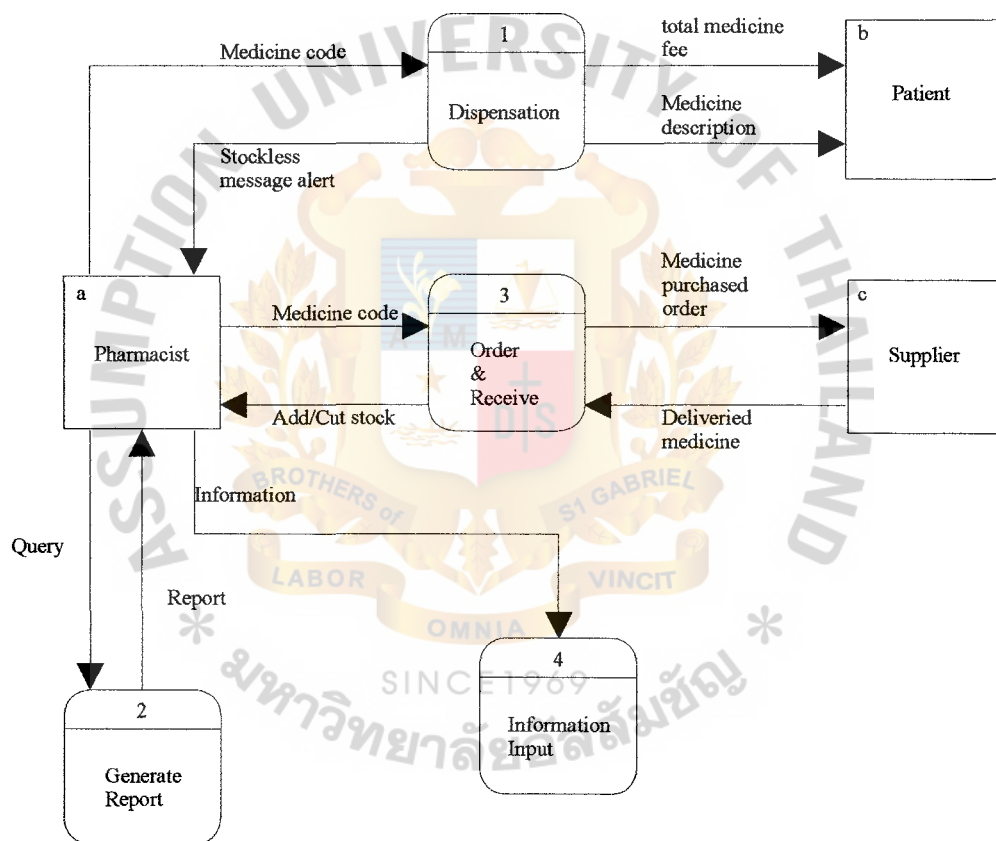Modified On: Jun-24-2000
Modified By: Chintana L.

**EXPIRED DATE**
------Key Data------
Med Code [PK]
Expired Date

has a   is set at

SAFETY STOCK
------Key Data------
Group_No. [PK]
Safty Limit

DISPENSATION
------Key Data------
Disp No. [PK]
Med Code [FK1]
Phar Code [FK2]
Patient Name

Date
Dispensed Quantity
Allocate Quantity
Extra Quantity
Price/Unit
Amount
VAT
Total
Remark

MEDICINE
------Key Data------
Med Code [PK]
Group No. [FK]
Generic Name
Trade Name
Expired Date
Strength
Type
Unit
Description

cut from

is taken as

DOSAGE
------Key Data------
Dose Code [PK]
Med Code [FK]
Age Classify
Strenght
Qunatity
Unit
Type
Time
Indication
Meal
Remark

is collected
to

is deliveried
by

dispense

STOCK
------Key Data------
Med Code [PK]
Balance Quantity
Stock in Date
Unit
Latest cost
Average Cost
Remark

DELIVERY
------Key Data------
Deliv No. [PK]
Supp Code [FK1]
Order No.
Amount
VAT
Total

SUPPLIER
------Key Data------
Supp Code [PK]
Company Name
Address
Distric
Provice
Zip code
Telephone
Fax

PHARMACIST
------Key Data------
Phar Code [PK]
Name
Surname
Description

Update to   Update to

is sent to

DELIVERY TRANSACTION
------Key Data------
Med Code [PK1]
Del No. [PK2]
Received Quantity
Received Cost
Remark

- ORDER
------Key Data------
PO No. [PK]
Med Code [FK1]
Supp Code [FK2]
Pharmacist [FK3]
Date
Order quantity
Remark

prints order

Figure 3.25. Fully Attributed ERD of Medicine Stock Management System.
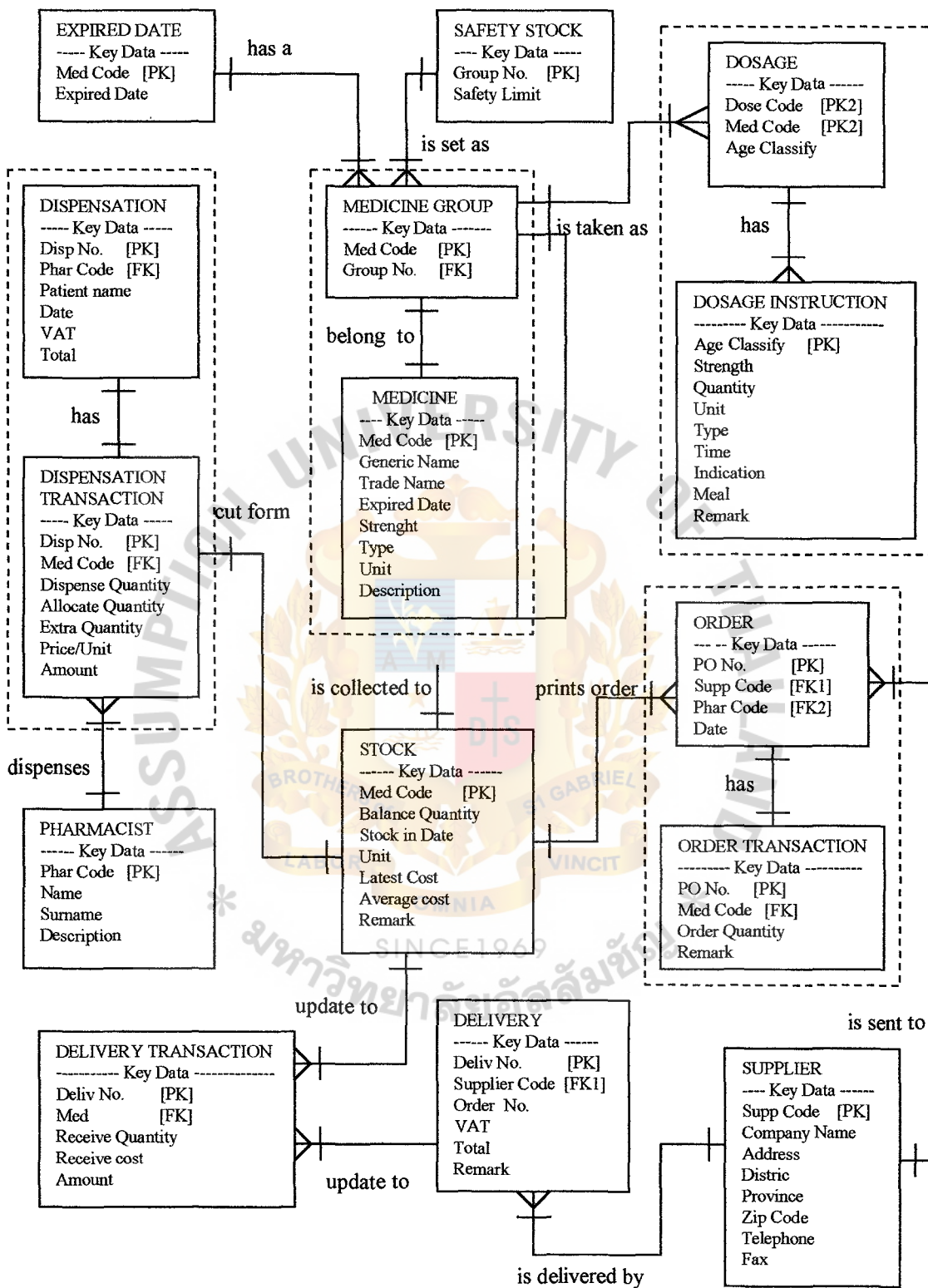
Figure 3.26. First Normal Form.
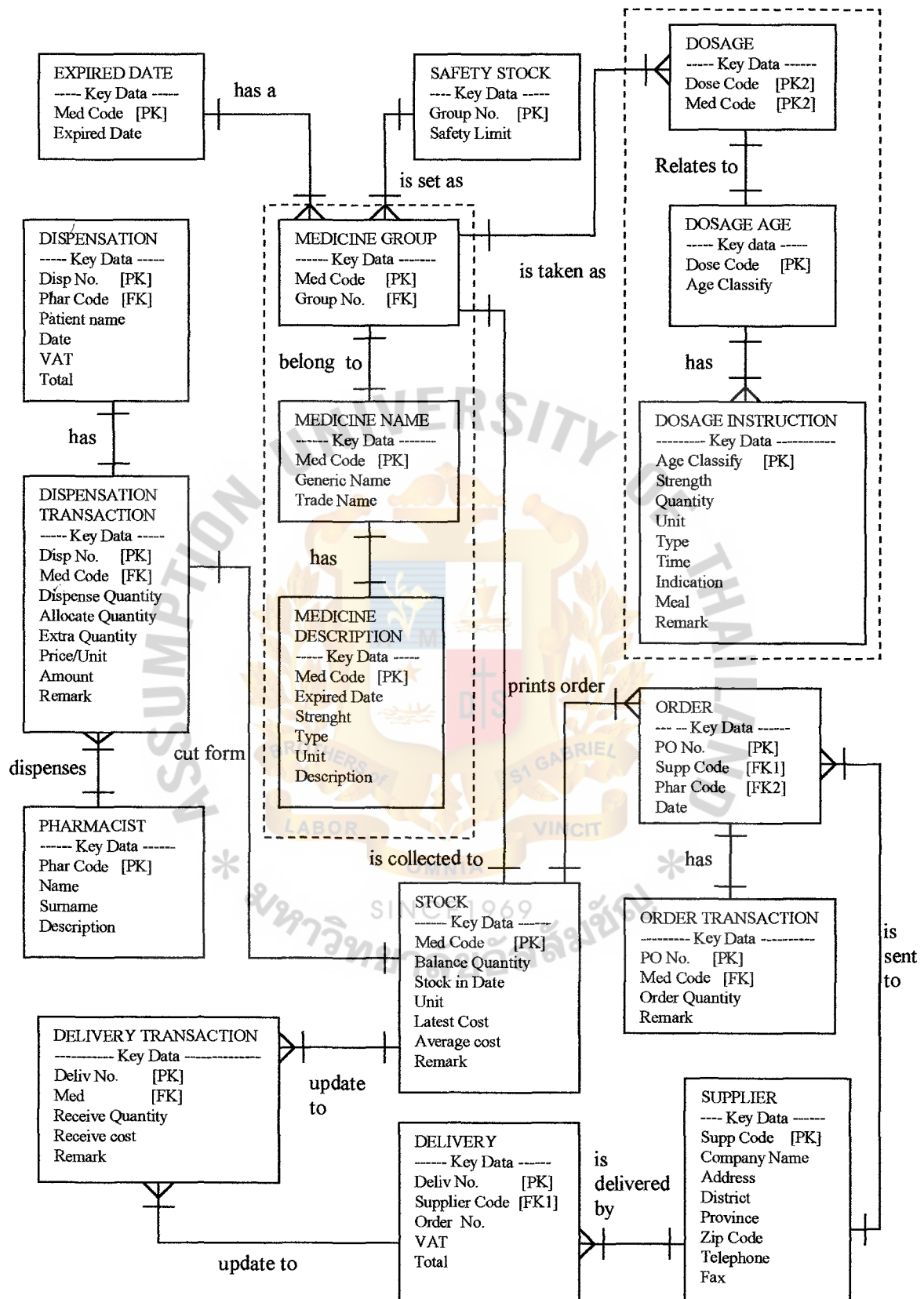
Figure 3.27.   Second Normal Form.

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Figure 3.28. Third Normal Form.

Software Design

Software design in this section does not mean as algorithm or logical design but it is how the programming specifications are presented to the compute programmers. Structure chart is a technique in breaking up the program into a hierarchy of modules that result in a computer program. It uses the structure charts that graphically depict a module design of a program. They show how the program has been partitioned into smaller more manageable modules, the hierarchy and organization of those modules and the communication interface.

Figure 3.29 represents the partitioned DFD of Transform Analysis of Dispensed Medicine System. The left side called afferent is performed input and editing such as initialize counter, read the first record and edits incoming data. The middle side called central transform is performed the real work, making decision such as checking medicine availability and calculate medicine fee. The right side called efferent is performed output such as update records to database, print report and display. Figure 3.30 represents the structure charts according in Figure 3.29.

As well as Figure 3.31 represents the partitioned DFD of Transform Analysis of Generated System and Figure 3.32 represents the structure chart according in Figure 3.31. Figure 3.33 represents the partitioned DFD of Transform Analysis of Ordered & Received Medicine System and Figure 3.34 represents the structure chart according in Figure 3.33. Finally, Figure 3.35 represents the partitioned DFD of Transform Analysis of Information Input System and Figure 3.36 represents the structure chart according in Figure 3.35.
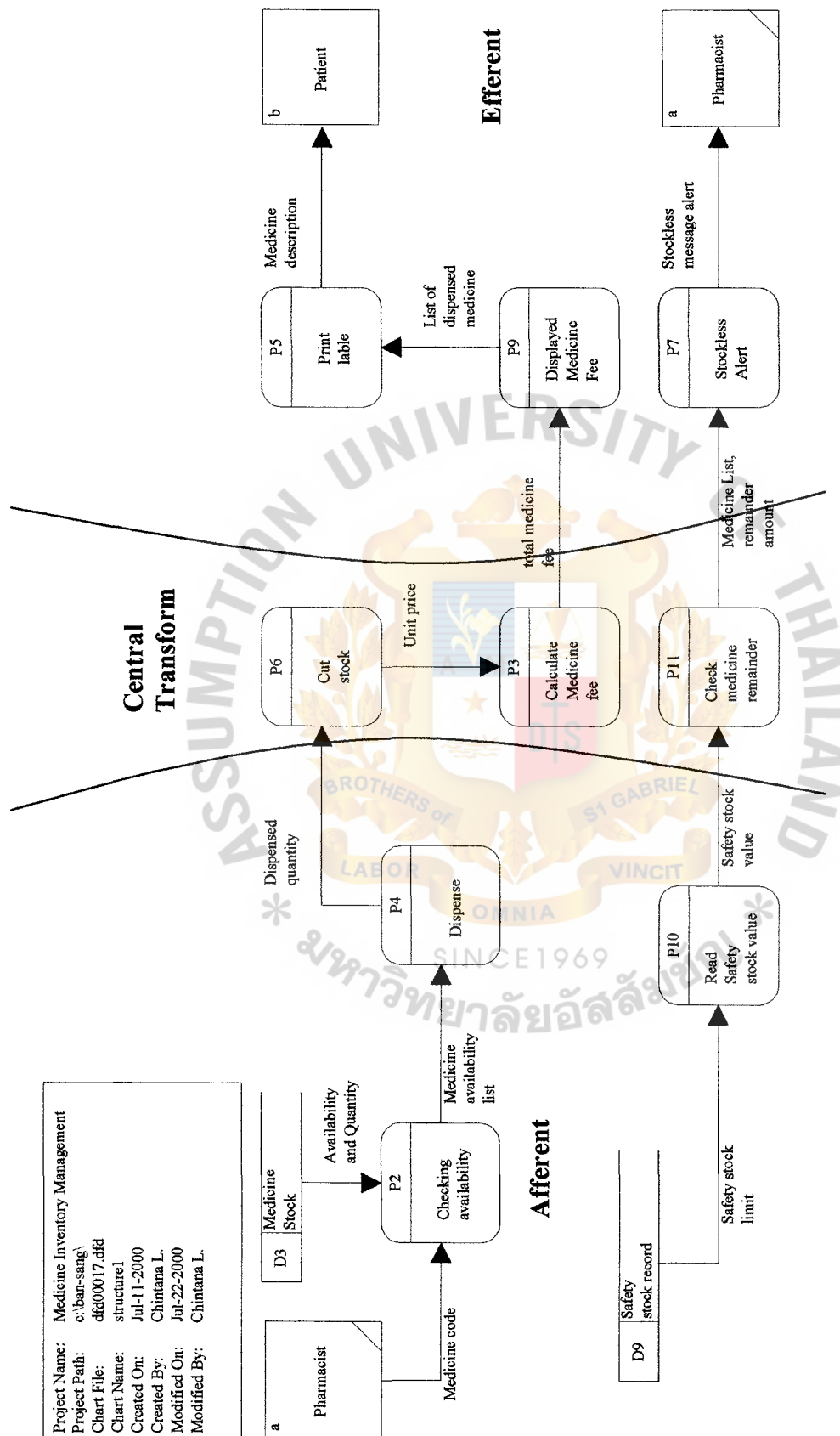
Figure 3.29. Transform Analysis of Dispensed Medicine System.

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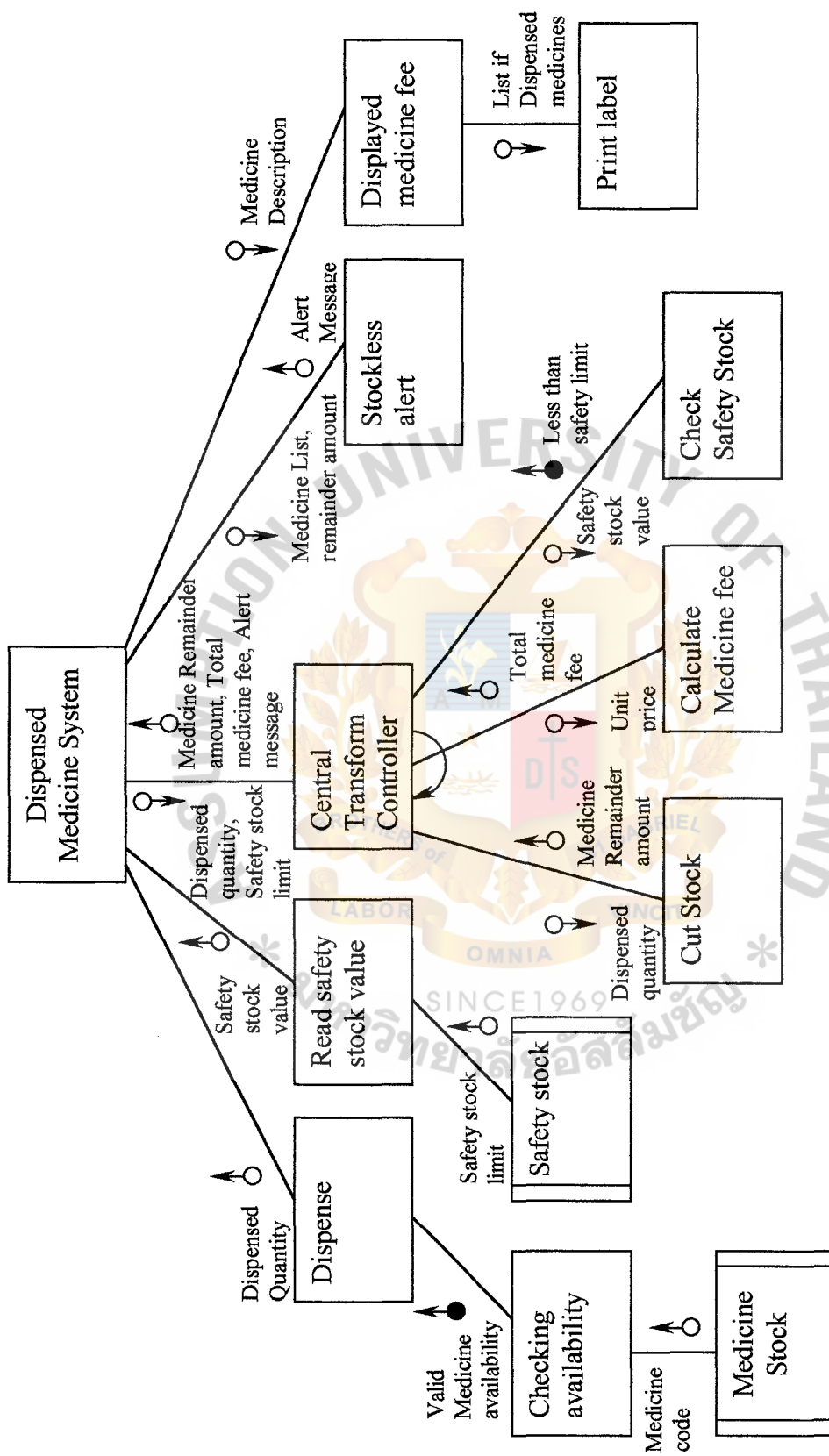
Figure 3.30.   Structure Chart of Dispensed Medicine System.

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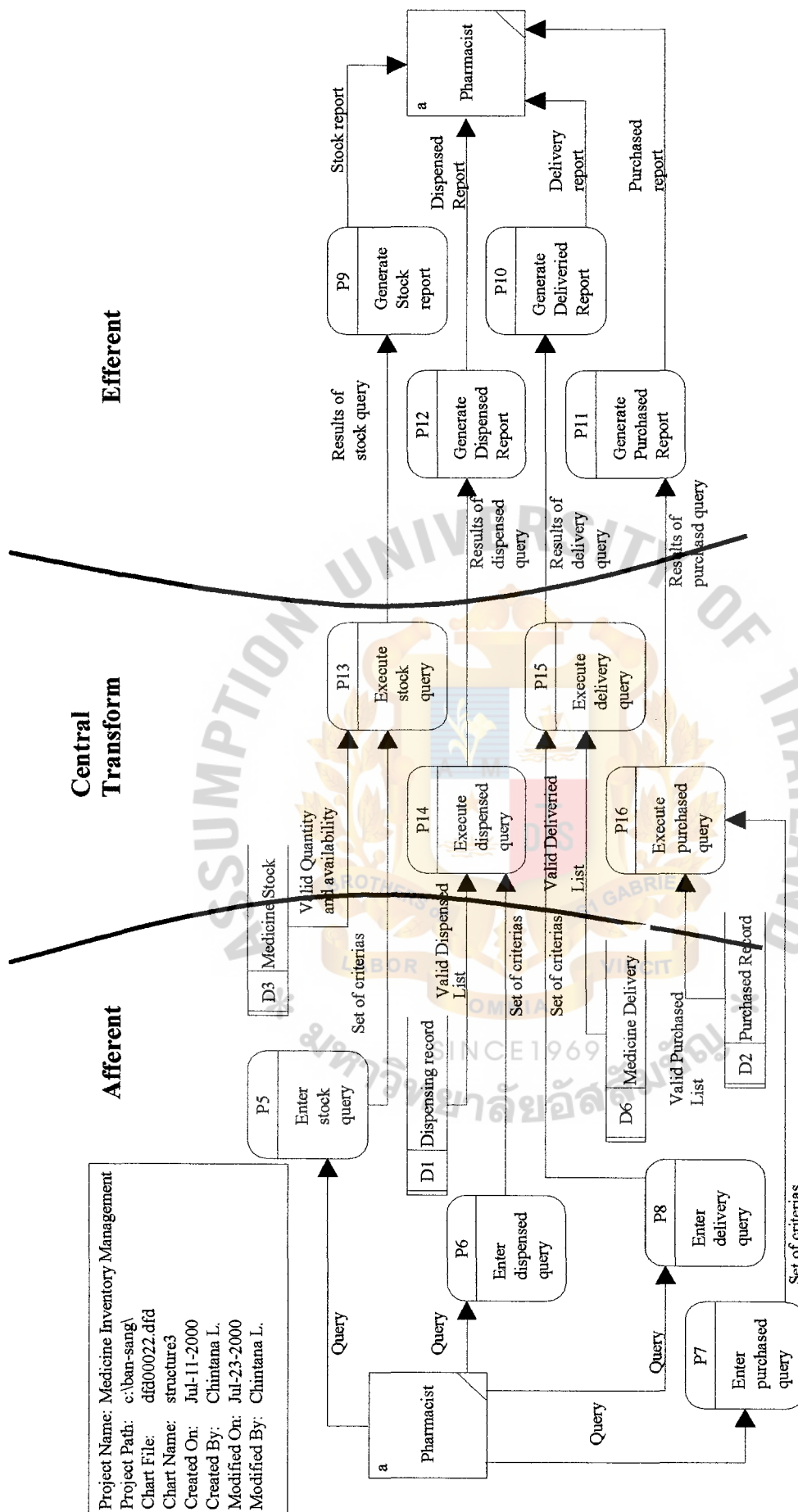
Figure 3.31. Transform Analysis of Generate Report System.

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Figure 3.32.   Structure Chart of Generate Report System.
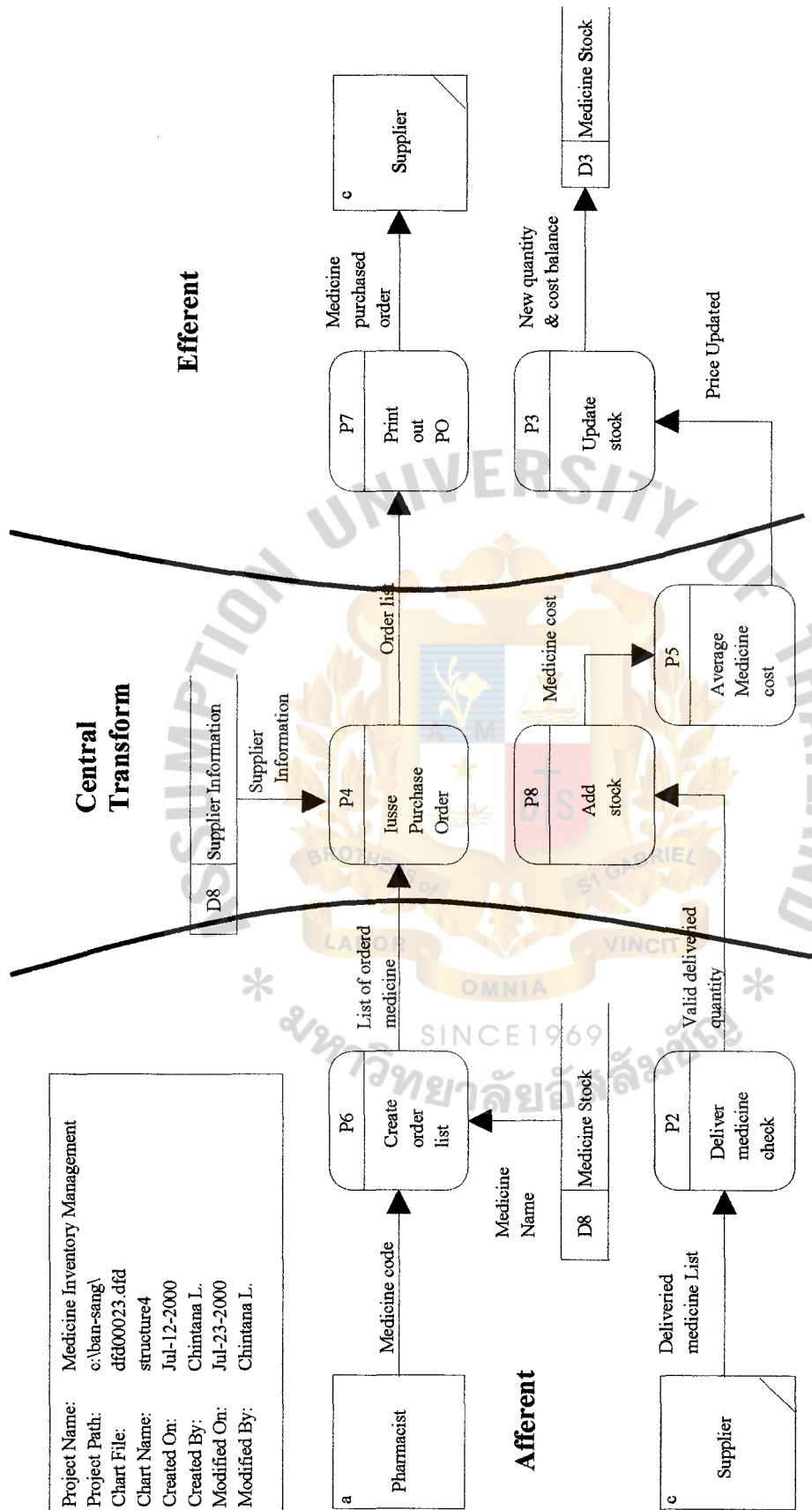
Figure 3.33. Transform Analysis of Ordered & Delivery System.

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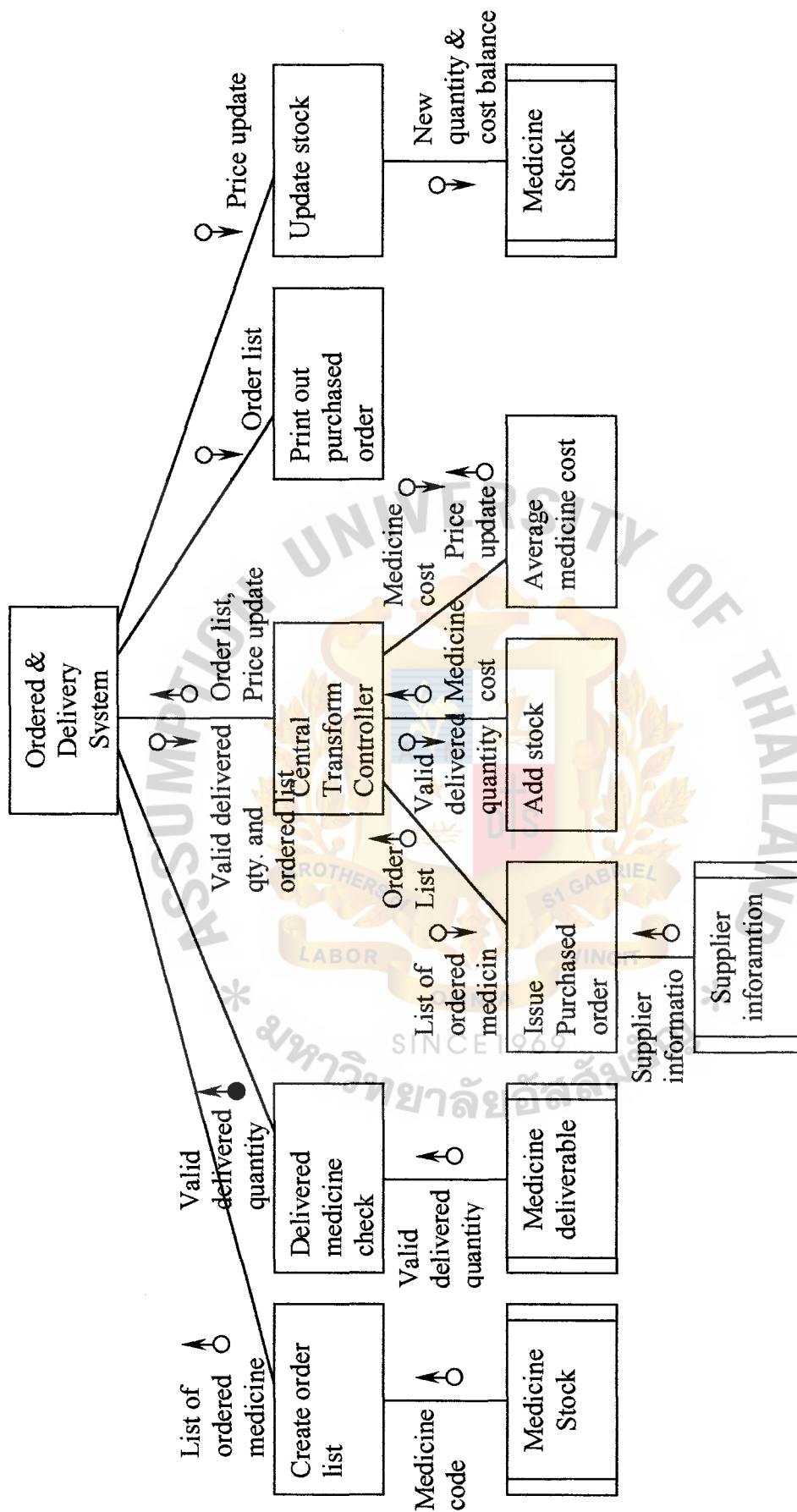
Figure 3.34.   Structure Chart of Ordered & Delivery System.
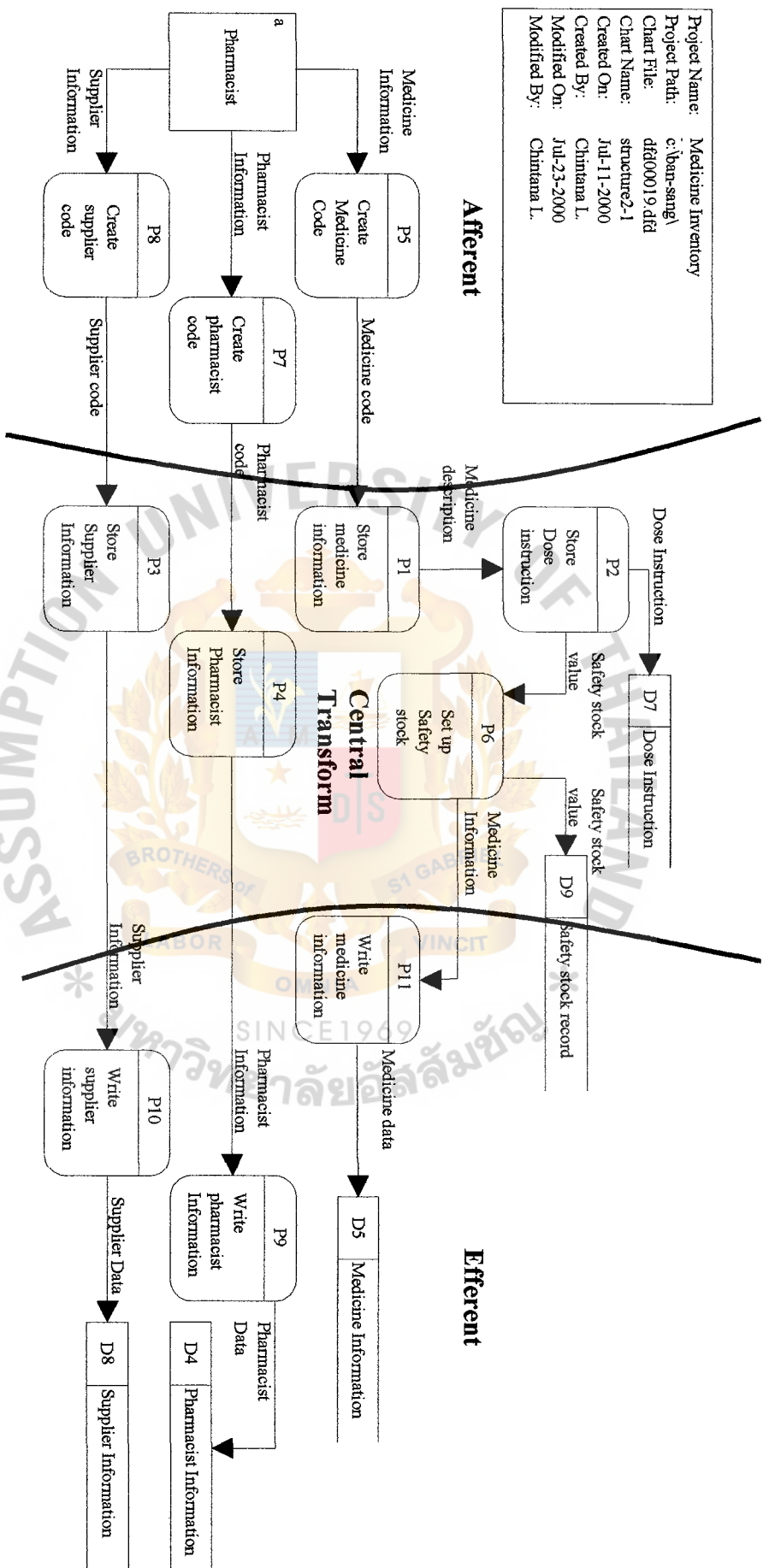
Figure 3.35. Transform Analysis of Information Input System.
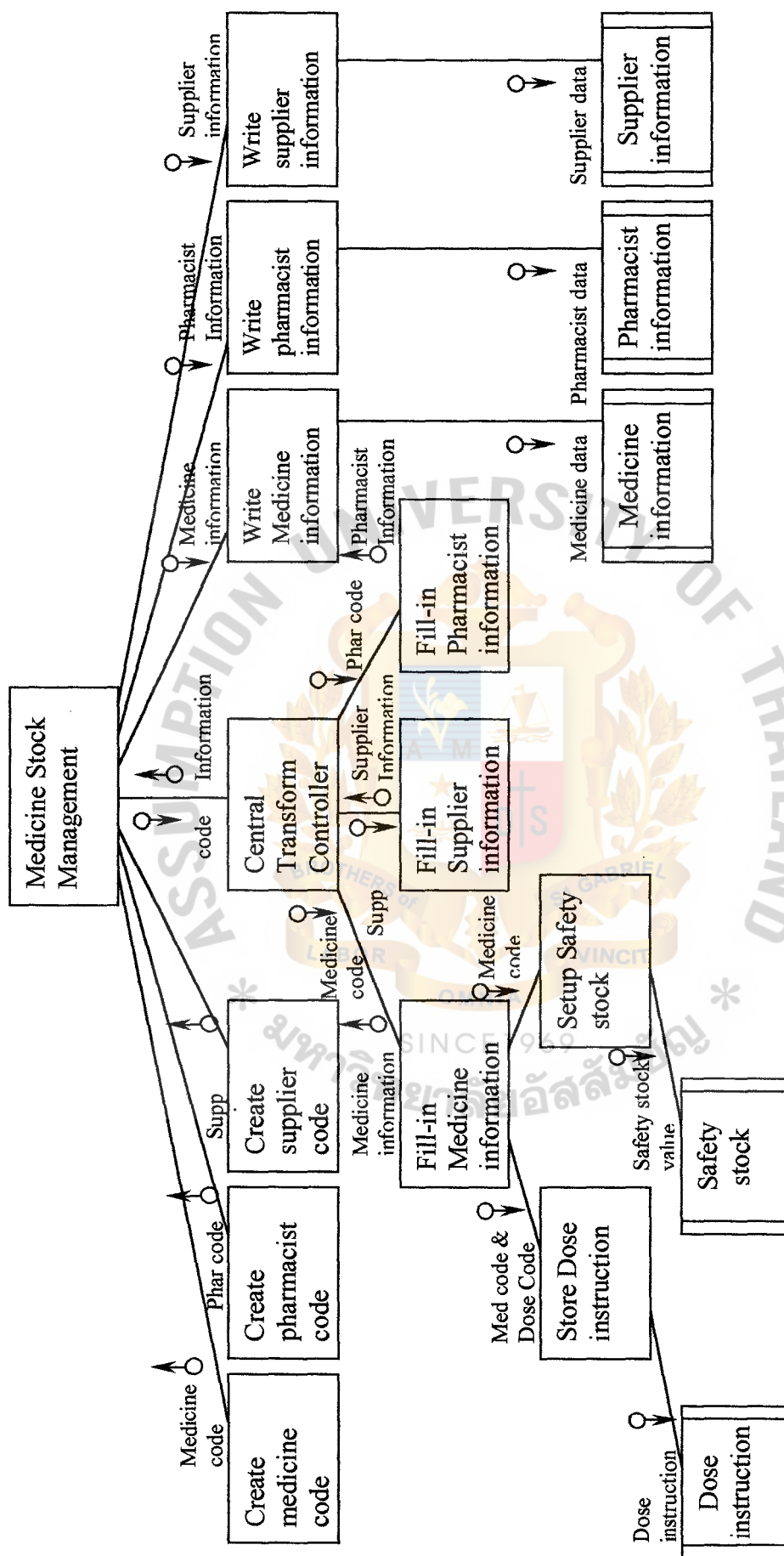
Figure 3.36. Structure Chart of Information Input System.

3.3 Hardware and Software Requirement

According to the system design in 3.2 issue, the computer system of Medicine Stock System has two-tiers; server and client. So, it needs at least 2 computer machines; one for Server machine and the other for Client machine. The hardware requirements of server machine should have hard disk capacity, CPU speed, RAM and liability higher than the client machine.

Regarding 3NF of proposed system in Figure 3.12 can estimate the capacity of Database. There are totally identical 56 fields, form 17 tables.(See Appendix C Database design) Therefore, one transaction of the 56 fields will take 4669 Bytes or 37352 bits. Assuming that there are 30 transactions per day. Thus, with in 1 year, there will be 10950 transactions per year. The data stored must have 409,004,400 bits or 410 MB. We can estimate the minimum size of harddisk to store data for 5 years which is 2.1 GB. Generally, not only the harddisk spaces to keep such data, they must also have some spaces for installing operating system and utility program. Thus, the minimum size of harddisk for database server is 4 GB.

Table 3.13 represents the hardware requirements for client machine. This client will have less capacity than the server because it retrieves the data from the server and then executes it. Then, it will pass the result to keep in the server. Thus the client is not necessary to have high power as the server. And Table 3.14 represents software requirement for server and client machine respectively. In addition, we also need the other network infrastructures such as printer for printing the report, network card for connecting to the network and cable for transferring data from one to another.

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Table 3.12.   Hardware requirement for Server Machine.

HARDWARE	SPECIFICATION
CPU	Intel Celeron 550
Memory	256 MB
Hard Disk	4 GB
Network Adapter	Fast Internet; 100MB
CD-ROM Drive	Phillip 40X or higher
Floppy Disk	1.44 MB
Monitor	CTX 14"

Table 3.13.   Hardware Requirement for Client Machine.

HARDWARE	SPECIFICATION
CPU	Intel Celeron 433
Memory	64 MB or higher
Hard Disk	2 GB or higher
Network Adapter	Fast Internet; 100MB
CD-ROM Drive	Phillip 40X (Optional)
Floppy Disk	1.44 MB
Monitor	CTX 14"

Table 3.14.   The Software requirement for the Client/Server Machine.

SOFTWARE	CLIENT	SERVER
Operating System	Windows 98	Windows NT
Database Server	Microsoft Access	Microsoft Access

After the final system design, the new network system will be adopted to the existing computers. Most computers are connected together as a LAN (Local Area network). A new computer designated as a central server approach offers the organization enormous benefits in creating a corporate data. Both data and application software can be accessed or downloaded to local workstations by authorized appropriate users. IP Sharing built in 8-port Hub can share Internet access to network computers with only one Internet account. A printer connected to a client will be a sharing printer. Figure 3.37 represents the network architecture of Medicine Stock Management System in Ban-Sang Hospital.
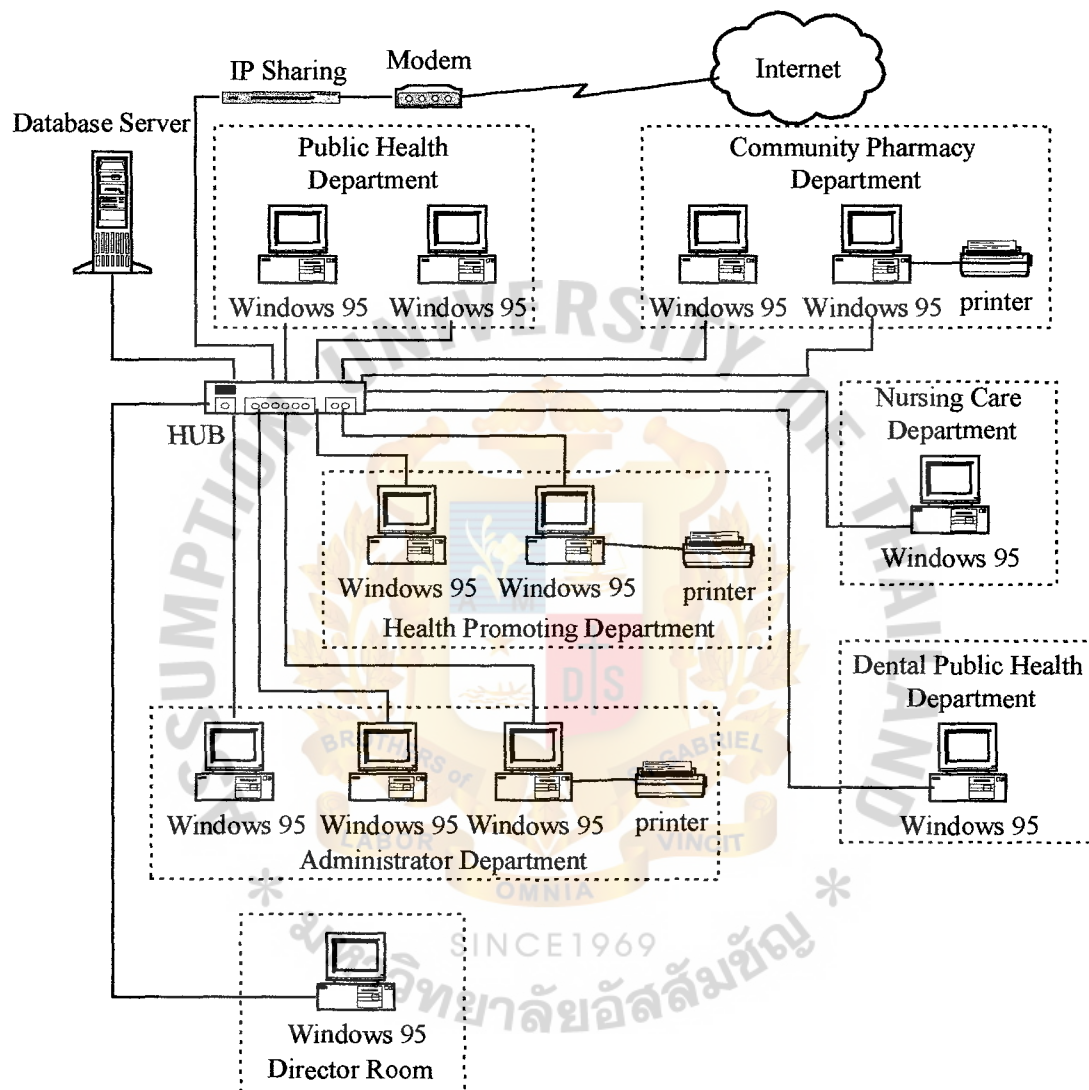
Figure 3.37. Network Architecture of Medicine Stock Management System.

3.4 Security and Control

Security: The network of Ban-Sang Hospital is connected to Internet. We allow only client computers to enable browsing Internet. Server computer is only database server and file server. Windows NT is the selected operating system running on the Server. It provides the users authentication log on. Only authorized users can access to network in order to obtain the data and use the network resources such as sharing printer and access to Internet. Therefore, the users will have their own secret passwords to log on to the network. In addition, access to Medicine Stock database, not only pass the network log on, it also passes the database log on too. The database users will have different permission levels in modifying data.

Control: Medicine Stock data is stored on the server. The data is retrieved from the server and will be executed on the client computer. It ensures that updates on one computer are updated on any computer in the network. Therefore, centralized data is easier to manage and maintain. Normally, every user must log on to the network, however, if any user needs to access to medicine stock database, they must have another log on password. The user's role in managing data will be differentiated by the password. Database administrator who is the highest user. Database administrator can assign the role and grant permissions to users. The supervisor only can delete/add/read permission. The operation users can have only add/read permission. The Hospital director can read permission only.

3.5 Cost/Benefit Analysis

The hardware and software specifications of existing computers are similar. Their operating system is Windows 95. We will design the database system that can be

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able to run on Windows 95. We decide to use the Microsoft Access to perform a database task. The initial costs of total hardware requirements for the new system are shown in the Table 3.15. Table 3.16 depicts the cost of computerized system for 5 years operation.

By comparing with the manual cost system and the computerized system, it seems the computerized system has an initial higher cost, because the computer hardware is quite expensive plus the system installation cost. However, the enormous benefits of computerized system, can reduce the cost many years later. It can reduce paper, the communication cost and improve the efficiency. The payback period will be 3 years. Figure 3.38 represents an intersection between the cost of manual system and computerized system.
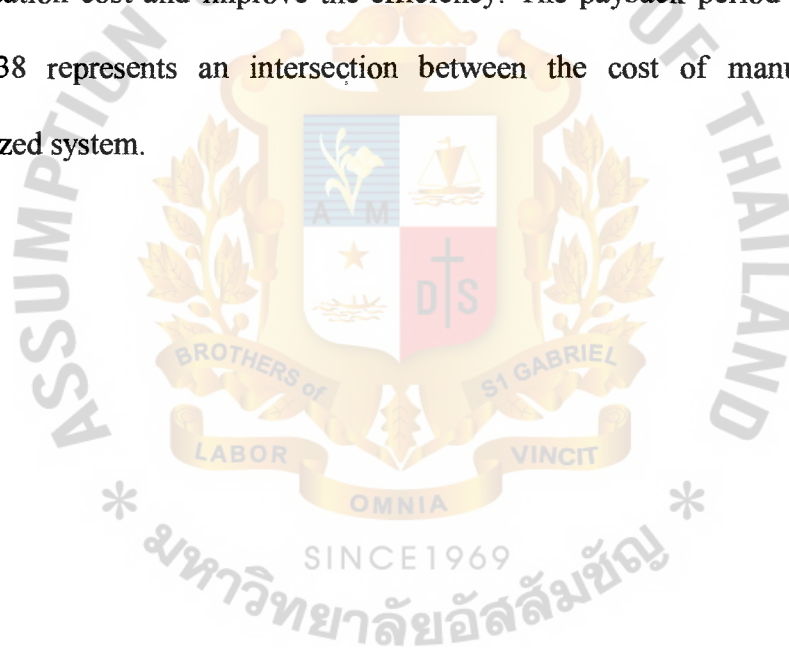
Table 3.15.   Development Cost Analysis of Proposed system.

Cost Items	Description	Amount	Unit Price (Baht/Month.)	Price (Baht)
1. Development Cost				
	1.1 Personal Cost:			
	System Analyst (1 month/ea)	1	25,000.00	75,000.00
	Programmer (1 month/ea)	1	14,000.00	42,000.00
	Subtotal 1:			117,000.00
	1.2 New Hardware:			
	Server Computer	1	43,000.00	43,000.00
	Client Computer	2	20,500.00	50,000.00
	IP Sharing	1	2,200.00	2,200.00
	SDRAM 64 MB	1	2,500.00	2,500.00
	Network Card	3	1,200.00	3,600.00
	UPS 500 VA	1	2,300.00	2,300.00
	Laser Printer	1	16,700.00	16,700.00
	Subtotal 2:			120,300.00
	1.3 New Software: MS Office 97	1	22,170.00	22,170.00
	Windows 98 license	1	1,650.00	1,650.00
	Windows NT Server	1	18,460.00	18,460.00
	Subtotal 3:			42,280.00
	1.4 Other Cost: Training	2	5,000.00	10,000.00
	Installation Charge	2	3,000.00	3,000.00
	Subtotal 4:			13,000.00
	Total Development Cost			298,580.00

From Table 3.15, the Development cost is 298,580 Baht paid on the first year.

The operation cost has not yet been included because the new system will have the

maintenance cost when it passes the first year of implementation.

Table 3.16. Projected Annual Operating Costs of Proposed system.

Cost Items	YEAR				
	1	2	3	4	5
1.1 Personal:					
Pharmacist Staff					
1 person (8700.00 B./month)	104400.00	104400.00	104400.00	104400.00	313200.00
Officer for Pharmacist					
1 persons (5500.00 B./month)	66000.00	66000.00	66000.00	66000.00	66000.00
Subtotal 1:	170400.00	170400.00	170400.00	170400.00	379200.00
1.2 Expenses:					
Maintenance	5000.00	10000.00	15000.00	20000.00	25000.00
Stationary	14000.00	16000.00	18000.00	20000.00	22000.00
Subtotal 2:	19000.00	26000.00	33000.00	45000.00	47000.00
Total Annual Operating Costs	189400.00	196400.00	230400.00	215400.00	426200.00

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Table 3.17. Projected Annual Operating Cost of Existing system.

Cost Items	Years				
	1	2	3	4	5
1.1 Personal:					
Pharmacist Staff					
1 persons (8700.00 B./month)	104400.00	208800.00	313200.00	313200.00	313200.00
Officer for Pharmacist					
1 person (5500.00 B./month)	132000.00	156600.00	165000.00	165000.00	198000.00
Subtotal 1:	236400.00	365400.00	478200.00	478200.00	511200.00
1.2 Expenses:					
Stationary	20000.00	30000.00	35000.00	40000.00	45000.00
Subtotal 2:	20000.00	30000.00	35000.00	40000.00	45000.00
Total Projected Annual Costs	256400.00	395400.00	513200.00	518200.00	556200.00

Table 3.18. The comparison of System costs.

| Year | Existing Cost(Baht) | | Proposed System Cost (Baht) | | |
	Annual Operating	Accumulated Cost	Development Cost	Annual Operating	Accumulated Cost
0	-	0.00	298580.00	-	298580.00
1	256400.00	256400.00	-	189400.00	487980.00
2	395400.00	647800.00	-	196400.00	684380.00
3	513200.00	1161000.00	-	230400.00	914780.00
4	518200.00	1679200.00	-	215400.00	1130180.00
5	556200.00	2235400.00	-	426200.00	1556380.00
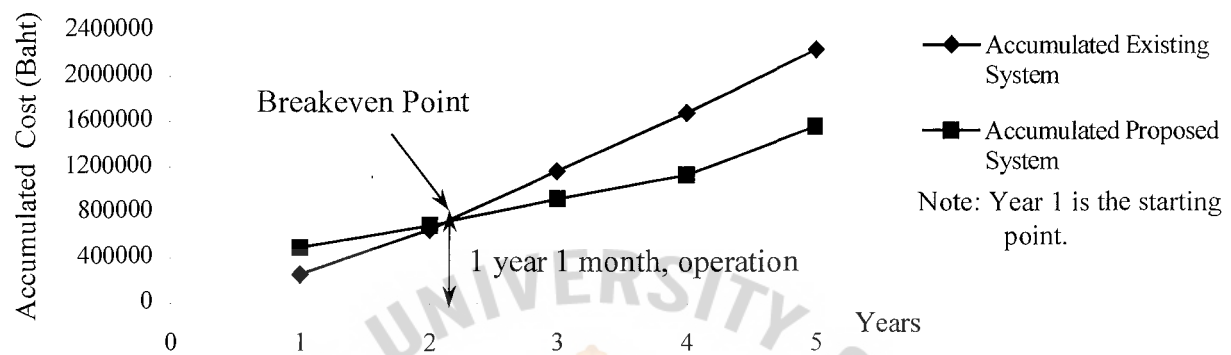
Figure 3.38. Cost Comparison between Existing and Proposed System.

Accumulated Column of proposed system in Table 3.18, are the summation of each annual operating cost plus projected development costs and then accumulate them till the end of 5 years. Because we need to compare the cost in terms of annual value, the development cost has to be projected into uniform annual cost for 5 years.

We take the data from both accumulated cost columns of manual and computerized system to plot the graph as figure 3.38. This figure depicts the breakeven point for the cost of manual and new computerized system at 1.09 years, approximately. It determines that the new system provides the benefits after 1.1 years up while the manual system makes a loss at the same time.

Table 3.19. Payback Analysis for Proposed system

Cash Flow Description	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Development cost (Baht)	261580.00					
Maintain cost		5000.00	10000.00	15000.00	20000.00	25000.00
Discount factor 10%	1.00	0.909	0.826	0.751	0.683	0.621
Time-Adjusted costs	261580.00	4545.00	8260.00	11265.00	13660.00	15525.00
Commutative Time-Adjust cost	261580.00	266125.00	274385.00	285650.00	299310.00	314835.00
Benefits derived from operating new system	0.00	63000.00	199000.00	282800.00	302800.00	130000.00
Discount Factor 10%	1.00	0.909	0.826	0.751	0.683	0.621
Time-Adjusted Benefits	0.00	57267.00	164374.00	212382.40	206812.40	80730.00
Commutative Time-Adjust Benefit	0.00	57267.00	221641.00	434023.80	640836.20	721566.20
Commutative Lifetime-adjusted (Costs + Benefits) Baht	-298580.00	-245858.00	-89744.00	11373.80	304526.20	369731.20
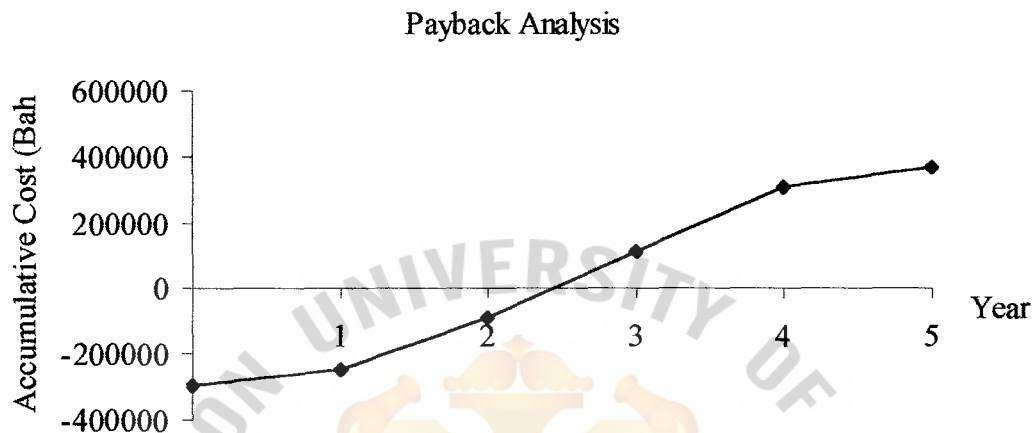
Payback Analysis

Figure 3.39.   Payback Analysis.

From the column Commutative Lifetime-Adjusted of table 3.19, we plot a graph in figure 3.39. This figure depicts the new system that will recover the investment at 2.5 years at 10% interest.

We can see that the Break even point value; 2.09 years, is almost the value of Payback Period; 2.5 years. Therefore, the new system can recover the investment in the next 2 years and its cost tends to decease while the manual system cost tends to increase, even if its has smaller cost at the beginning.

IV. PROJECT IMPLEMENTATION PLAN

4.1 Overview

The purpose of project implementation is to smoothly construct and deliver the Medicine Stock Management System into the existing manual system. The plan helps to manage the tasks for example how much time will be required or what task must be completed before the other tasks are started. Testing program also helps to ensure that the development program can correctly perform their function corresponding to our design. They can be possibly changed to meet the users' requirements. In addition, preparing the users' readiness is necessary. Users, who operate this system, must know how to use this program and initially maintain it, so that, the Medicine Stock Management System will truly improve in efficiency and really eliminate the problems of Medicine stock.

4.2 Coding

Microsoft Access is the selected application program. Since the pharmacist staff is around 2-3 persons plus the Director and other related persons in total they do not exceed 10 persons. Thus, Microsoft Access can comfortably serve that operation.

Time to coding program will take 2 weeks but does not exceed 3 week. Some modules will be done parallel with the testing period.

4.3 Testing Plan

To test the program helps to ensure that all modules can correctly perform their function and they are able to validate the data entry. The following processes are the example of testing. This period will take around 1-2 weeks parallel with coding period.

Table 4.1. The Expected Results of the Correct Performing Processes.

Process Name	Input Data	Expected Result	Remark
Safety Stock Checking	300 tablets	Alert!	Balance stock = 450 tablets
Calculate Medicine Fee	24 Tablets	96 Baht	4 Baht/Tablet
Medicine Information	M100	Acetamin	M100=Acetamin
VAT calculation	3000 Baht	210 Baht	VAT =7%
Balance Stock	Dispense 50 Tablets	Balance stock = 450 Tablets	Stock 500 Tablets
Supplier Code	S100	Boehringer	S100 Boehringer

Table 4.2. The Expected Results of Validation of Correct Performing Processes.

Process Name	Input Data	Validate Results	Remark
Date Entry	Ms. Janphan	Not accept data	dd/mm/yyyy
Data Entry	16/5/2000	16/5/2000	dd/mm/yyyy
Medicine Code	S100	Not accept data	Mxxx Not allow duplicate
Medicine Code	M104	M100	Mxxx Not allow duplicate
Medicine Fee Calculation	40	Warning Message	Numeric Number
Medicine Fee Calculation	40	40	Numeric Number

4.4 Hardware Installation

Refer to the network architecture of new system, there are new equipment that will be integrated into the existing network. LAN Wiring is the first thing to be done. We can install Network Card, Server Machine and clients, while LAN is wiring. HUB will be setup after LAN wiring is finished. IP sharing and modem will be installed and

configuration to be compatible with the server. The Figure 4.1 represents the time schedule for hardware installation.

4.5   Software Installation

Windows NT is the selected operating system. It is firstly installed on server. Then database will be constructed and application is the next. The Figure 4.1 represents the time schedule for software installation.

4.6   Conversion and Training

To convert system from the manual operation to computerize operation, it starts with entering all information such as Medicine Name, Characteristic, Dose, Pharmacist Name, Surname, Suppliers Name, address and Stock Amount. Code and Safety Stock has to be defined and set. In addition, the previous data, which were collected manually, must be entered to the new system completely. Thus, the new system can gather the old data and the new data.

Training is also essential. Users have to learn how to operate it properly. Users have to learn what these functions are and how they work. Users can be able to generate the report.

ID	Task Name	November W1	W2	W3	W4	W5	W6	December W7	W8	W9	W10	W11	January W12	W13	W14	W15
1	I. System Analysis															
2	Define the Objective and Scope		▓													
3	Study the Existing System			▓												
4	Identify the Existing Problems				▓											
5	Studying the Existing System					▓										
6	Develop Context Diagram						▓									
7	Develop Data Flow Diagram							▓								
8	Cost & Benefit Analysis								▓							
9	II. System Design															
10	Input & Output Design									▓						
11	Report Design									▓						
12	Database Design										▓					
13	Network Design											▓				
14	Program Design											▓				
15	III. System Implementation															
16	Coding												▓			
17	Testing													▓		
18	Hardware Installation													▓		
19	Software Installation														▓	
20	Conversion															▓

Figure 4.1. Project Implementation Plan.

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V. CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The study of system development project of Medicine Stock Management System for Community Hospital reveals a need for managing medicine stock to utilize a computer system. A system, which automates the dispensation and updates the stock processes, offers users a great deal of benefit, compared to the manual system. A clear tangible that a hospital organization receives from using computer system is reducing the time consumed to update the stock and increase the accuracy of medicine fee calculation. The computerized system also provides a lot of intangible benefits, in term of data security, efficiency and control, to the organization. Moreover, tasks, which are tedious, complex and repetitive, can be eliminated.

The advantages of this project are:

(1) Improve efficiency to manage the medicine availability in stock.

(2) Reduce time consumed to update stock and generate report

(3) Improve the accuracy in medicine fee calculation.

(4) Paperless system

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

Process	Existing System	Proposed System
Checking Availability Process	5 mins	2 mins.
Medicine Fee Calculation Process	5 mins	1 min.
Update Stock Process	15 mins.	3 mins.
Monthly Report Process	2 hr.	5 mins.
Total	2 hrs. 30 mins.	11 mins.

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Table 5.1 presents the time efficiency on each process of the existing system versus the proposed system. It shows that each process performed by the proposed system executes time less than the existing system. So, it can be concluded that the proposed system is more efficient and effective that the existing system.

5.2 Recommendations

The system presented in this project was designed for a Community Hospital in general. Some modifications may be required in order that the system is fit user requirements of a specific organization. Well-known and popular tools are used to develop the system. This ensures that the system tools won't be obsolesced in the near future, and can be upgraded to newer versions. The operating system and network operation system are also easy to use and maintain. The hardware suggested, computer and network equipment, are the high-end of its range. This is because the hardware technology changes very fast and the system will be able to cope with future expansion

Although, the system was designed to assist users in almost all the functions and processes, more enhancements can be added to the system to provide even greater benefits to users. The following features are the recommendations of enhancements that should be added to the system.
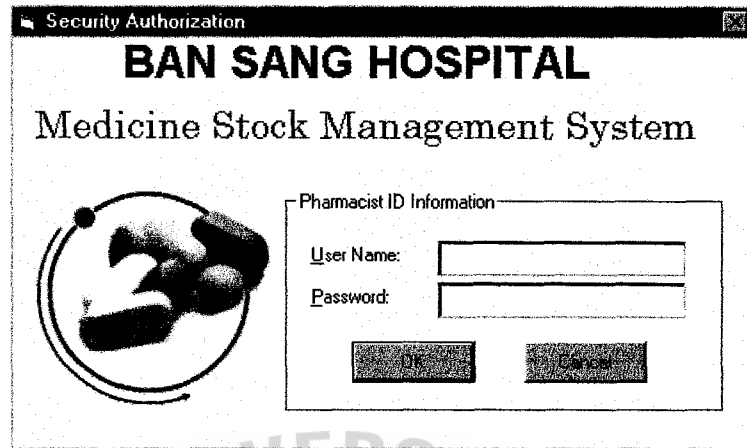
(1) Interface and link to the patient profile system for automatic printing name and address.

(2) Interface and link to the account system for automatic calculation of other fees such as doctor fee and medical equipment fee.

(3) Graphic displays of medicine tablet, bottle or brand for convenience to remember.

(4) A patients' remedy history module for reference in dispensation.

APPENDIX   A

INPUT AND OUTPUT SCREEN DESIGN
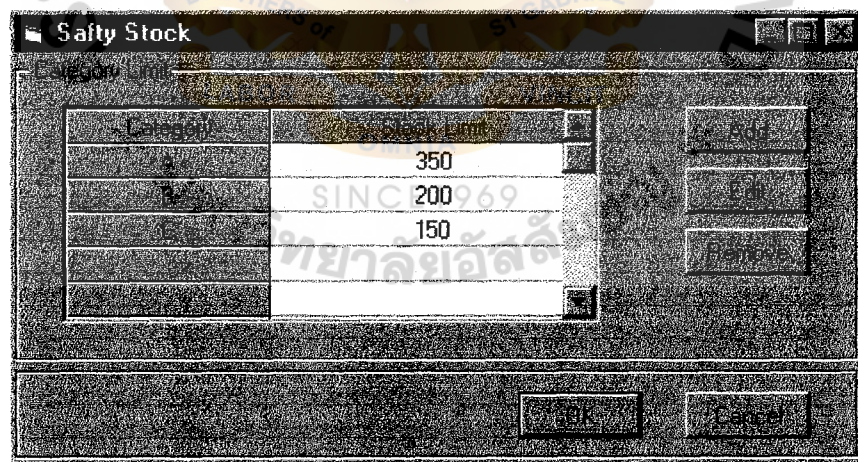
Figure A.1.   Security Authorization Screen.

Figure A.2.   Safety Stock Input Screen.

Figure A.3.   Medicine Information Input Screen.

Figure A.4.   Dosage Instruction Input Screen.

Figure A.5.   Pharmacist Information Input Screen.

Figure A.6.   Supplier Information Input Screen.

Figure A.7.   Purchase Order form Screen.

Figure A.8.   Dispensation Input Screen.

Figure A.9.   Order Medicine Form.

APPENDIX   B

REPORT DESIGN

Table B.1. Medicine Stock Report.

Medicine Stock Report

Medicine Code	Generic Name	Trade Name	Strength	Unit	Type	Balance Quantity	Stock In-date	Remark
AC100	Acetamin	Acetamin	250	mg.	Tablets	850	Jan 28,2000	
AS100	Aspirin	Azdone	500	mg.	Tablets	500	Dec 1,1999	
AM100	Antidiabetic	Amaryl	500	mg.	Capsules	950	Feb15,2000	
CA100	Calcium	Calen	500	mg.	Capsules	500	May 4,2000	
CE100	Pseudoephedrine	Cenafed	500	mg.	Tablets	1000	May 1,2000	

Table B.2. Dispensation Weekly Report.

Dispensation Weekly Report
Date: March 1-7, 2000

Medicine Code	Trade Name	Last Transaction	Total Dispensation	Balance Quantity	Price/Unit Baht	Total Amount (Included VAT)	Remark
AC100	Acetamin	March 7,2000	70	850	3.50	262.15	
AS100	Azdone	March 2,2000	300	500	1.50	481.50	
AM100	Amaryl	March 7,2000	150	950	0.75	120.37	
CA100	Calen	March 7,2000	20	500	5	107.00	
CE100	Cenafed	March 5,2000	200	1000	1	214.00	
					Grand Total	1185.02	

Table B.3.   Medicine Average Cost Report.

Medicine Code	Trade Name	Stock In-date	Previous Quantity	Previous Cost (Baht)	Received Quantity	Received Cost (Baht)	Update Price (Baht)	Balance Quantity	Effective Date
AC100	Acetamin	Jan 28,2000	350	3.50	500	3.50	3.50	850	Feb 1,2000
AS100	Azdone	Dec 1,1999	500	1.50	-	1.50	1.50	500	Jan 1,2000
AM100	Amaryl	Feb15,2000	950	0.75	-	0.75	0.75	950	Feb29,2000
CA100	Calen	May 4,2000	500	5	-	5	5	500	June 4,2000
CE100	Cenafed	May 1,2000	500	1	500	1	1	1000	June 1,2000

Table B.4.   Medicine Purchase Order Report.

Medicine Code	Trade Name	Strength	Unit	Type	Stock In-date	Balance Quantity	Safety Stock	PO No.	Order Date	Supplier Name
AC100	Acetamin	250	mg.	Tablets	Jan 28,2000	120	150	111	Feb 1,2000	Boehringer Ingelheim
AS100	Azdone	500	mg.	Tablets	Dec 1,1999	70	150	112	Jan 1,2000	Hau Sin Drug Co., LTD
AM100	Amaryl	500	mg.	Capsules	Feb15,2000	50	100	113	Feb29,2000	Singcharoen Drug Co., LTD
CA100	Calen	500	mg.	Capsules	May 4,2000	150	200	114	June 4,2000	GPO
CE100	Cenafed	500	mg.	Tablets	May 1,2000	180	200	114	June 1,2000	GPO

APPENDIX   C

DATABASE DESIGN

Table C.1.   Structure of MEDICINE NAME Table.

	Filed Name	Field Type	Index	Unique	Nullable	Foreign Key to table	Key Type
1	Med Code	Varchar(6)	*Y	Y	N	DISPENSATION TRANSACTION, DELIVERY TRANSACTION, ORDER TRANSACTION	Primary Key
2	Generic Name	Varchar(256)					Attribute
3	Trade Name	Varchar(256)					Attribute

Table C.2.   Structure of MEDICINE DESCRIPTION Table.

	Filed Name	Field Type	Index	Unique	Nullable	Foreign Key to table	Key Type
1	Med Code	Varchar(6)	*Y	Y	N	DISPENSATION TRANSACTION, DELIVERY TRANSACTION, ORDER TRANSACTION	Primary Key
2	Strength	Int(6)					Attribute
3	Type	Varchar(128)					Attribute
4	Unit	Varchar(64)					Attribute
5	Description	Varchar(256)					Attribute

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Table C.3. Structure of MEDICINE GROUP Table.

	Filed Name	Field Type	Index	Unique	Nullable	Foreign Key to table	Key Type
1	Med Code	Varchar(6)	Y	Y	N	DISPENSATION TRANSACTION, DELIVERY TRANSACTION, ORDER TRANSACTION	Primary Key
2	Group No.	Int(4)					Attribute

Table C.4. Structure of EXPIRED DATE Table.

	Filed Name	Field Type	Index	Unique	Nullable	Foreign Key to table	Key Type
1	Med Code	Varchar(6)	Y	Y	N	DOSAGE, STOCK, DISPENSATION	Primary Key
2	Expired Date	Date					Attribute

Table C.5. Structure of SAFETY STOCK Table.

	Filed Name	Field Type	Index	Unique	Nullable	Foreign Key to table	Key Type
1	Group No.	Varchar(1)	Y	Y	N	MEDICINE	Primary Key
2	Safety Limit	Int(6)					Attribute

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Table C.6.   Structure of STOCK Table.

	Filed Name	Field Type	Index	Unique	Nullable	Foreign Key to table	Key Type
1	Med Code	Varchar(6)	Y	Y	N	DISPENSATION TRANSACTION, DELIVERY TRANSACTION, ORDER TRANSACTION	Primary Key
2	Balance Quantity	Int(9)					Attribute
3	Stock in Date	Date					Attribute
4	Unit	Varchar(64)					Attribute
5	Latest Cost	Decimal (9.2)					Attribute
6	Average Cost	Decimal (9.2)					Attribute
7	Remark	Varchar(256)					Attribute

Table C.7.   Structure of DISPENSATION Table.

	Filed Name	Field Type	Index	Unique	Nullable	Foreign Key to table	Key Type
1	Disp No.	Int(9)	Y	Y	N		Primary Key
2	Phar Code	Varchar(6)	Y	Y	N	DISPENSE TRANSACTION	Foreign Key
3	Date	Date(8)					Attribute
4	VAT	Percent(3,2)					Attribute
5	Total	Decimal (9.2)					Attribute

Table C.8. Structure of DISPENSE TRANSACTION Table.

	Filed Name	Field Type	Index	Unique	Nullable	Foreign Key to table	Key Type
1	Disp No.	Int(9)	Y	Y	N	DISPENSATION	Primary Key
2	Med Code	Varchar(6)	*	Y	N		Foreign Key
3	Dispensed Quantity	Int(6)					Attribute
4	Allocate Quantity	Int(6)					Attribute
5	Extra Quantity	Int(6)					Attribute
6	Price/Unit	Decimal(6,2)					Attribute
7	Remark	Varchar(256)					Attribute

Table C.9. Structure of DOSAGE Table.

	Filed Name	Field Type	Index	Unique	Nullable	Foreign Key to table	Key Type
1	Dose Code.	Int(9)	Y	Y	N		Primary Key
2	Med Code	Varchar(6)	Y	Y	N		Foreign Key

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Table C.10. Structure of DOSAGE AGE Table.

	Filed Name	Field Type	Index	Unique	Nullable	Foreign Key to table	Key Type
1	Dose Code.	Int(9)	Y	Y	N		Primary Key
2	Age classify	Varchar(128)					Attribute

Table C.11. Structure of DOSAGE INSTRUCTION Table.

	Filed Name	Field Type	Index	Unique	Nullable	Foreign Key to table	Key Type
1	Age classify	Varchar(128)	Y	Y	N		Primary Key
2	Quantity	Int(6)					Attribute
3	Time	Varchar(64)					Attribute
4	Indication	Varchar(64)					Attribute
5	Meal	Varchar(64)					Attribute
6	Remark	Varchar(256)					Attribute

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Table C.12. Structure of PHARMACIST Table.

	Filed Name	Field Type	Index	Unique	Nullable	Foreign Key to table	Key Type
1	Phar Code	Varchar(6)	Y	Y	N	DISPENSEATION, DELIVERY, ORDER	Primary Key
2	Name	Varchar(256)					Attribute
3	Surname	Varchar(256)					Attribute
4	Description	Varchar(256)					Attribute

Table C.13. Structure of ORDER Table.

	Filed Name	Field Type	Index	Unique	Nullable	Foreign Key to table	Key Type
1	Order No.	Int(9)	Y	Y	N		Primary Key
2	Supp Code	Varchar(6)	Y	Y	N		Foreign Key
3	Phar Code	Varchar(6)	Y	Y	N		Foreign Key
4	Date	Date(8)					Attribute

Table C.14.   Structure of ORDER TRANSACTION Table.

	Filed Name	Field Type	Index	Unique	Nullable	Foreign Key to table	Key Type
1	Order No.	Varchar(6)	Y	Y	N	DISPENSATION	Primary Key
2	Med Code	Varchar(6)	Y	Y	N		Foreign Key
3	Order Quanity	Int(6,2)					Attribute
4	Remark	Varchar(256)					Attribute

Table C.15.   Structure of DELIVERY Table.

	Filed Name	Field Type	Index	Unique	Nullable	Foreign Key to table	Key Type
1	Deliv No.	Int(6)	Y	Y	N		Primary Key
2	Phar Code	Varchar(6)	Y	Y	N		Foreign Key
3	Date	Date(8)					Attribute
4	VAT	Percent(3,2)					Attribute
5	Total	Decimal (9.2)					Attribute

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Table C.16.   Structure of DELIVERY TRANSACTION Table.

	Filed Name	Field Type	Index	Unique	Nullable	Foreign Key to table	Key Type
1	Deliv No.	Varchar(6)	Y	Y	N	DELIVERY	Primary Key
2	Med Code	Varchar(6)	Y	Y	N		Foreign Key
3	Receive Quanity	Int(6,2)					Attribute
4	Receive Cost	Decimal(6,2)					Attribute
5	Remark	Varchar(256)					Attribute

Table C.17.   Structure of SUPPLIER Table.

	Filed Name	Field Type	Index	Unique	Nullable	Foreign Key to table	Key Type
1	Supp Code	Varchar(6)	Y	Y	N	ORDER, DELIVERY	Primary Key
2	Company Name	Varchar(256)					Attribute
3	Address	Varchar(256)					Attribute
4	District	Varchar(128)					Attribute
5	Province	Varchar(128)					Attribute
6	ZIP Code	Int(5)					Attribute
7	Telephone	Int(9)					Attribute
8	Fax	Int(9)					Attribute

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APPENDIX   D

PROCESS SPECIFICATION

Table D.1.   Process Specification of Setup Safety Stock Process.

Process Name	Setup Safety Stock
Data In	Medicine Quantity Limit
Data Out	Alert Message
Process	1. Get the value of medicine quantity. 2. Record that value in the Medicine store. 3. Check the balance quantity before dispensation. 4. Repeat step 3 until the balance quantity is less or equal to safety stock limit. 5. Alert message
Attachment	◆ Category ◆ Medicine Store D3

Table D.2.   Process Specification of Stockless Alert Process.

Process Name	Stockless Alert
Data In	Balance medicine quantity from the stock
Data Out	Alert Message
Process	1 Before dispensation, check the balance medicine quantity in the stock. 2 Repeat step 1 until the balance quantity is less or equal to safety stock limit. 3 Alert message. 4 Ignore, and confirm to dispensation. The dispense amount will be cut from the stock 5 Repeat step 1- 4 until the balance quantity is run out off the stock. 6 Alert message.
Attachment	◆ Stock ◆ Medicine Store D3

Table D.3.   Process Specification of Generate Report Process.

Process Name	Generate Report
Data In	Dispense transaction, Order and Delivery transaction
Data Out	Stock report
Process	1. Analyze the queries to capture the relevant data. 2. Print those data in the fix format
Attachment	◆ Stock ◆ Medicine Store D3

Table D.4.   Process Specification of Check Medicine Reminder Process.

Process Name	Check Medicine Reminder
Data In	Dispense Medicine transaction.
Data Out	Balance quantity,
Process	1. Before dispensation, check the balance medicine quantity in the stock. 2. Repeat step 1 until the balance quantity is less or equal to safety stock limit. 3. Alert message. 4. Ignore, and confirm to dispensation. The dispense amount will be cut from the stock 5. Repeat step 1- 4 until the balance quantity is run out off the stock. 6. Alert message. 7. Ignore, and confirm to dispensation. The dispense amount will be stored in Extra field 8. Clear the amount in Extra field
Attachment	◆ Dispensation ◆ Dispensation transaction ◆ Dispensation Store D1

Table D.5.   Process Specification of Calculate Medicine fee Process.

Process Name	Calculate Medicine Fee
Data In	Dispense transaction, Stock.
Data Out	Dispensation transaction
Process	1. Entry the Medicine code and dispensed quantity. 2. Multiple the unit price with dispensed quantity 3. Summarize all medicine list. 4. Calculate VAT and Grand total
Attachment	◆ Dispensation ◆ Dispensation transaction ◆ Stock ◆ Dispensation Store D1

Table D.6.   Process Specification of Issue Purchase Order Process.

Process Name	Issue Purchase Order
Data In	Medicine orders list.
Data Out	Order transaction
Process	1. Record the Order Number 2. Entry the Supplier code 3. Entry the Medicine code and order quantity. 4. Print the medicine orders list
Attachment	◆ Order ◆ Order transaction ◆ Delivery Store D6

Table D.7.   Process Specification of Delivery Medicine Process.

Process Name	Delivery Medicine
Data In	Delivery Transaction.
Data Out	Medicine quantity update.
Process	1. Record the Delivery Number regarding with Order Number 2. Record the Delivered quantity of each ordered Medicine. 3. Update the stock
Attachment	◆ Delivery ◆ Delivery transaction ◆ Delivery Store D6

Table D.8.   Process Specification of Average Medicine Cost Process.

Process Name	Average Medicine Cost
Data In	Delivery Medicine Price
Data Out	Average Medicine Cost.
Process	1. Record the latest Delivered Price and Medicine Quantity 2. Multiple the previous quantity with its cost and multiple the latest quantity with its cost. 3. Plus both multiple result and then divide it by the sum of both quantities. 4. Record new cost.
Attachment	Medicine store D3

Table D.9.   Process Specification of Stock Update Process.

Process Name	Stock Update
Data In	Dispense transaction, Delivery transaction
Data Out	Balance stock
Process	1. Subtract the dispensed amount from the current amount. 2. Before dispensation, check the balance medicine quantity in the stock. 3. Repeat step 3 until the balance quantity is less or equal to safety stock limit. 4. Add the delivered amount to the current amount.
Attachment	Dispense transaction, Delivery transaction Medicine store D3

Table D.10.   Process Specification of Store Medicine Information Process.

Process Name	Store Medicine Information
Data In	Medicine Information
Data Out	Medicine Record
Process	1. Get necessary medicine generic name, trade name, quantity, cost, price and assign new medicine code. 2. Record medicine data into Medicine database.
Attachment	• Medicine store D3

Table D.11.   Process Specification of Store Supplier Information Process.

Process Name	Store Supplier Information
Data In	Supplier Information
Data Out	Supplier Record
Process	1. Get necessary supplier name, address, telephone, fax and assign new medicine code. 2. Record supplier data into Supplier database.
Attachment	• Supplier store D8

Table D.12.   Process Specification of Store Dose Instruction Process.

Process Name	Store Dose Instruction
Data In	Dose Instruction Information
Data Out	Dose instruction Record
Process	1. Get necessary Medicine name, Patient Type, strength, amount of taken, when to take and how to take. 2. Record dose instruction data into Dose Instruction database.
Attachment	Dose Instruction store D7

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APPENDIX   E

DATA DICIONARY

Table E.1.   Data Dictionary of Medicine Stock Management Database.

Field Name	Meaning
Med Code	Medicine unique code for a primary key
Generic Name	Generic name of Medicine
Trade Name	Trade name of medicine
Expired Date	The expired date of medicine
Strength	The strength of medicine will cure the disease
Type	Tablets, Capsules, Bottles
Unit	Milligrams, Pounds, Oz.
Description	The characteristic of medicine
Group No.	Type of group, which is the minimum quantity availability of medicine
Balance Quantity	The totally amount of reminded medicine in the stock
Stock In-date	The date of received medicine in the stock
Average cost	The average cost between new coming medicine and the previous medicine
Lasted Cost	The updated cost of medicine after average it
Remark	The note of something that related to medicine
Disp No	The running number of Dispensed form
Phar Code	The unique code of Pharmacist
Date	Date
Amount	The multiplied result between unit price and quantity
VAT	Value added tax
Patient Name	The name of patient
Dispense Quantity	The number of dispensing medicine
Allocate Quantity	The number of physical dispensing medicine
Extra Quantity	The number of dispensing medicines that beyond the stock
Price/Unit	The medicine price per unit
Dose Code	Unique code of medicine dosage instruction
Time	The frequency of taken medicine such as every hour, 4 hours
Indication	Before meal or After meal
Meal	Breakfast, lunch, dinner, night
Name	Name of pharmacist
Surname	Sure name of pharmacist

Table E.1. Data Dictionary of Medicine Stock Management Database (Continue).

Field Name	Meaning
Description	Additional information regarding with pharmacist
Delivery No.	The running number of Delivery form
Receive Quantity	The amount of received medicine
Received Cost	The cost of delivered medicine
Expired Date	The expired date of medicine
Supp Code	The supplier unique code
Company	The company name of supplier
Address	Address of supplier company
District	District of supplier company's address
Province	Province of supplier company's address
Zip Code	Zip code of supplier company's address
Telephone	Telephone number of supplier company
Fax	Fax number of supplier company

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