Patient Registration Information System of Bangkok Healthcare Hospital

by

Ms. Sunun Chaiprasitpol

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
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Project Title	Patient Registration Information System of Bangkok Healthcare Hospital
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Academic Year	March 2001

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 Systems.

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ABSTRACT

Patient Registration Information System is the computerized information system to support the registration department. The existing workflow of the department is done manually. It takes a lot of time to process and also produces inaccurate results. In addition, the increased volume of patient causes it difficult to manually process efficiently.

Therefore, the Information System is developed to solve the problem occurring from the existing system and to support the process and services in registration of the Bangkok Healthcare Hospital. The system consists of five processes: register patient, screening patient, medical services, arrange appointment, and maintain patient. The computerized system can provide accuracy, increase throughput, and reduce response time.

Apart from the increased efficiency in registration department process and service, the Information System also provides management reports needed in decision making and future planning.

ACKNOWLEDGEMENTS

The writer is grateful to several people who have made contribution to the preparation of this project report. She would like to acknowledge their effort and thank them for their contributions.

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She extends her sincere thanks to the registration department of the hospital, the staff of the hospital who gave the information and details of the operations of the registration department. Special thanks to her sister: the nurse, for her guidance. Finally, she is thankful to her parents who inspire and support her throughout her studies in numerous ways.

It hardly needs saying that much of the value of this project report is due to their assistance. However, any omissions or errors that remain between the covers are rested on her responsibility.

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1.1 Background of the Project

Nowadays, providing improved efficiencies and achieved global standard of healthcare in for hospital covering all medical and administration service have been greatly emphasized. To complete effectively, the hospital needs to get a much better integration between a registration department and several other departments.

The Bangkok Healthcare Hospital is a private hospital, offering a 24 hours service. Because of the increasing volume of patients, the existing manual system in the registration department has become inadequate in providing the data needed to satisfy the patients. In addition, the registration department also causes the high cost of management expenses. It needs a lot of empower to maintain the operation process, whereas it cannot support the daily decision making because the information is manually stored in document form that is difficult to search and sort. The cost of the pre-printed forms, relevant documents and maintenance are very high and flexible.

Therefore, it is timely that the hospital needs an effective information system; a computerized system, to facilitate the process of the registration and administration services by providing all required information that must be timely, accurate, and up to date. It should be easily accessible and readily available in order to improve as well as provide quality patient care. Furthermore, daily reports will be produced to use as a tool for planning and decision making for the future.

1.2 Objectives of the Project

The objective of this project is to provide efficient medical service and to ensure that operation method and registration of registration department have good and

standardized quality and provide convenience in searching for patient record. To achieve this objective, the following tasks are carried out:

(1) To improve the registration management of the organization by 70%.

(2) To reduce a number of workers by 50%.

(3) To reduce a lot of paper and document leading to an effective cost reduction by at least 75%.

(4) To increase efficiency and to reduce processing time including storing and retrieving the data by 80%.

(5) To increase efficiency for security of document by 80%.

(6) To develop decision making by using the method of accessing that is faster by 75%.

1.3 Scope of the Project

The project presents the analysis, design, and proposed solution for the registration system that concentrates on the patient information, patient medical record, and medical services dealing with taking care of patients who visit the hospital. The scope of the project can be categorized into:

1.3.1 Review the Current Operation Model

(1) Develop understanding of present and future operation model (e.g. patient, doctor, and service facilities).

(2) Review existing operation method and reporting.

(3) Interview operational person and management to identify requirements and gaps.

(4) Prepare a concept design for the patient information requirements.

(5) Prepare a summary report with finding, conclusions and recommendations.

1.3.2 Development of the proposed system that covers major parts of the Patient Registration Information System as follows:

(1) Register

(a) Create patient medical record.

(b) Create new patient.

(c) Issue magnetic patient card.

(2) Maintain patient record

(a) Keep tracking and maintain patient treatment record.

(b) Update patient information.

(c) Record doctor's diagnosis.

(d) Delete old patient's record.

(3) Manage appointment

(a) Make appointment.

(b) Check appointment schedule.

(c) Cancel appointment.

(4) Admission

(a) Create admitted patient's record.

(b) Discharge in-patient.

(5) Inquiry

(a) Inquiry patient information.

(b) Inquiry appointment schedule by doctor.

(c) Inquiry admitted patient.

(d) Inquiry patient medical record.

(e) Inquiry daily list of visit by department.

(f) Inquiry prescription by HN.

(6) Operation reports

(a) Patient list report by department.

(b) Patient medical record report.

(c) Patient profile report.

(d) Appointment list report by doctor.

(7) Management reports

(a) Generate patient statistics by month.

(b) Generate patient statistics by department.

(c) Generate patient statistical comparison between year.

1.4 Deliverables

The deliverables for the system development project are as follows:

(1) Work flow of the Existing System.

(2) Context Diagram and Data Flow Diagram of the Proposed System.

(3) Screen Layout and Report.

(4) Cost and Benefit Analysis.

1.5 Project Plan (Include Gantt Chart)

The project plan is illustrated in the form of Gantt Chart as shown in Figure1.1.

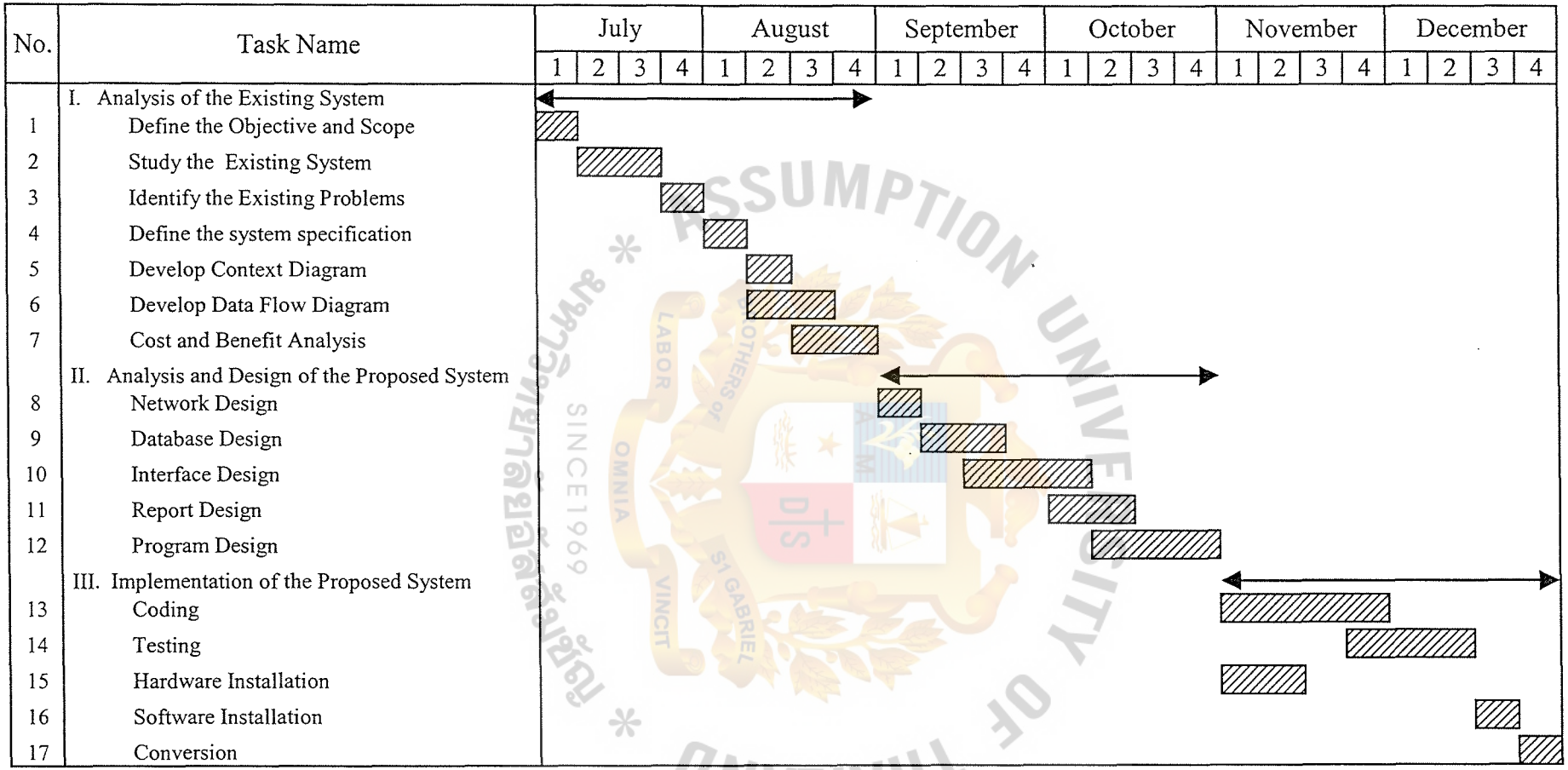

Figure 1.1. Project Plan of Patient Registration Information System.

II. THE EXISTING SYSTEM

2.1 Background of the Organization

The Bangkok Healthcare Hospital, established in 1985, was operated by skilled professionals specializing in a wide range of fields, medical equipment for treatments and diagnosis, and a highly trained and qualified medical staff ready to provide quality service.

The hospital had a 3-floor building, capable of receiving 80 patients. There were between 5 and 6 highly respected doctors and 20 nurses. The hospital had the very latest technology in it's modern operating room and was highly respected and trusted by the people. Since its establishment the hospital has extended its facilities and services through continued investment in the latest technology and the employment of expert doctors and specialists.

At present, the Bangkok Healthcare Hospital has a 7-floor building. It has 140 beds, 30 examining rooms and is capable of serving 750 outpatients a day. There are 9 specialist centers whose expert staff can diagnose and treat all kinds of diseases.

The Bangkok Healthcare Hospital operates a 24 hour service. It is a medical center caring for patients of all nationalities and a place where medical technology and compassion met together for the well being of its patients. The organization chart of the Bangkok Healthcare Hospital is shown in Figure 2.1.

2.2 Existing Business Functions

The business functions of the Bangkok Healthcare Hospital are categorized into five main functions to act in its hospital as follows:

2.2.1 Administration Section: This section consists of:

(1) Administration Department

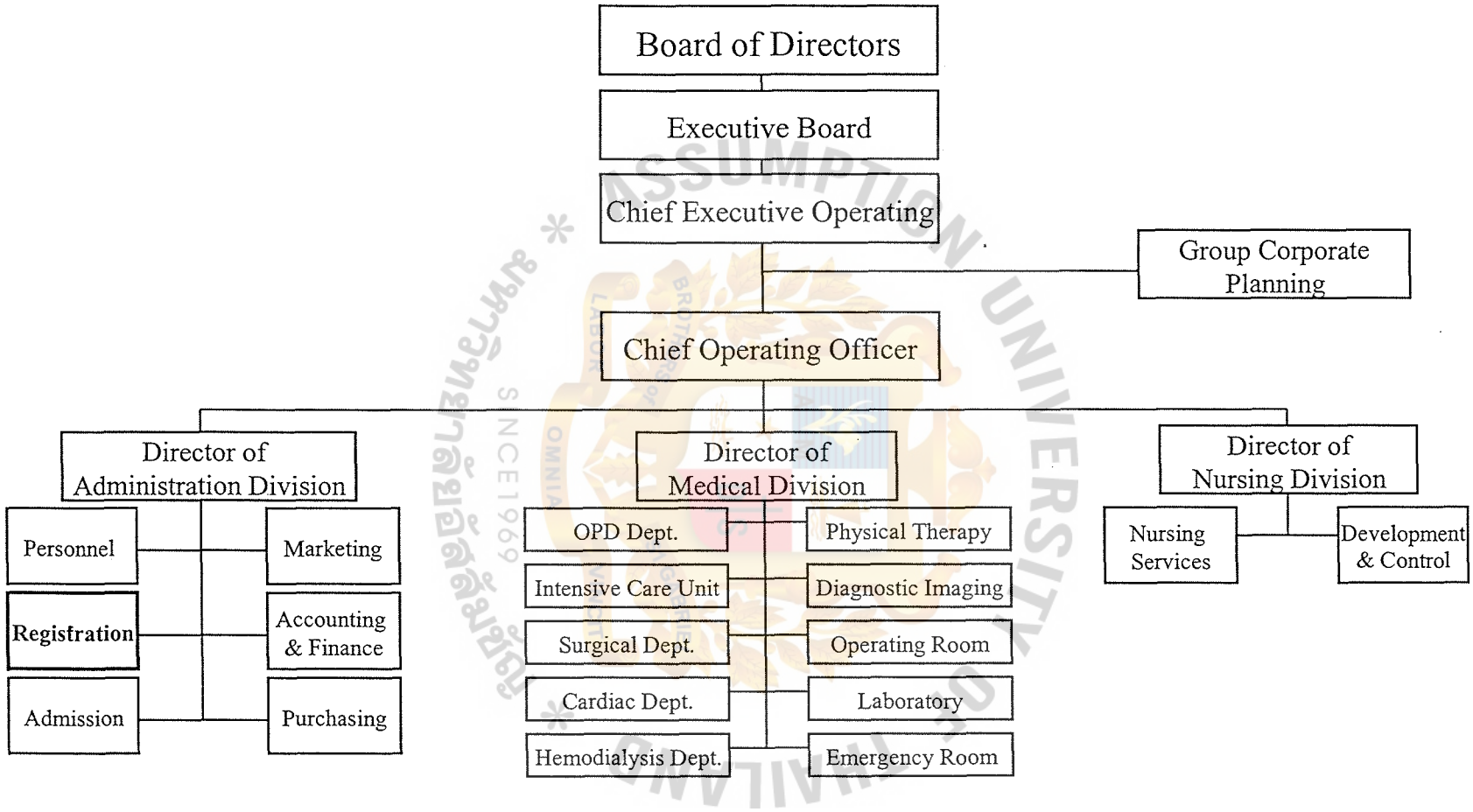

Figure 2.1. Organization Chart of Bangkok Healthcare Hospital.

They control and manage in the general matter of the hospital.

(2) Registration Department: The main duties are below:

(a) Creating patient record.

(b) Keeping confidential patient record.

(c) Providing patient services.

(d) Screening patient.

(e) Record patient's diagnosis.

(f) Update patient's information.

(g) Deleting patient's record.

(3) Personnel Department: The main duties are composed of:

(a) Controlling the employment system.

(b) Verifying time working of employee.

(c) Making employee payroll from employee system every month.

(d) Keeping confidential employee data.

2.2.2 Operation: This section consists of:

(1) Diagnostic Imaging Department

They operate X-ray, Ultrasound, and various diagnostic examination.

(2) Laboratory Department

They are responsible for the establishment of appropriate procedures, collection of specimens, analysis of body tissues and fluids, and prompt reporting results.

2.2.3 Inventory Management and Control

They are responsible for the procurement, receiving, processing storage and distribution of all of the hospital pharmaceutical and supplies.

2.2.4 Finance Section: There are two sections in the department:

(1) Finance Department: The duties of department are as below:

(a) Managing the cash flow system.

(b) Controlling the payment system.

(c) Connecting with account payable and receivable.

(d) Requesting the credit facilities from bank or financial institution.

(2) Accounting Department: The duties of department are as below:

(a) Verifying payment voucher.

(b) Managing the cash flow system.

(c) Making financial statement for supporting executive's requirement and public shareholders.

(d) Collecting financial document.

(e) Controlling customers credit term of the company.

2.2.5 Group Corporate Planning

The actions in this department are as the secretary of the company. They have external connection to inform the news of the company. They have created the vision of the company and contracted with both local and foreign subsidiary companies. And they also handle the legal section because the company has more risk in their business and in the agreement.

2.3 Current Problems and Area for Improvement

Several problem domains are identified during the analysis of the existing system. Those problems are in unstructured problem classified by using the PIECES Problem-Solving Framework as follows:

P-PERFORMANCE

Throughput

Problems:- Small number of work is accomplished due to the slow manual system.

Response time

Problems:- Inability to provide fast services for data searching which causes a delay in report as well as admission of patient. This is because of the slow manual system.

I-INFORMATION (and Data)

Outputs

Problems:- Information is difficult to produce and is not timely for subsequent use because it is processed manually so it takes much time in preparing a report.

Opportunities: - Enable to provide ad-hoc report and select format of reports.

Directives: - Enable to relate information between registration system and others.

Inputs

Problems:- There is a lot of redundancy of patient information since patient forgets H.N. card, it is difficult to find the record. Officer needs to make a new record.

- Data are not captured such as doctor forgets to record appointment on O.P.D. card.

Stored Data

Problems:- It is difficult to maintain or arrange data and documents because there is a great number of data and documents.

- Data are not secure to accident
- Data are not easy to meet new information needs from stored data

Opportunities: - Using DBMS to manage data.

E-ECONOMICS

Costs

Problems:- Costs of material and workers are more than necessary.

C-CONTROL (and Security)

Too little security or control

Problems:- No back up and recovery plan when patient information is lost.

- Lack of access to management and decision-making information.
- There is no efficient control O.P.D. card so they do not know where O.P.D. card is.

Opportunities: - Using login and password to access the registration system.

- Defining authorization of each staff for accessing the system.

E-EFFICIENCY

People, machines, or computer waste time

Problems:- Work is not processed smoothly because it is done manually so it cannot efficiently provide patient information or good services.

S-SERVICE

The system produces inaccurate results

Problems:- Accurate results are not good enough.

The system is inflexible to new or exceptional situations

Opportunities: - Enable to underlie to new diagnosis of each patient.

The system is inflexible to change

Problems:- Since there is no database, it is inflexible to update information or to expand the information system in the future.

The system dose not coordinate with other systems

Directives: - Using online processing to enable to coordinate with other systems.

2.4 The Existing Manual System

2.4.1 The Existing System Process

The process of the existing system is summarized as follows:

(1) Register Patient

(a) For a new patient, filling a registration form to create a new patient record, H.N. card, and O.P.D. card.

(b) For a current patient, verifying H.N. card, registering patient for an O.P.D. card.

(c) Sending O.P.D. card that is separated by symptom to each department.

(2) Maintenance Patient Record

(a) Searching, updating, keeping, and deleting patient information and O.P.D. card.

(b) Record doctor's diagnosis.

(3) Medical Services

(a) Changing out-patient status to in-patient, sending admission note to admission department for room reservation.

(b) Filling investigation form for more diagnoses, and send to laboratory.

(c) Filling all treatment in prescription by doctor, and send to pharmacy department.

(4) Appointment

(a) Making appointment for a follow-up progression.

(b) Updating appointment schedule.

All transactions of the registration department in the hospital are done manually by staff. Documents are also delivered by staff and management information, tracking of statistical information is not available.

2.4.2 Workflow of Existing System

The context diagram of the existing system is shown in Figure 2.2 interacting with 7 external entities that are Patient, Doctor, Laboratory, Pharmacy Department, Admission, Insurance Company, and Other Departments.

2.4.3 Existing System Cost

The existing system costs include the cost of personnel, utilities, and other expenses. The existing system costs (annual cost) as follows:

(1)	Personnel		
	(a) Registration Manager	23,000 baht * 1 person	276,000 baht
	(b) Registration Officer	9,000 baht * 6 persons	648,000 baht
	(c) Staff	8,000 baht * 11 persons	1,056,000 baht
(2)	Office supplies and Miscellaneous costs		114,200 baht
(3)	Other expenses		41,150 baht
		Total annual existing costs	2,135,350 baht

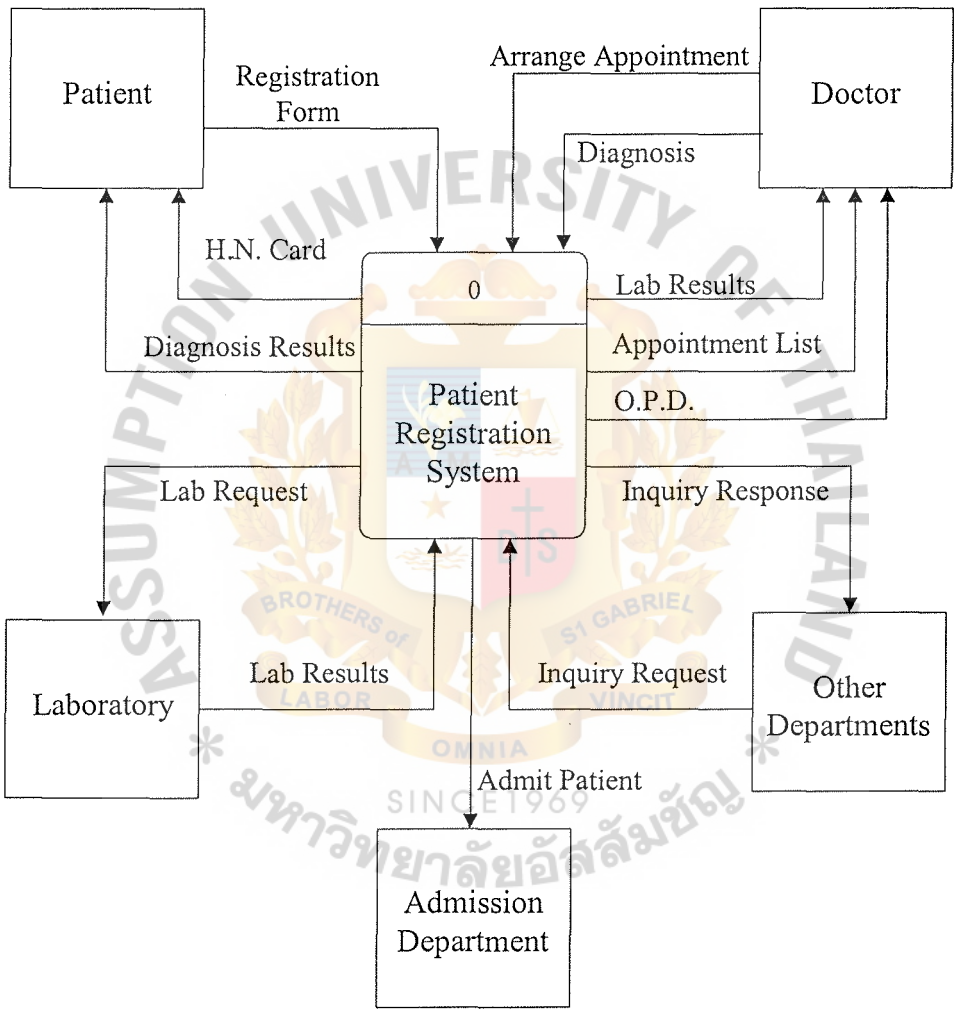

Figure 2.2. Context Diagram of Existing System.

III. THE PROPOSED SYSTEM

3.1 System Specification

According to the previous chapter, Bangkok Healthcare Hospital now requires an effective Patient Registration Information System, which can facilitate the various processes of Registration, and solve the problems occurring from the existing manual system.

In order to achieve the target, the new proposed Patient Registration Information System should have the components as follows:

(1) Provide a computerized system to assist with the process of registration.

(2) Provide and maintain a computerized patient database replacing the existing manual system to provide current patient information on demand and to enable to add, change, and delete patient information.

(3) Provide and maintain an appointment's schedule database to facilitate the staff's work, to provide current appointment information on demand, and to solve the problem occurring from the current system.

(4) Provide patient information reports such as the number of patients for a time period (days, months, and annual) by department.

(5) Provide GUI screen for user to interact with the system friendly.

(6) Provide security and control procedure to prevent unauthorized person and defining authorization of each level for accessing the system.

(7) Provide data retrieval process to access easily and fast.

(8) Provide the link to integrate with other systems.

3.2 System Design

3.2.1 Entity Relationship Diagram

(1) Logical Data Model

In the proposed system, there are nine entities; Patients, OPD, Department, Doctor, Appointment, Company, Prescription, Laboratory, Admission, Figure 3.1 and Figure 3.2 illustrates the entities and relationship that have already been normalized into 3NF.

(2) Physical Database Schema

The database schema shown in Appendix A represents the technical implementation of the logical data model.

3.2.2 Data Flow Diagram

(1) Context Diagram

The context diagram for the proposed system is constructed to define the scope and boundary for system as shown in Figure 3.3. It contains one process; Patient Registration Information System, 8 external entities, and data flows that define the interaction of system with the boundaries.

(2) Functional Decomposition Diagram

Figure 3.4 and Figure 3.5 illustrate the top-down functional structure of the Patient Registration System divided into five subsystems as follows:

(a) Register Patient

(1) For a new patient, filling a registration form to create a new patient record, magnetic patient card, and O.P.D.

(2) For a current patient, verifying H.N. card, registering patient for an O.P.D.

(b) Screening Patient

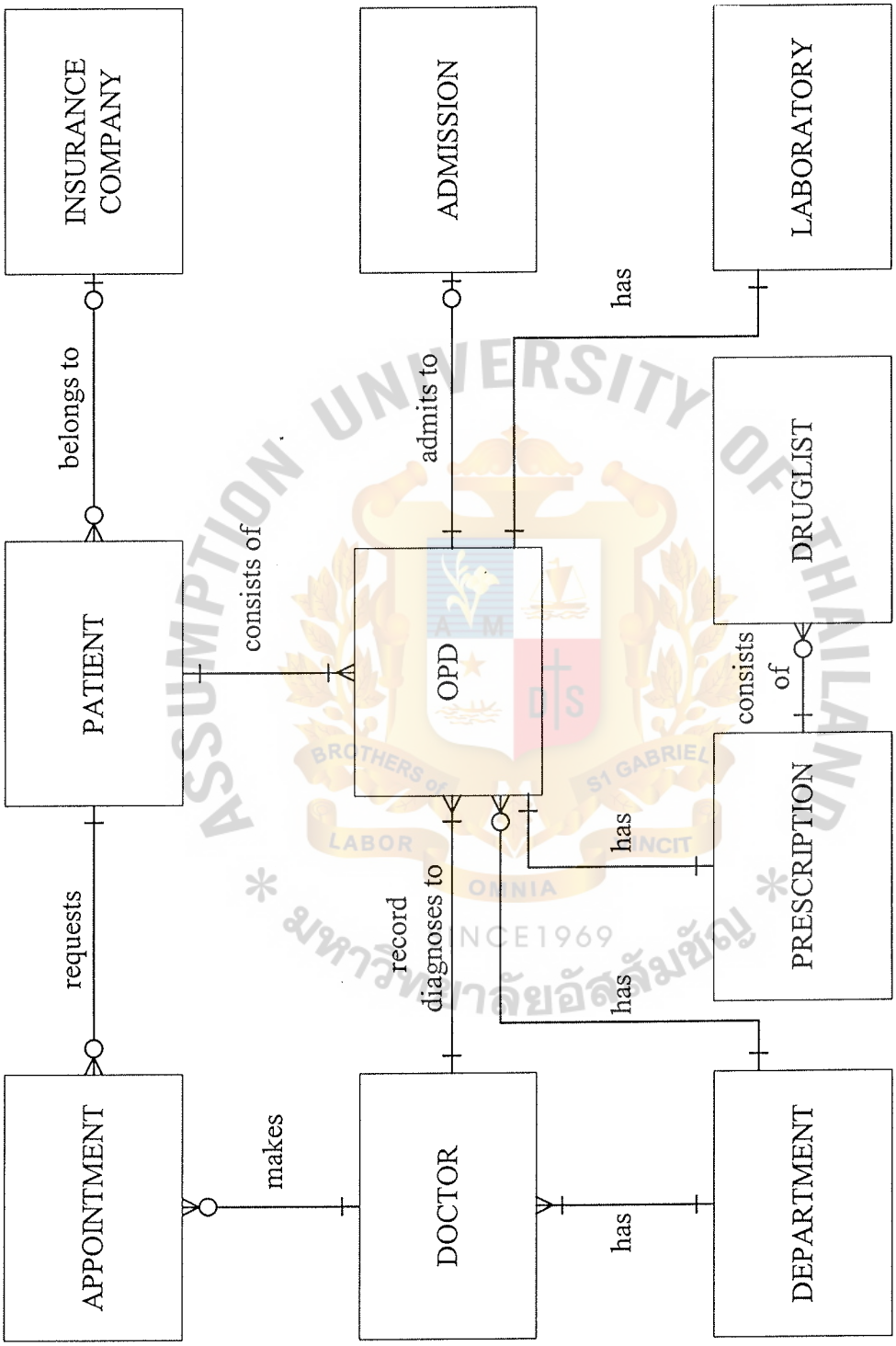

Figure 3.1. Context Data Model of Patient Registration Information System.

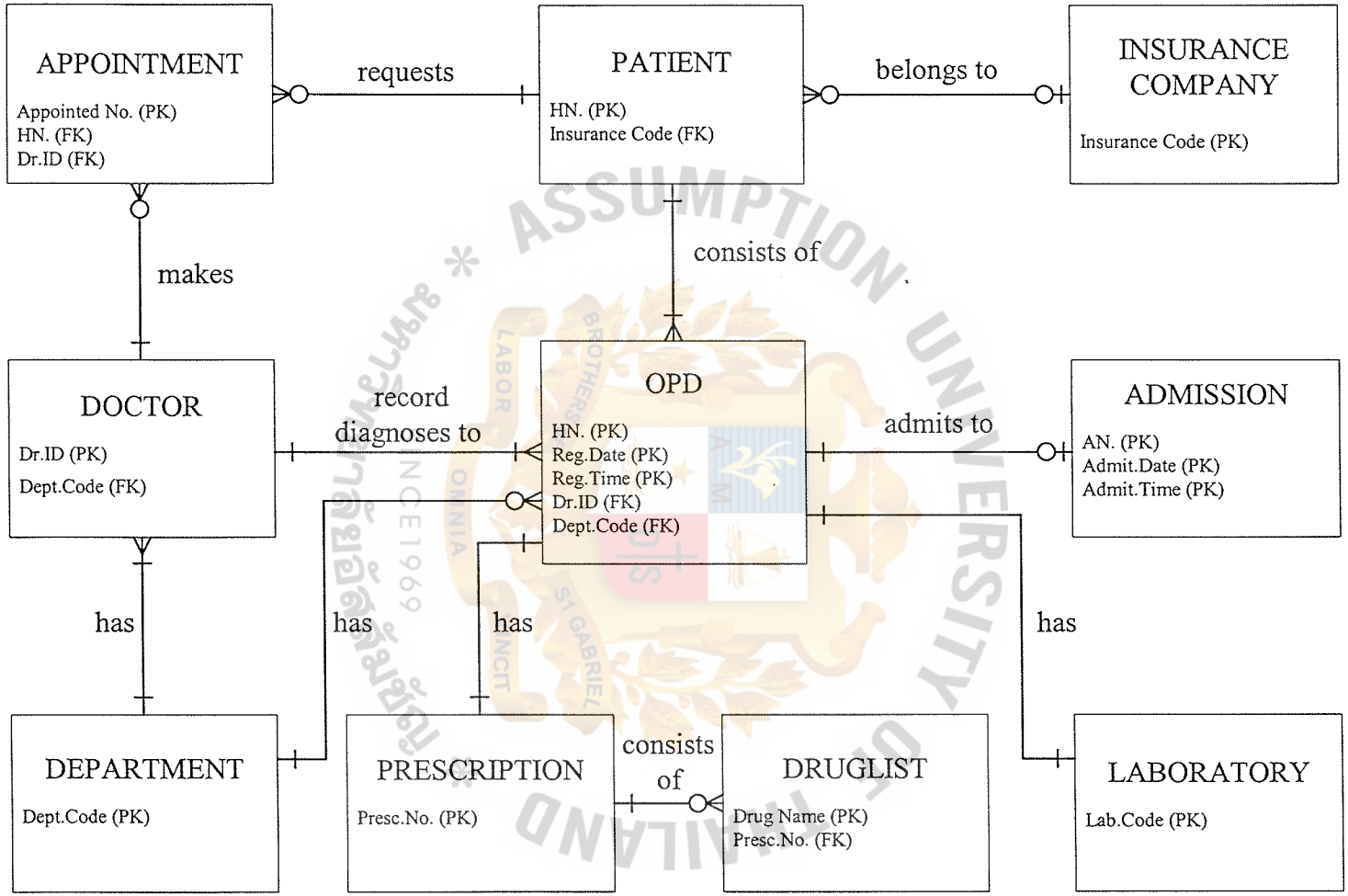

Figure 3.2. Key-Based Data Model of Patient Registration Information System.

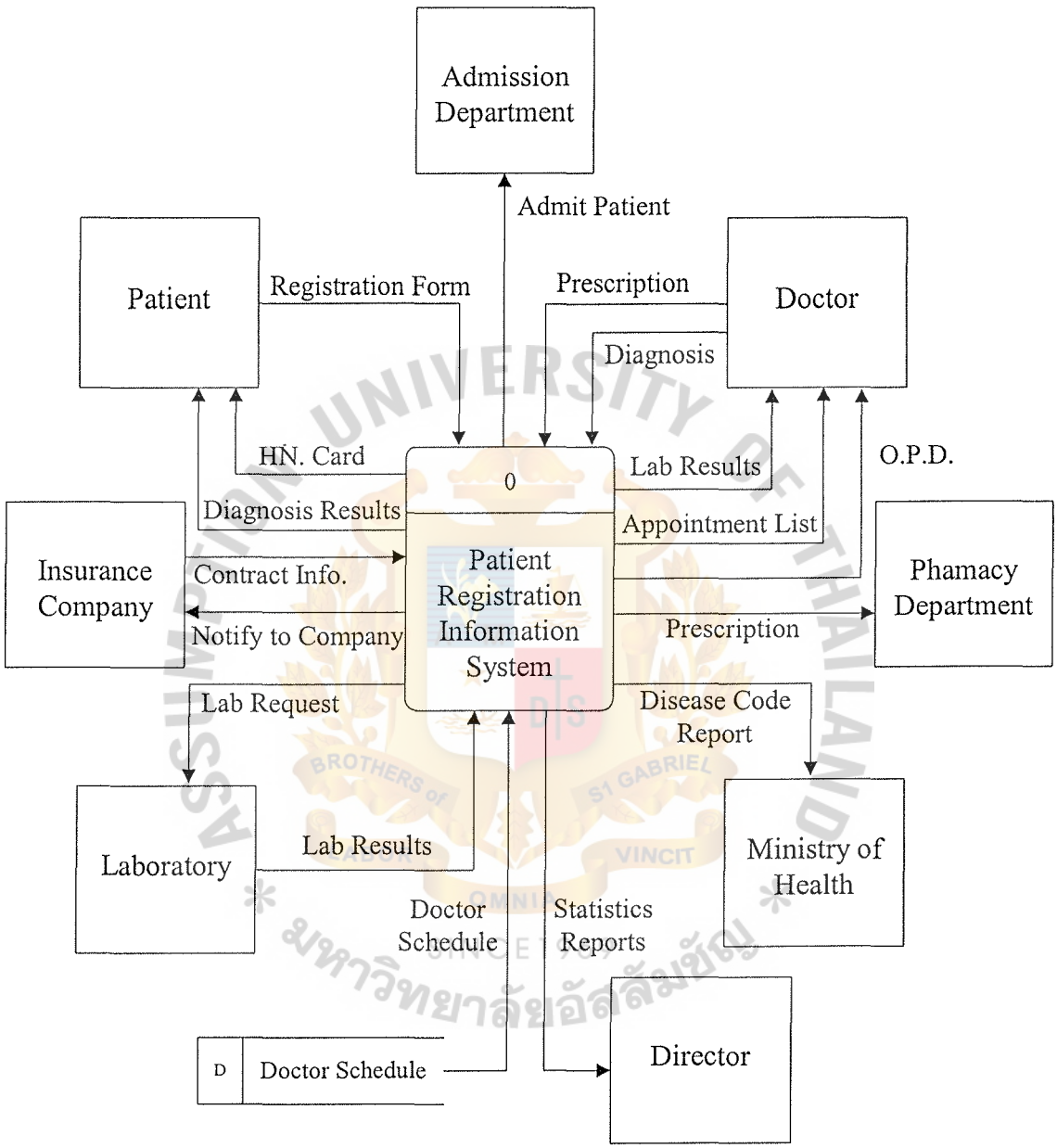

Figure 3.3. Context Diagram of Patient Registration Information System.

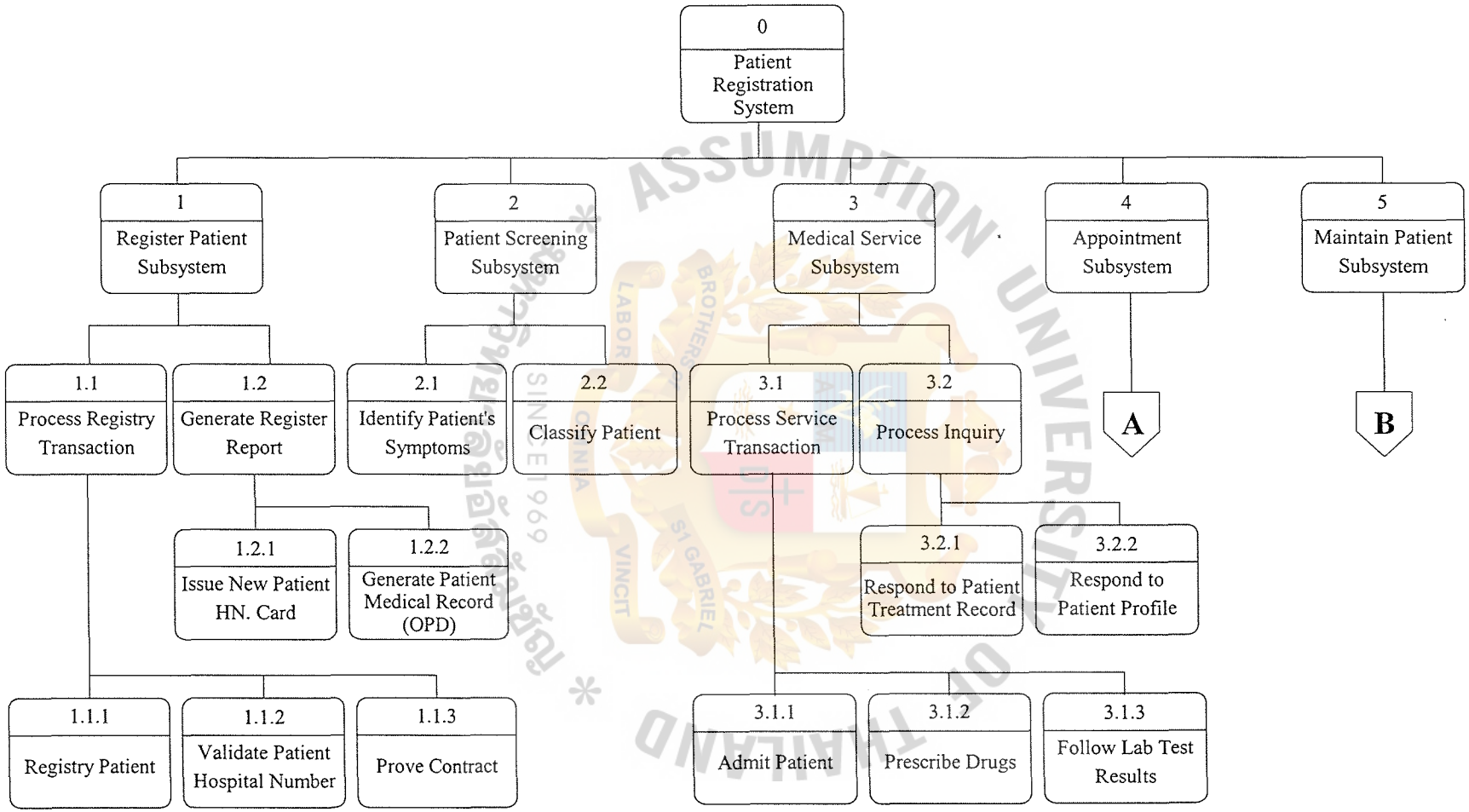

Figure 3.4. Functional Decomposition Diagram of Patient Registration Information System.

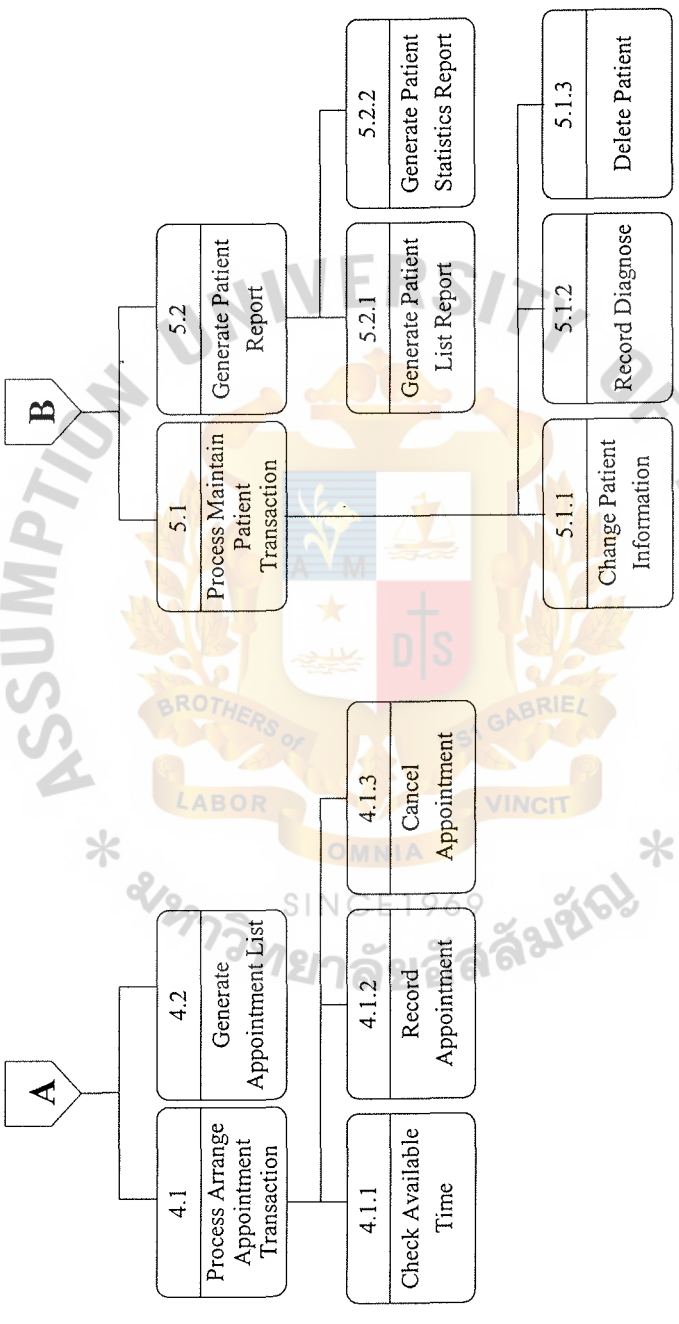

Figure 3.5. Functional Decomposition Diagram of Patient Registration Information System (Continued).

(1) Having vital sign measures, and identify patient's symptom.

(2) Classifying patient by symptom, and send patient to each department.

(c) Medical Service

(1) Changing out-patient status to in-patient, and send O.P.D. to admission department for room reservation.

(2) Following laboratory test results, and record laboratory code into O.P.D.

(3) Record all treatments in prescription by doctor, and send to pharmacy department.

(d) Appointment

(1) Checking availability to make appointment for a follow-up progression.

(2) Updating appointment schedule.

(e) Maintain Patient

(1) Searching, updating, and deleting patient profile and O.P.D.

(2) Record doctor's diagnosis.

(3) Generating operation and management reports.

(4) System Diagram

The level 1 data flow diagram of the proposed system shown in Figure 3.6 illustrates the interactions between five systems. The remainder of the data flow diagram is shown in Appendix B.

(5) Process Specification

The process specification for the data flow diagram of the proposed system is listed in Appendix C.

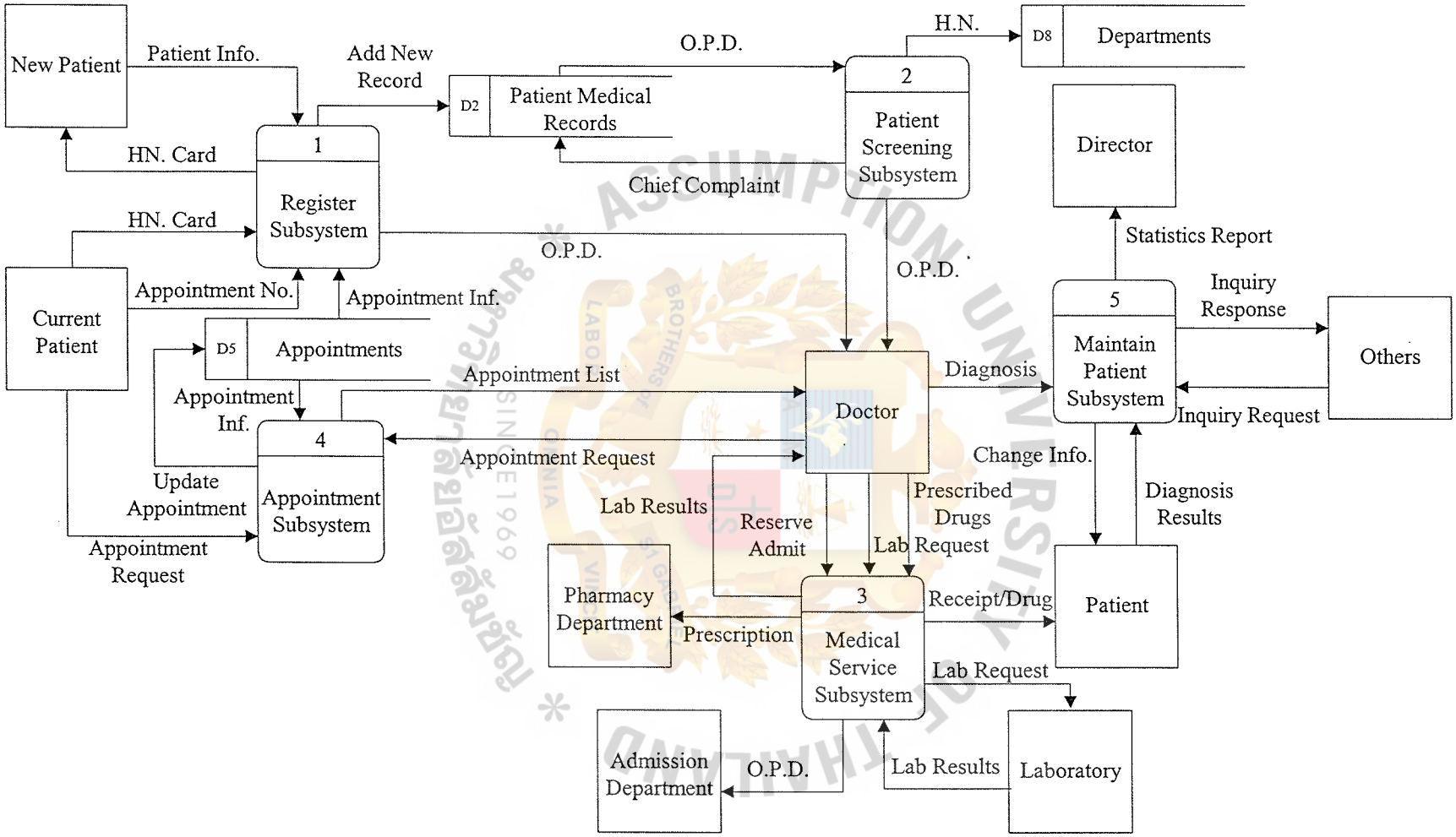

Figure 3.6. System Diagram of Patient Registration Information System.

3.2.3 System Structure Chart

The system structure charts for the proposed system are shown in Appendix D. The system structure charts show the hierarchy and organization of partitioned modules, and the communication interfaces between modules.

3.2.4 Interface Design

The proposed system uses method called On-line processing that input editing and output formatting occur on client computers in an on-line mode. Input transactions and information requests are transmitted on-line to several computers for processing, so updating, inquires, and reports can be processed immediately.

All input screens of the proposed system are shown in Appendix F. All output screens and reports of the proposed system are shown in Appendix G.

3.3 Hardware and Software Requirement

3.3.1 Candidate Solution

For the patient registration information system, we identify alternative candidate solutions for a proposed system by using a matrix format. The candidate system matrix shown in Table 3.1 is used to provide overview characteristics concerning the portion of the system to be computerized, the business benefits, and software tools.

3.3.2 Network Requirement

The proposed system uses the computing model called Client/Server Computing in form of two-tier client/server that this architecture places the information system's stored data on a server and the business logic and user interface on clients connected by a local area network using Star Network Topology in which each computer attaches to a central point called a hub. This topology will be cooperated with a LAN operating system using Microsoft Windows NT 4.0 Server. The network configuration for the proposed system is shown in Figure 3.7.

Table 3.1. The Candidate System Matrix.

Characteristics	Candidate 1	Candidate 2	Candidate 3
Portion of System Computerized Brief description of the portion of the system that would be computerized in this candidate.	Patient Registration in relation to register, maintain, and service systems.	Patient Registration in relation to register, maintain, and service systems.	Patient Registration in relation to register,maintain and service systems.
Benifits Brief description of the business benefits that would be realized for this candidate.	Fully supports user required registration systems for BKK Healthcare Hospital. Plus more efficient interaction with patient.	This solution can be implemented quickly because it's a packaged solution.	This solution can be implemented quickly because it's a packaged solution.
Servers and Workstations A description of the servers and workstations needed to support this candidate.	Technically architecture dictates Compaq ML530 Processor 1 GHz Dual CPU, Windows NT class servers, and Pentium III 550 MHz, MS Windows NT 4.0 workstations (clients).	Technically architecture dictates Compaq ML530 XEON 900 MHz Dual CPU, Windows NT class servers, and Pentium III 550 MHz, MS Windows NT 4.0 workstations (clients).	Technically architecture dictates 556 MHz Intel Pentium III 550 MHz, MS Windows NT class servers, and Celeron II 466 MHz, MS Windows NT 4.0 workstations (clients).
Software Tools Needed Software tools needed to design and build the candidate.	MS Visual C++ 6.0, MS Visual Basic 6.0 and MS Developer Network (MSDN).	MS Visual Basic 6.0, Oracle 8.0, and MS Developer Network (MSDN).	MS Access 97, and MS Developer Network (MSDN)
Application Software 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.	Client/Server Real-time On-line processing	Client/Server On-line processing	Client/Server Batch processing
Output Devices and Implications The output devices that would be used, special output requirements, and output considerations.	(2) HP8100 DN laser printers (1) EPSON LQ1200 printer	(2) HP8100DN laser printers (1) EPSON LQ1200 printer	(2) HP5SI LAN laser printers (1) EPSON LQ1200 printer
Input Devices and Implications The input devices that would be used, special output requirement, and input considerations.	Keyboard and Mouse	Keyboard and Mouse	Keyboard and Mouse
Storage Devices and Implications Brief description of what storage media would be used, how much storage capacity would be needed, and how data would be organized.	MS SQL Server DBMS with 100 GB arrayed capability.	Oracle 8.0 DBMS with 100 GB arrayed capability.	MS Access DBMS with 80 GB arrayed capability.
Peopleware People needed to build and support.	(1)Network Administrator (1)Database Administrator (3)Application Administrators	(1)Network Administrator (1)Database Administrator (3)Application Administrators	(1)Network Administrator (1)Database Administrator (3)Application Administrators

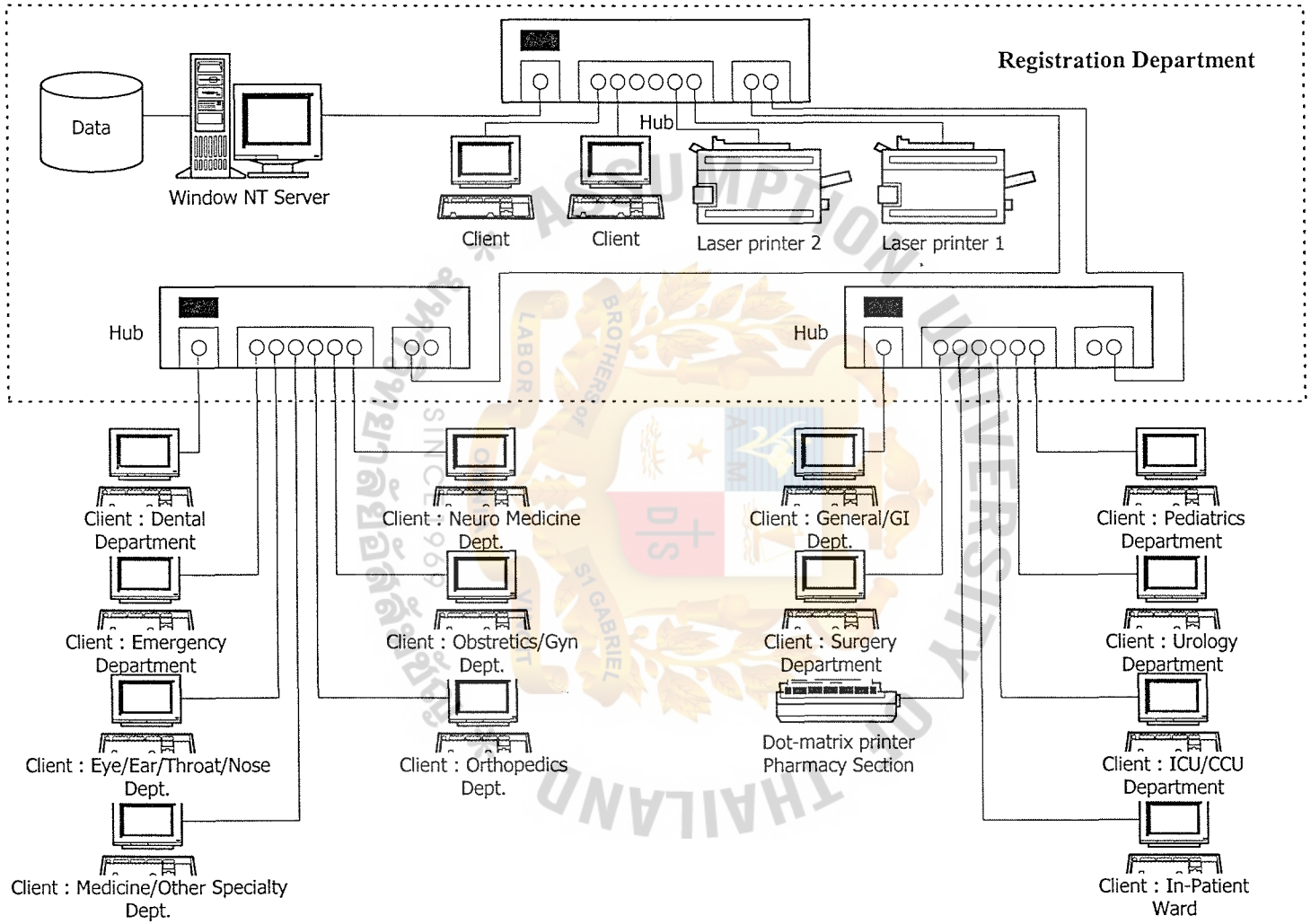

Figure 3.7. Network Configuration of Patient Registration Information System.

3.3.3 Hardware Requirement

Table 3.2. The Hardware Specification for the Computer Server.

Hardware	Specification
CPU	Pentium III Dual CPU 900 MHz.
Cache	256 KB or higher
Mainboard	ASUS CUBX Socket 370 ATX.
Memory	SDRAM 2 GB. PC 100 MHz.
Hard Disk	100 GB (7200 RMP)
CD-Rom Drive	50X
Floppy Drive	1.44 MB
Network Adapter	Ethernet 10-Base T (RJ45 connector)
Display	21" SVGA monitor
VGA	ASUS V3800/TNT/16Mb
UPS	600 VA.

Table 3.3. The Hardware Specification for Each Client Machine.

Hardware	Specification
CPU	Intel Pentium III 550 MHz.
Mainboard	GIGABYTE Socket 370 ATX.
Memory	SDRAM 128 MB. PC 100 MHz.
Hard Disk	10.3 GB (5400 RMP)
CD-Rom Drive	40X
Floppy Drive	1.44 MB
Network Adapter	Ethernet 10-Base T (RJ45 connector)
Display Adapter	SVGA card
Display	17" SVGA monitor
UPS	600 VA.

Table 3.4. The Peripheral Specification.

Hardware	Specification
Laser Printer	HP8100DN
Dot Matrix Printer	EPSON LQ 1200
HUB	8 Port 10/100 Mbit

3.3.4 Software Requirement

The proposed system uses Oracle 8.0 as file server to store all data on server and uses MS Visual Basic as the software program to run the business logic of the information system application on the clients. The software specification for server and clients are shown in Table 3.5 and Table 3.6 respectively.

Table 3.5. The Software Specification for the Computer Server.

Software	Specification
Operating System	Microsoft Windows NT Server 4.0
Application Server	Microsoft Visual Basic Version 6.0
Database Server	Oracle 8.0

Table 3.6. The Software Specification for Each Client Machine.

Software	Specification
Operating System	Microsoft Windows NT 4.0
Application Program	Microsoft Visual Basic Version 6.0
Database Server	Oracle 8.0

3.4 Security and Control

In a health care environment of hospital, guaranteeing to keep personal information private and secure, and employ special precautions for any personal health information is essential so a number of security concerns must be addressed including confidentiality (identification, authentication, and authorization) and integrity (authorized modification of information).

The proposed system must be able to use security procedures to protect personal information against unauthorized disclosure and to control integrity ensuring that the things users are trying to do are correct.

The proposed system provides the security and control are as follows:

(1) Login-Password

The first level of security is login to system. When user signs on to the system, it requires their user ID and password to recognize the requesting user. Then the only authorized person will be able to gain access to the system and its input screens.

(2) Access Permission

The system supports user group to share the same user ID in each level. Each level can access to different part of the system that provides procedures for users to review and correct their personal information of patient including other information.

(3) Integrity Control

There are two parts of control as follows:

(a) Input Control

The proposed system provides checking the accuracy and validity of data whenever any data updated operation is attempted.

The system uses Limit and Range Checks to determine whether the input data for each field falls within the legitimated range of values defined for that field.

(b) Output Control

Each printed report must be approved by manager before sending to the destination who is the right person.

(4) Back Up

Both system database and user database will be backed up daily onto tape back up system to ensure that data can be recovered whenever the system is crashed.

3.5 Cost and Benefit Analysis

3.5.1 Cost Analysis

System costs are categorized into:

(1) Fixed Cost

(a) Hardware purchase.

(b) Software purchase.

(c) Implementation cost, including preparation of computer site, training, and documentation for a new system, and file conversion.

(d) Personnel hours for analysis, design, programming, and testing.

(2) Operating Cost

(a) Hardware and software maintenance contracts.

(b) Day-to-day personnel cost, including computer operations, data entry operators, and end-user costs.

(c) Office supplies and miscellaneous costs.

Table 3.7 and Table 3.9 illustrate existing manual system costs and estimated computerized system costs for the proposed new system respectively.

(1) Costs of Manual System

Table 3.7. Manual System Cost Analysis, Baht.

Cost items	Years				
	1	2	3	4	5
Fixed Cost					
Typewriter 3 units @ 7,500	22,500.00	–	–	–	–
Facsimile 2 units @ 7,450	14,900.00	–	–	–	–
Calculator 3 units @ 1,250	3,750.00	–	–	–	–
Total Fixed Cost	41,150.00	–	–	–	–
Operating Cost					
Personnel Cost:					
Registration Manager 1 person @ 23,000	276,000.00	303,600.00	333,960.00	367,356.00	404,091.60
Registration officer 6 persons @ 9,000	648,000.00	712,800.00	653,400.00	862,488.00	948,736.80
Staff 11 persons @ 8,000	1,056,000.00	1,161,600.00	1,089,000.00	1,405,536.00	1,546,089.60
Total Annual Personnel Cost	1,980,000.00	2,178,000.00	2,076,360.00	2,635,380.00	2,898,918.00
Office Supplies & Miscellaneous Cost:					
Stationary Per Annual	36,000.00	39,600.00	43,560.00	47,916.00	52,707.60
Paper Per Annual	45,800.00	50,380.00	55,418.00	60,959.80	67,055.78
Utility Per Annual	16,800.00	18,480.00	20,328.00	22,360.80	24,596.88
Miscellaneous Per Annual	15,600.00	17,160.00	18,876.00	20,763.60	22,839.96
Total Annual Office Supplies & Miscellaneous Cost	114,200.00	125,620.00	138,182.00	152,000.20	167,200.22
Total Annual Operating Cost	2,094,200.00	2,303,620.00	2,533,982.00	2,787,380.20	3,066,118.22
Total Manual System Cost	2,135,350.00	2,303,620.00	2,533,982.00	2,787,380.20	3,066,118.22

Table 3.8. Five Years Accumulated Manual System Cost, Baht.

Year	Total Manual Cost	Accumulated Cost
1	2,135,350.00	2,135,350.00
2	2,303,620.00	4,438,970.00
3	2,533,982.00	6,972,952.00
4	2,787,380.20	9,760,332.20
5	3,066,118.22	12,826,450.42
Total	12,826,450.42	–

(2) Costs of Computerized System

Table 3.9. Computerized System Cost Analysis, Baht.

Cost items	Years				
	1	2	3	4	5
Fixed Cost					
Hardware Cost:					
Computer Server 1 unit @ 287,500	57,500.00	57,500.00	57,500.00	57,500.00	57,500.00
Computer Client 15 units @ 56,500	169,500.00	169,500.00	169,500.00	169,500.00	169,500.00
Laser Printer 2 units @ 142,500	57,000.00	57,000.00	57,000.00	57,000.00	57,000.00
Dot Matrix 1 unit @ 9,500	1,900.00	1,900.00	1,900.00	1,900.00	1,900.00
HUB 8 Port 3 units @ 8,500	5,100.00	5,100.00	5,100.00	5,100.00	5,100.00
Total Hardware Cost	291,000.00	291,000.00	291,000.00	291,000.00	291,000.00
Software Cost:					
Server Software	39,000.00	39,000.00	39,000.00	39,000.00	39,000.00
DBMS Server Software (Oracle)	22,000.00	22,000.00	22,000.00	22,000.00	22,000.00
Client Software	27,000.00	27,000.00	27,000.00	27,000.00	27,000.00
Total Software Cost	88,000.00	88,000.00	88,000.00	88,000.00	88,000.00
Implementation Cost:					
Preparation of Computer Site	22,000.00	–	–	–	–
Training	30,000.00	–	–	–	–
Document for New System 15 units @ 200	3,000.00	–	–	–	–
File Conversion	17,500.00	–	–	–	–
Total Implementation Cost	72,500.00	–	–	–	–
Personnel Cost:					
System Analyst 2 persons @ 1,250	825,000.00	–	–	–	–
GUI Designer 1 person @ 750	112,500.00	–	–	–	–
Programmer 2 persons @ 850	357,000.00	–	–	–	–
IT Specialist 1 person @ 1,450	72,500.00	–	–	–	–
Database Specialist 1 person @ 1,150	28,750.00	–	–	–	–
Total Personnel Cost	1,395,750.00	–	–	–	–
Total Fixed Cost	1,847,250.00	379,000.00	379,000.00	379,000.00	379,000.00
Operating Cost					
Maintenance Cost:					
Maintenance for Server	–	18,500.00	20,350.00	22,385.00	24,623.50
Maintenance for Software	–	13,000.00	14,300.00	15,730.00	17,303.00
Total Maintenance Cost	–	31,500.00	34,650.00	38,115.00	41,926.50
Personnel Cost:					
Registration Manager 1 person @ 25,000	300,000.00	330,000.00	363,000.00	399,300.00	439,230.00
Computer Operator 3 persons @ 10,000	360,000.00	396,000.00	435,600.00	479,160.00	527,076.00
Staff 4 persons @ 8,000	384,000.00	422,400.00	464,640.00	511,104.00	562,214.40
Total Annual Personnel Cost	1,044,000.00	1,148,400.00	1,263,240.00	1,389,564.00	1,528,520.40
Office Supplies & Miscellaneous Cost:					
Stationary 550 per month	6,600.00	7,260.00	7,986.00	8,784.60	9,633.06
Preprinted Form 750 per month	9,000.00	9,900.00	10,890.00	11,979.00	13,176.90
Utility 3,150 per month	37,800.00	41,580.00	45,738.00	50,311.80	55,342.98
Miscellaneous 400 per month	4,800.00	5,280.00	5,808.00	6,388.80	7,027.68
Annual Office Supplies & Miscellaneous Cost	58,200.00	64,020.00	70,422.00	77,464.20	85,210.62
Total Operating Cost	1,102,200.00	1,243,920.00	1,368,312.00	1,505,143.20	1,655,657.52
Total Computerized System Cost	2,949,450.00	1,622,920.00	1,747,312.00	1,884,143.20	2,034,657.52

Table 3.10. Five Years Accumulated Computerized Cost, Baht.

Year	Total Computerized Cost	Accumulated Cost
1	2,949,450.00	2,949,450.00
2	1,622,920.00	4,572,370.00
3	1,747,312.00	6,319,682.00
4	1,884,143.20	8,203,825.20
5	2,034,657.52	10,238,482.72
Total	10,238,482.72	–

(3) The Comparison of the System Costs between Computerized System and Manual System

Table 3.11. The Comparison of the System Costs, Baht.

Year	Accumulated Manual Cost	Accumulated Computerized Cost
1	2,135,350.00	2,949,450.00
2	4,438,970.00	4,572,370.00
3	6,972,952.00	6,319,682.00
4	9,760,332.20	8,203,825.20
5	12,826,450.42	10,238,482.72

A method is commonly used for comparing two or more information systems called breakeven analysis. The method is presented as a comparison between an existing and a proposed system.

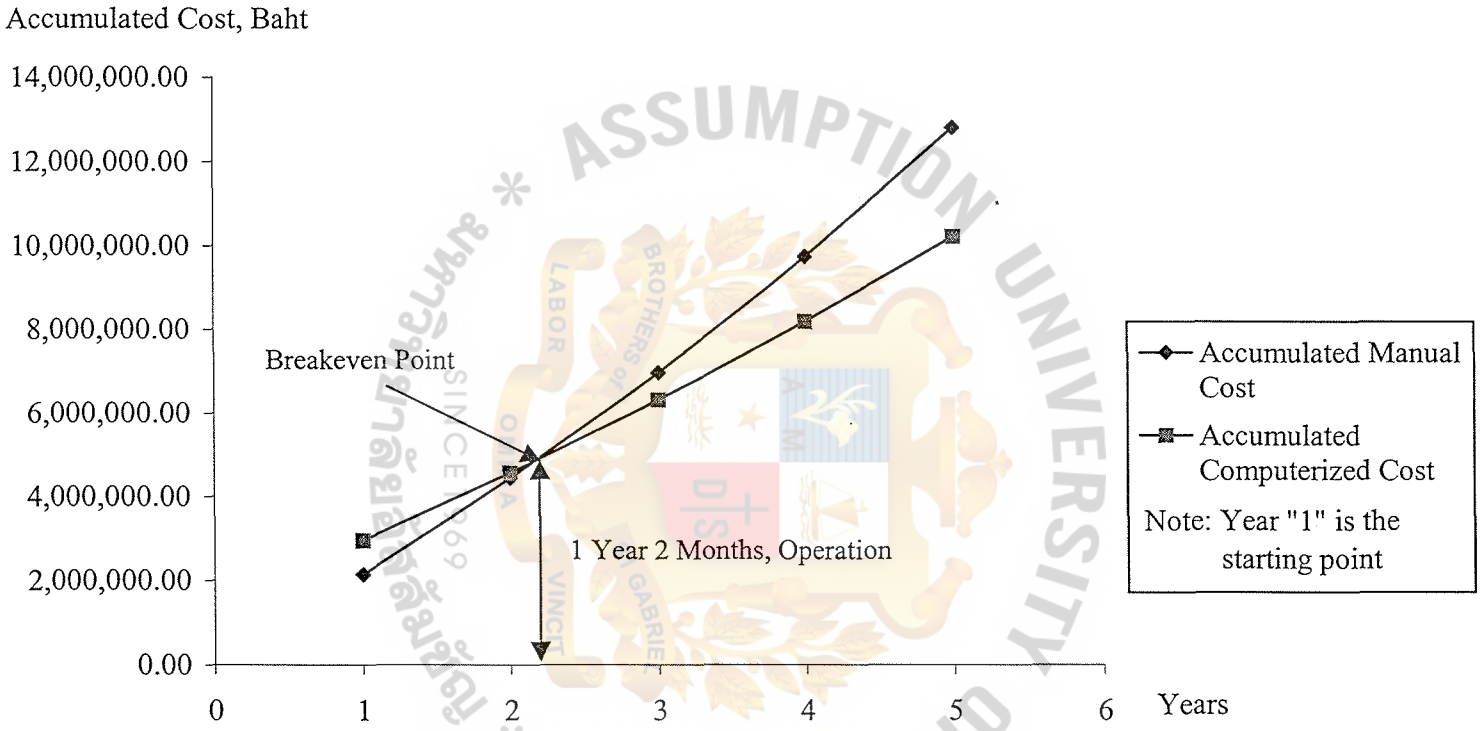

Figure 3.8. Cost Comparison between Manual and Proposed System.

Figure 3.8 illustrates breakeven analysis. At year 1.2, the costs of the proposed system intersect the costs of the existing system. At this point of intersection, the proposed system begins to generate a positive monetary return in comparison with the existing system.

3.5.2 Benefit Analysis

Benefits increase profits or decrease costs both highly desirable characteristics of a proposed system. Benefits are classified as follows:

(1) Tangible Benefits

(a)	Reduction of redundant work (2,880 hrs@20 baht)	158,400 baht
(b)	Reduction of transaction delay (4,620 hrs@15 baht)	254,100 baht
(c)	Reduction of office supply expenses	56,000 baht
(d)	Reduction of personnel cost	936,000 baht
(e)	Reduction of time for report (396 hrs@75 baht)	12,600 baht
	Total annual benefit costs	1,530,500 baht

(2) Intangible Benefits

(a) Improve service to patients.

(b) Improve decision making by providing statistical reports to manager.

(c) Improve image of the hospital.

(d) Improve operation and management efficiency.

(e) Improve security and control to information of patients.

Payback analysis is the method for determining when an investment will pay for itself. The exact point at which initial investment costs are recovered completely and new system saving begins is the payback period. All payback period analysis of candidates is shown in Appendix H. Compute the payback period as follows:

$$\text{Payback period} = \begin{array}{l}\text{Last year of} \\ \text{negative cash flow} \\ \text{difference}\end{array} + \frac{\begin{array}{l}\text{Cumulative difference} \\ \text{last negative year}\end{array}}{\begin{array}{l}\text{Absolute value of} \\ \text{cumulative difference} \\ \text{(last negative plus} \\ \text{first positive year)}\end{array}}$$

In addition, Net Present Value Analysis is the technique that compares alternatives with different lifetimes. Appendix H illustrates the net present value calculation. Costs are represented by negative cash flows while benefits are represented by positive cash flows. After discounting all costs and benefits, subtract the sum of the discounted costs from the sum of the discounted benefits to determine the net present value.

3.5.3 Feasibility Analysis

Table 3.12 illustrates feasibility analysis matrix. It complements the candidate systems matrix with an analysis and ranking of the candidate systems.

The columns of the matrix correspond to the same candidate solutions as shown in the candidate systems matrix mentioned in hardware and software requirement section. Rows correspond to the feasibility criteria and a ranking of the candidates. A score is recorded directly in the cell for each candidate's feasibility criteria assessment.

Table 3.12. The Feasibility Analysis Matrix.

Feasibility Criteria	Weight	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 supports user required functionality Score: 100	Only supports authorized user requirements and current registration process would have to be modified to take advantage of software functionality. Score: 90	Only supports authorized user requirements and current registration process would have to be modified to take advantage of software functionality. 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 candidate system.	30%	Maturity of product is risk and company charges an additional monthly fee for technical support. Required train MS Visual C++ expertise to perform modifications for integration requirements. Score: 50	Although current technical staff has only simple computer experience, the senior analysts who saw the MS VB demonstration and presentation have agreed the transition will be simple and finding experienced VB programmers will be easier than finding others and at a much cheaper cost. MS Visual Basic 6.0 is a muture technology based on version number. Score: 95	Although current technical staff is comfortable with Access, management is concerned with recent acquistion of Access Because of this we have no guarantee future versions of Access will play well with current version of server Score: 60
Economic Feasibility Cost to develop (Baht): Payback period (Baht): Net present value (Baht): ROI (Baht): Detailed Calculations:	30%	 Approximately 3,193,850.00 Approximately 4.4 years. Approximately 549,139.87 7.2 percent per annual See Appendix H Score: 60	 Approximately 1,847,250.00 Approximately 3.11 years. Approximately 613,394.81 9.3 percent per annual See Appendix H Score: 95	 Approximately 1,057,100.00 Approximately 3.9 year. Approximately 506,649.51 9.23 percent per annual See Appendix H Score: 90
Schedule Feasibility An assessment of how long the solution will take to design and implement.	10%	12 months Score: 70	4-5 months Score: 90	Less than 4 months Score: 95
Ranking	100%	70	93	81.5

IV. PROJECT IMPLEMENTATION

4.1 Overview of Project Implementation

After the approval of the technical design statement and prototypes, the System Implementation can proceed. The System Implementation is the construction of the new system and the delivery of the final system into operation. The processes of the System Implementation are:

(1) Hardware Acquisition and Installation

According to the Hardware Requirement section in Chapter 3, both computer server and clients are built for system implementation. In addition, the new network must be implemented before writing and installing computer program.

(2) Computer Programming

According to the Design Specification in Chapter 3, programmers are responsible for writing program following those requirements. Then implement management reporting and decision support programs. Finally, backup and recovery programs are written.

(3) Testing

Programs are tested and debugged top-down as they are coded. There are three levels of testing mentioned in the Testing section.

(4) Training and User Document

Converting to a new system, it is necessary for users to be trained and provided with document that guides them through using the new system.

Users need to familiarize with the computerized system including functions of the hardware and software. They should be trained on how to

use the system properly and efficiently such as how to perform data entry, how to print reports.

(5) Conversion

This conversion process must be carried out carefully. The conversion plan includes detailed installation strategies to follow for converting from the manual existing system to the new computerized information system.

4.2 Source Code

The source code of all modules of the proposed system are written under MS Visual Basic 6.0 using Oracle as database.

4.3 Test Plan

Test plans are developed at the same time the requirements specification document is being developed and can be refined and updated during design as well.

Testing strategy of the proposed system is the same as the strategy mentioned in the Computer Programming section that is Top-down testing. It starts at an overview of the system to be tested, then works its way down into the details of the system such as update databases, print lines on a report, and display text or graphics on a screen.

There are three levels of testing to be performed:

(1) Unit/Module Testing

It is done while the program is in the process of creating the individual module. It serves to detect error in coding and errors in logic. Finally, unit testing is done with test data created by the programmers themselves.

(2) Function Testing

It is the combining of one or more integration-tested groups of modules that collectively perform a user identified function, as documented

in the requirement specification document. For example, adding new patient in registration system would be treated for testing purposes.

(3) System Testing

It is a test that ensures that application programs written in isolation work properly when they are integrated into the total system.

Whenever testing discovers errors at any level of the methodology, the programmer will need to make coding changes followed by a trip back through the layers to ensure defect-free code in all test levels.

4.4 Conversion

Once a successful system test has been completed, the last process of project implementation is the delivery of the new system into operation. The strategy for converting from the old system to the new system is Parallel Conversion that allows the user to continue to use the old system and new system simultaneously for a period of time.

This is done to ensure that all major problems in the new system have been solved and everyone is satisfied with the new system that can operate correctly. This strategy minimizes the risk and ability to compare results with the old system. However it increases transition cost.

V. CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

From the analysis of the existing registration system of Bangkok Healthcare Hospital, the existing manual system is found to be inefficient and many problems are located; data entry problem, time consuming medical services, and inability in information sharing with other departments. Some problems exceed the capacity of manual system to support: the complexity of medical data, security and confidential concerns.

Therefore, the new patient registration Information System is developed to solve problem occurring from the existing manual system, the proposed system is a computerized system. It improves and facilitates the sequence of the workflow for Input process that can control and verify data entry recorded by system users, Data processing process that decreases processing time in data accessing, retrieving, and inquiry. It increases throughput as well. Output processing is presented in graphical mode including presenting in form of statistical reports sent to director who uses them for decision making and evaluation.

Since the new system is developed from manual system to computerized system, selecting information technology in implementation is one key factor that is concerned. The implementation of the proposed system uses two-tier client/server connected by a local area network using Star network topology and uses Oracle as software to implement RDBMS that can monitor user operations and provide for backup, recovery, and security. The other concern of information system in hospital is security and confidentiality of information that provides access to patient's data only to authorized person with login-password.

The proposed system can achieve the business solution eventhough it can increase little revenue because the cost of information technology is much more expensive than paper-based system. It can increase service to patient, reduce response time as well as personnel cost. The cost of analysis shows that the information system will be developed at a cost of 1,847,250 baht, the break-even point will occur approximately 1.2 years after the system begins operating, and the payback period will take 3.11 years to recover its development costs. The information system yields a net present value of 613,394.81 baht and an average ROI of 9.30 percent per year.

Finally, eventhough changing from the manual to the computerized system may induce users to confusion at the first period of time, after that, users will be familiar with and able to use the new system efficiently. It facilitates users in many ways for example redundant type are reduced because user can retrieve information stored in database, doctors receive patient information faster than before, and director can take information for a better decision making.

Table 5.1 presents the achievement of the proposed system compared with the existing system. It shows that more than 50 percent of time required for the process of the proposed system can be saved in comparison with that required for the existing system.

(1) New Patient Register Process

Officer does not have to write patient information many times. Patient information can easily be retrieved from the system.

(2) Current Patient Register Process

With the new system, H.N. is verified quickly since it can be easily retrieved from the system. Then patient information is shown automatically that ready to register patient for issuing O.P.D.

(3) Arrange Appointment Process

The time it takes to check availability to make appointment can be reduced since appointment schedule can easily be retrieved from the system.

(4) Inquiry Process

A response time to inquiry patient information can be reduced since patient information can easily be retrieved from the system.

(5) Maintenance Patient Information Process

Documents can easily be maintained since they are stored in a shared database.

(6) Report Process

Officer does not have to gather information from multiple files. The system can select the required information from the shared database and produces a formatted report easily.

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

Process	Existing System	Proposed System
New Patient Register Process	30 minutes	10 minutes
Current Patient Register Process	20 minutes	5 minutes
Arrange Appointment Process	1.30 hours	40 minutes
Inquiry Process	15-30 minutes	5 minutes
Maintenance Patient Process	20 minutes	5 minutes
Report Process	50 minutes	15 minutes

5.2 Recommendations

The proposed system is developed to serve in the patient registration system, so the next phase that needs to develop to improve and increase degree of service is planned as follows:

(1) Data can be transferred on-line linked to other branches and should be real-time interactive consults with medical institutions to exchange technological knowledge and expertise with them to offer treatment to patient.

(2) H.N. card of patient should be replaced with smart card that holds information of patient in electronic form.

(3) Pharmacy system including inventory department and prescription should create a bar code-based label for all kinds of drug in order to eliminate keying error.

(4) Hospital should create web site to provide medical information and service including profile, organization, and the number of staff. In addition, web site should provide appointment arrangement to facilitate distance patients to check schedule by themselves.

(5) Admission department should facilitate patient in selecting the room by viewing on computer.

(6) For laboratory, test results should be available in electronic form and can be integrated with the basic demographic information.

(7) Financial process should record patient data in order to ensure they are correctly billed for the treatment they receive.

APPENDIX A

DATABASE DESIGN

Fully Attributed Database

Database D1

Table A.1. Structure of Patient Table.

No.	Field Name	Field Type	Unique	Nullable	Foreign Key from Table	Check	Key Type
1	HN.	Int (10)	*Y				Primary Key
2	ID. Card	Int (13)	Y				Alternate Key
3	Patient Name	Varchar (30)					Attribute
4	Patient Surname	Varchar (50)					Attribute
5	Gender	Value Set				{Female,Male}	Attribute
6	Date of Birth	Date				ddmmyyyy	Attribute
7	Age	Int					Attribute
8	Marital Status	Value Set				{Single,Married,Divorced, Widowed,Priest}	Attribute
9	Nationality	Varchar (15)					Attribute
10	Home Address	Varchar (70)					Attribute
11	Zip Code	Int					Attribute
12	E-mail Address	Varchar (30)		Y			Attribute
13	Home Phone	Varchar (10)		Y			Attribute
14	Mobile Phone	Int (7)		Y			Attribute
15	Insurance Name	Varchar (30)		Y	Insurance Company		Attribute
16	Drug Allergy	Varchar (50)					Attribute

Database D2

Table A.2. Structure of OPD. Table.

No.	Field Name	Field Type	Unique	Nullable	Foreign Key from Table	Check	Key Type
1	HN.	Int (10)			Patient		Primary Key
2	Reg.Date	Date				ddmmyyyy	Primary Key
3	Reg.Time	Time				hhmm	Primary Key
4	Chief Complaint	Varchar (50)					Attribute
5	Dept.Code	Int (4)			Department		Attribute
6	Dr. ID	Int (5)			Doctor		Attribute
7	X-Ray No.	Varchar (6)		Y			Attribute
8	Lab Code	Varchar (6)		Y	Laboratory		Attribute
9	Presc.No.	Int (4)			Prescription		Attribute
10	Diagnosis	Varchar (100)					Attribute

Database D3

Table A.3. Structure of Insurance Company Table.

No.	Field Name	Field Type	Unique	Nullable	Foreign Key from Table	Check	Key Type
1	Insurance Code	Int (5)	Y				Primary Key
2	Insurance Name	Varchar (30)	Y				Attribute
3	Insurance Addr.	Varchar (70)					Attribute
4	Insurance Phone	Varchar (10)					Attribute

Database D4

Table A.4. Structure of Doctor Table.

No.	Field Name	Field Type	Unique	Nullable	Foreign Key from Table	Check	Key Type
1	Dr. ID	Int (5)	Y				Primary Key
2	Dr. Name	Varchar (30)	Y				Attribute
3	Dr. Phone	Varchar (10)					Attribute
4	Dept.Code	Int (5)	Y		Department		Attribute

Database D5

Table A.5. Structure of Appointment Table.

No.	Field Name	Field Type	Unique	Nullable	Foreign Key from Table	Check	Key Type
1	Appoint No.	Int (5)	Y				Primary Key
2	Appoint Date	Date					Attribute
3	Appoint Time	Time					Attribute
4	HN.	Int (10)	Y		Patient		Attribute
5	Dr. ID	Int (5)	Y		Doctor		Attribute
6	Remark	Memo		Y			Attribute

Database D6

Table A.6. Structure of Prescription Table.

No.	Field Name	Field Type	Unique	Nullable	Foreign Key from Table	Check	Key Type
1	Presc.No.	Int (4)	Y				Primary Key
2	HN.	Int (10)	Y		Patient		Attribute
3	Dr. ID.	Int (5)	Y		Doctor		Attribute
4	Receive Status	Yes/No					Attribute

Database D7

Table A.7. Structure of Admission Table.

No.	Field Name	Field Type	Unique	Nullable	Foreign Key from Table	Check	Key Type
1	AN.	Int (5)	Y				Primary Key
2	Admit Date	Date					Primary Key
3	Admit Date	Date					Primary Key
4	Room No.	Int (3)					Attribute
5	Building	Varchar (20)					Attribute
6	Discharge Date	Yes/No					Attribute
7	Discharge Status	Int (10)	Y				Attribute

Database D8

Table A.8. Structure of Department Table.

No.	Field Name	Field Type	Unique	Nullable	Foreign Key from Table	Check	Key Type
1	Dept.Code	Int (5)	Y				Primary key
2	Dept.Name	Varchar (20)	Y				Attribute

Database D9

Table A.9. Structure of Laboratory Table.

No.	Field Name	Field Type	Unique	Nullable	Foreign Key from Table	Check	Key Type
1	Lab Code	Varchar (6)	Y				Primary Key
2	Lab Detail	Memo					Attribute

Database D10

Table A.10. Structure of DrugList Table.

No.	Field Name	Field Type	Unique	Nullable	Foreign Key from Table	Check	Key Type
1	Drug Name	Varchar (6)	Y				Primary Key
2	Presc.No.	Int (4)			Prescription		Primary Key
3	Drug Descr.	Varchar (50)					Attribute
4	Qty	Varchar (10)					Attribute

APPENDIX B

DATA FLOW DIAGRAM

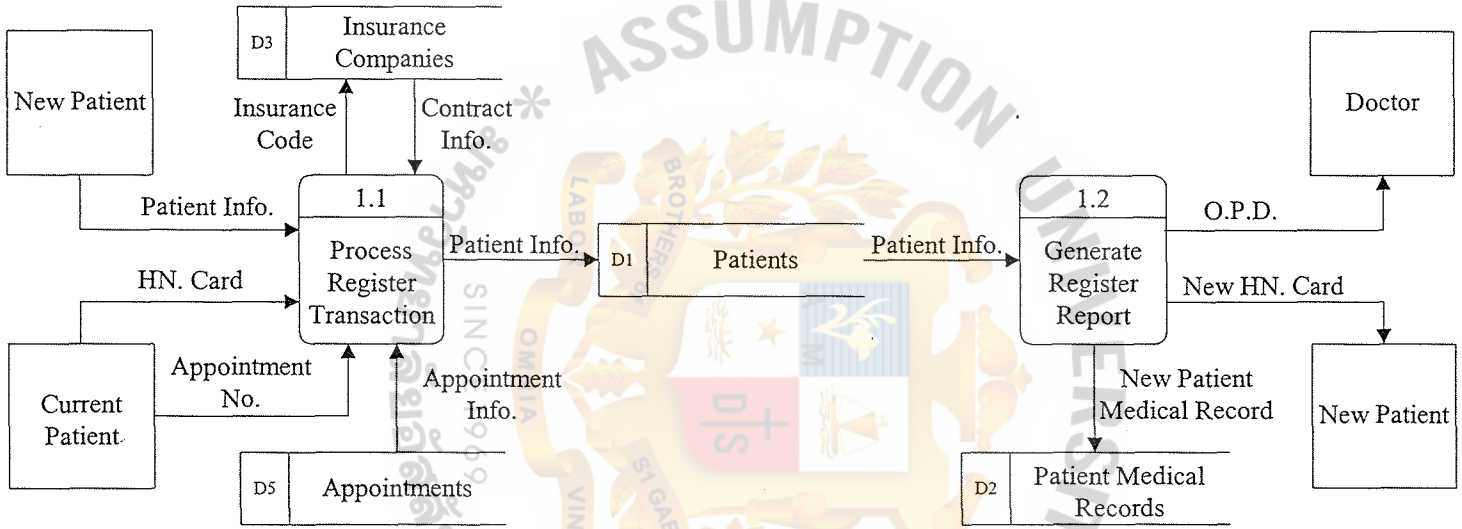

Figure B.1. Level 2 Data Flow Diagram of Register Subsystem of Patient Registration Information System.

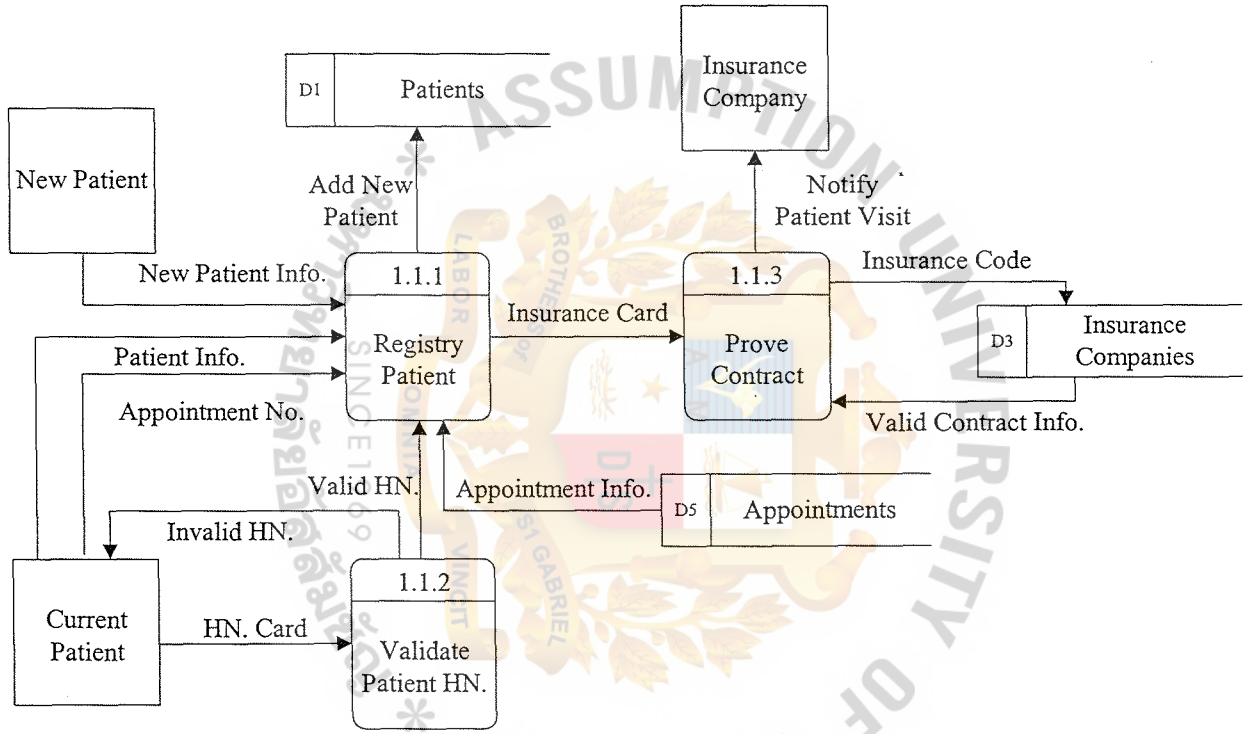

Figure B.2. Level 3 Data Flow Diagram of Registry Transaction Process of Patient Registration Information System.

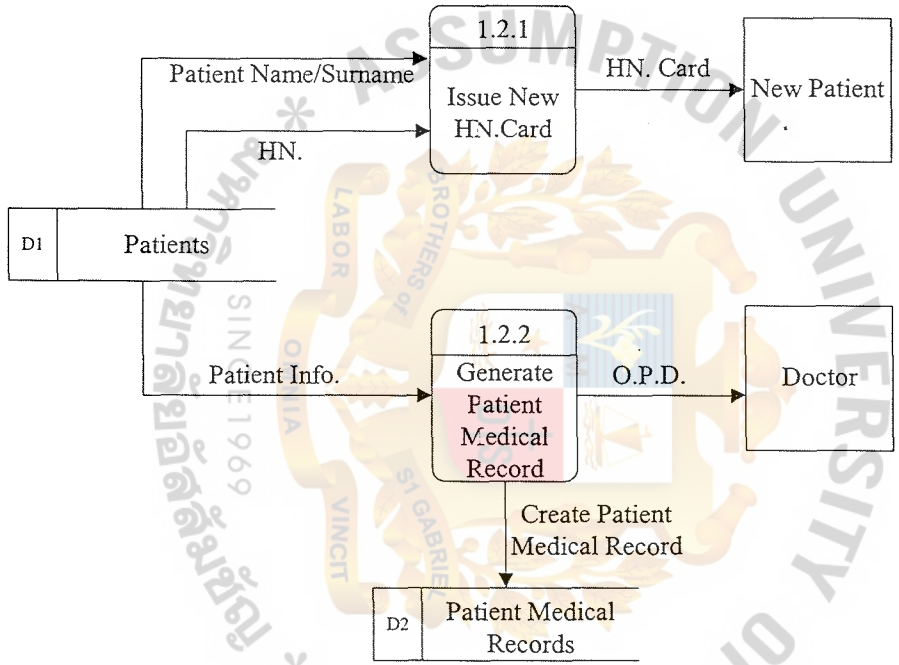

Figure B.3. Level 3 Data Flow Diagram of Register Report Process of Patient Registration Information System.

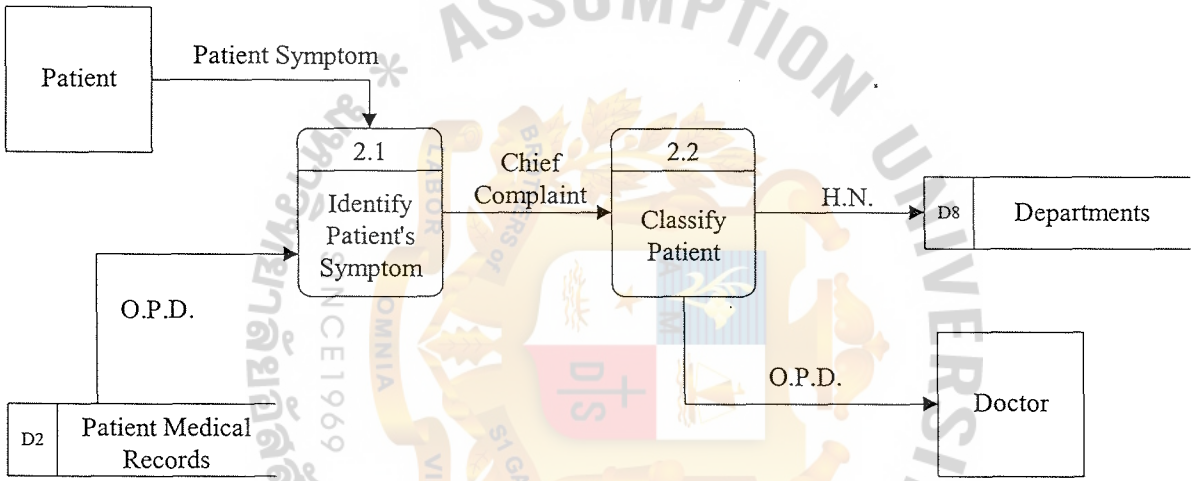

Figure B.4. Level 2 Data Flow Diagram of Patient Screening Subsystem of Patient Registration Information System.

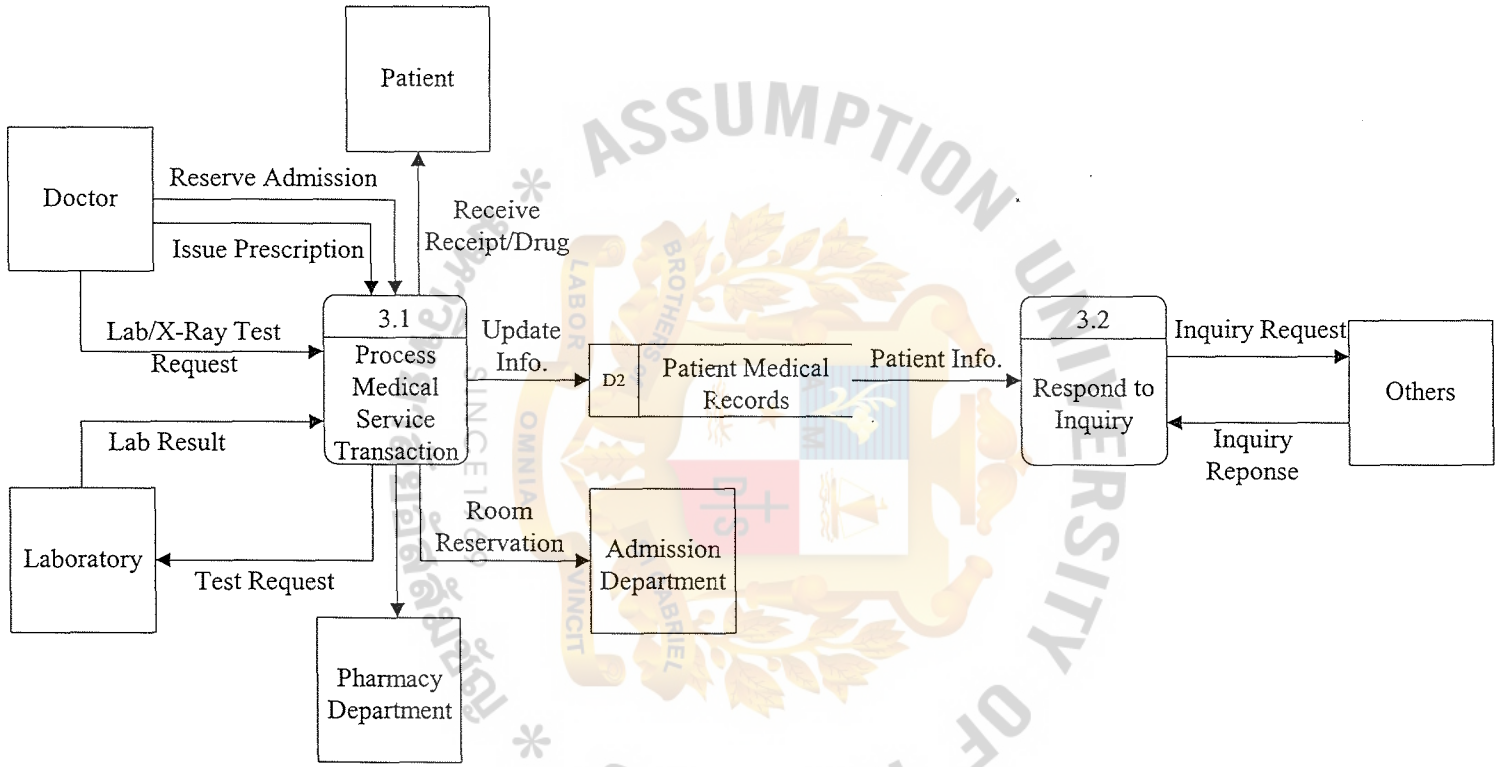

Figure B.5. Level 2 Data Flow Diagram of Medical Service Subsystem of Patient Registration Information System.

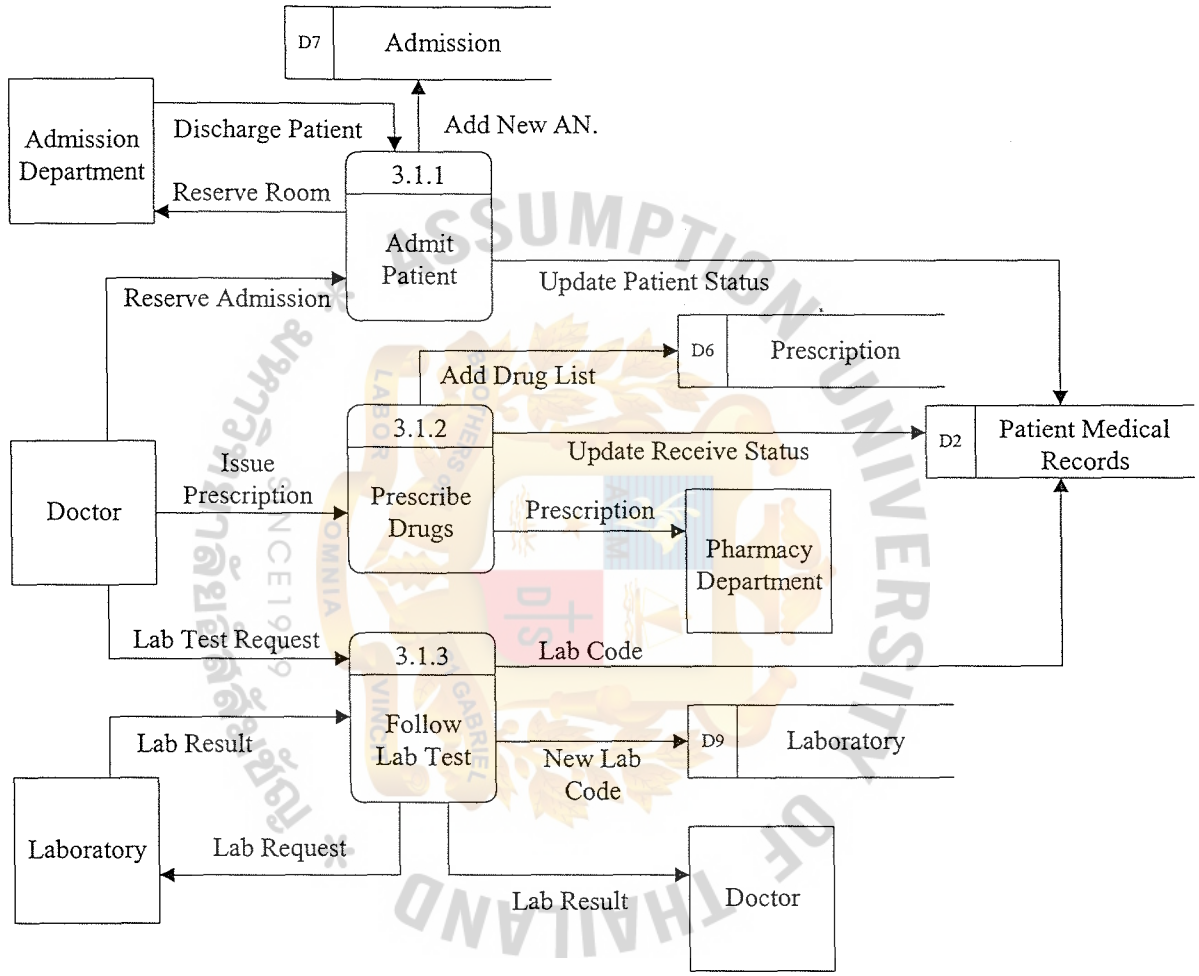

Figure B.6. Level 3 Data Flow Diagram of Service Transaction Process of Patient Registration Information System.

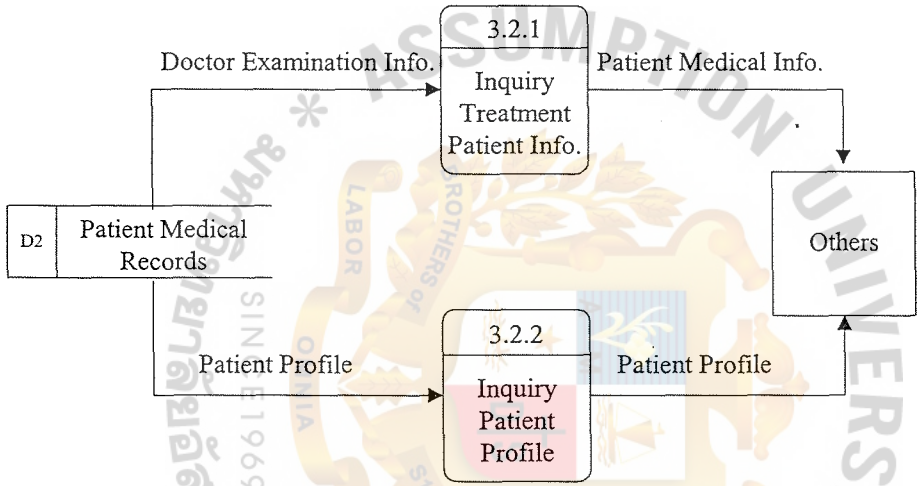

Figure B.7. Level 3 Data Flow Diagram of Inquiry Process of Patient Registration Information System.

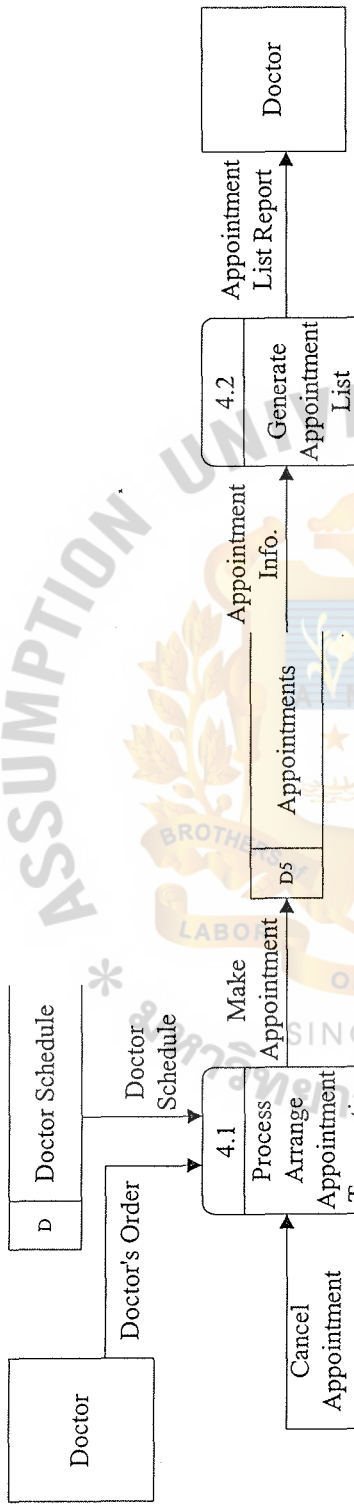

Figure B.8. Level 2 Data Flow Diagram of Appointment Subsystem of Patient Registration Information System.

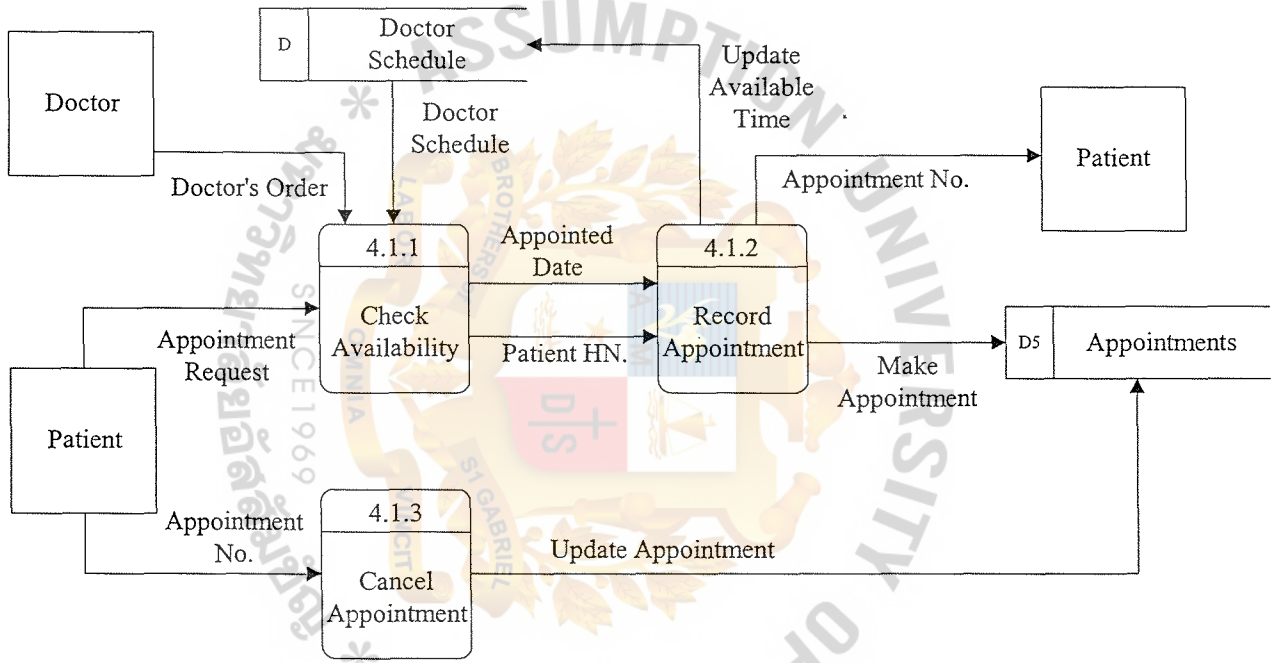

Figure B.9. Level 3 Data Flow Diagram of Make Appointment Transaction Process of Patient Registration Information System.

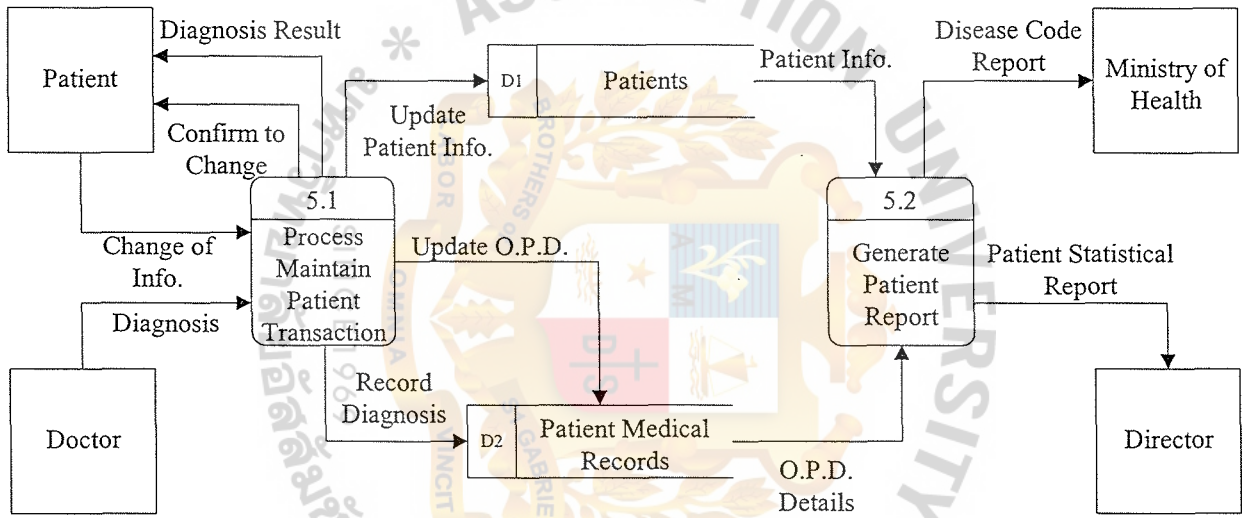

Figure B.10. Level 2 Data Flow Diagram of Maintain Patient Subsystem of Patient Registration Information System.

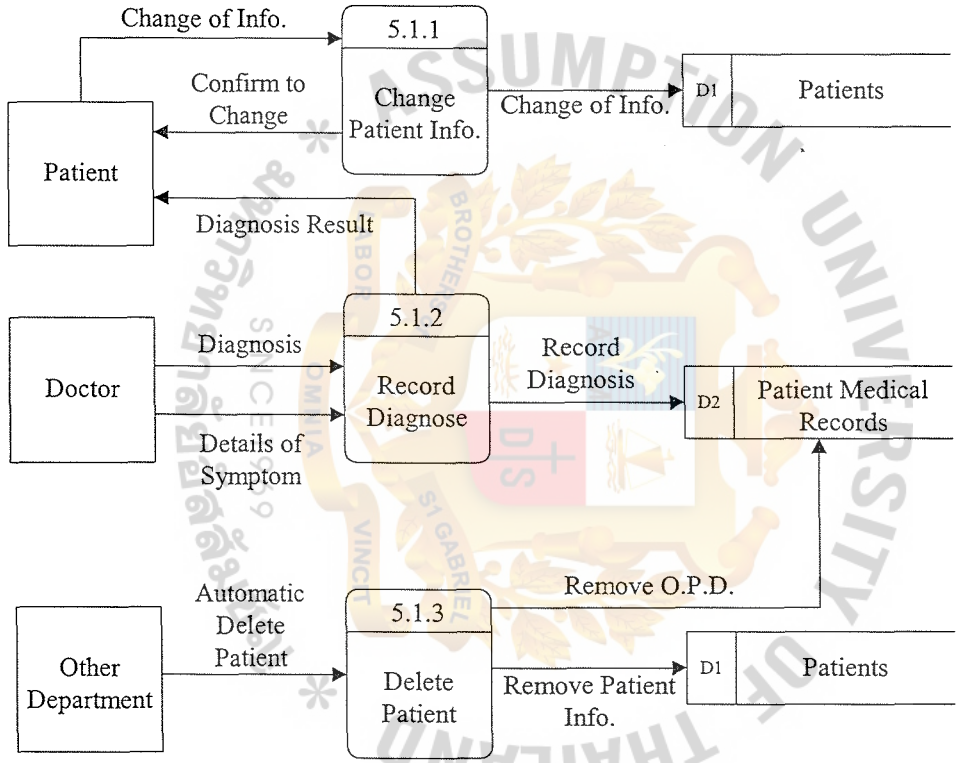

Figure B.11. Level 3 Data Flow Diagram of Maintain Patient Transaction of Patient Registration Information System.

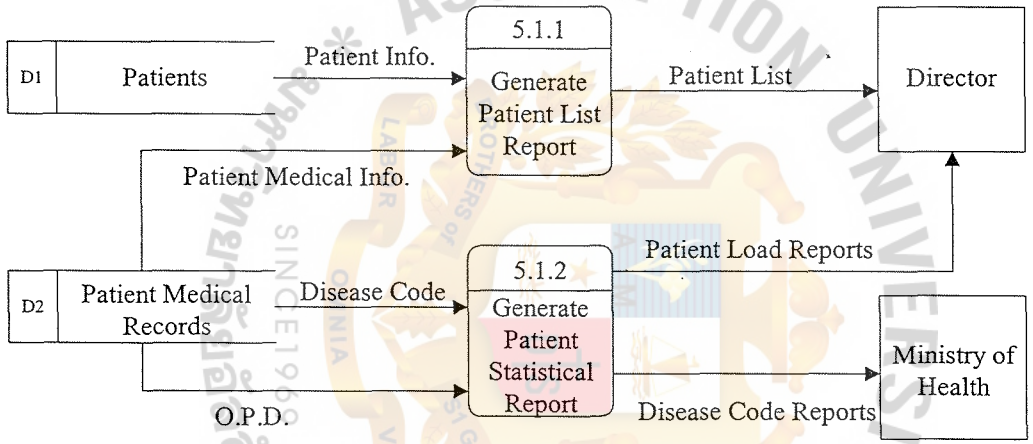

Figure B.12. Level 3 Data Flow Diagram of Generate Patient Report of Patient Registration Information System.

APPENDIX C

PROCESS SPECIFICATION

PROCESS SPECIFICATION

Table C.1. Process Specification of Process 1.1.1.

Process Name:	Registry Patient
Data In:	Patient Info Valid Patient HN. Appointment No.
Data Out:	Patient Profile Patient HN. Insurance Company
Process:	(1) Get necessary patient data, patient name, address, phone number, etc. and assign new Patient Hospital Number (2) Receive the HN. or Appointment No. from the current patient (3) Record the new patient data into Patient database
Attachment:	(1) Patient (2) Data Store D1 (3) Data Store D5

Table C.2. Process Specification of Process 1.1.2.

Process Name:	Validate Patient HN.
Data In:	HN. Card
Data Out:	Valid H.N.
Process:	(1) Receive the HN. Card from the current patient (2) Verify HN.
Attachment:	(1) Patient (2) Data Store D1

Table C.3. Process Specification of Process 1.1.3.

Process Name:	Prove Contract
Data In:	Insurance Card or Insurance Name
Data Out:	Insurance Code Notify to Insurance Company
Process:	(1) Get Insurance Card or Company name (2) Prove contract (3) Notify patient visit to insurance company
Attachment:	(1) Data Store D3 (2) Insurance Company

Table C.4. Process Specification of Process 1.2.1.

Process Name:	Issue New Patient HN. Card
Data In:	HN. Patient Name
Data Out:	HN. Card
Process:	(1) Get HN., patient name, and surname (2) Print HN. Card
Attachment:	(1) New Patient (2) Data Store D1

Table C.5. Process Specification of Process 1.2.2.

Process Name:	Generate Patient Medical Record
Data In:	Patient Information
Data Out:	Patient Medical Record (OPD)
Process:	(1) Get patient data, and HN. (2) Create patient medical record (3) Add patient medical record into Patient Medical Record database (4) Send patient medical record to Doctor
Attachment:	(1) Data Store D2 (2) Doctor

Table C.6. Process Specification of Process 2.1.

Process Name:	Identify Patient's symptom
Data In:	Patient Symptom HN.
Data Out:	Chief Complaint
Process:	(1) Get patient symptom (2) Identify patient's symptom (3) Record the chief complaint into Patient Medical Record database
Attachment:	(1) Patient (2) Data Store D2

Table C.7. Process Specification of Process 2.2.

Process Name:	Classify Patient
Data In:	Chief Complaint
Data Out:	Screened Patient by Department
Process:	(1) Get chief complaint (2) Classify patient (3) Record HN. by department into Department database (4) Put patient on queue to see the doctor
Attachment:	(1) Data Store D8 (2) Doctor

Table C.8. Process Specification of Process 3.1.1.

Process Name:	Patient Admission
Data In:	Reserve Requirement
Data Out:	Patient Status Patient Medical Record New AN. Reserved Room
Process:	(1) Receive the requirement to reserve from doctor (2) Reserve admit location (3) Send patient medical record to Admission Department (4) Add new Admission Number into Admission database (5) Update patient status into Patient Medical Record database
Attachment:	(1) Patient (2) Doctor (3) Admit Department (4) Data Store D2 (5) Data Store D7

Table C.9. Process Specification of Process 3.1.2.

Process Name:	Prescribe Drugs
Data In:	Drug Lists
Data Out:	Prescription
Process:	(1) Receive the prescription from doctor (2) Add drug list into Prescription database (3) Send prescription to Pharmacy Department (4) Update receive status into Patient Medical Record database
Attachment:	(1) Doctor (2) Pharmacy Department (3) Data Store D2 (4) Data Store D6

Table C.10. Process Specification of Process 3.1.3.

Process Name:	Follow Lab Test Results
Data In:	Patient Medical Record Requirement
Data Out:	Laboratory Code Laboratory Results
Process:	(1) Receive the requirement from doctor (2) Send patient medical record to laboratory (3) Follow laboratory result (4) Record laboratory code into Patient Medical Record database, and inform result to doctor (5) Add new lab code into Laboratory database
Attachment:	(1) Doctor (2) Data Store D2 (3) Data Store D7

Table C.11. Process Specification of Process 3.2.1.

Process Name:	Inquiry Treatment Patient Information
Data In:	Inquiry Request Doctor Examination Info. Patient Medical Record
Data Out:	Inquiry Response to Patient Medical Information
Process:	(1) Receive inquiry from other departments (2) Retrieve information from Patient database and Patient Medical Record database (3) Respond to inquiry
Attachment:	(1) Others (2) Data Store D1 (3) Data Store D2

Table C.12. Process Specification of Process 3.2.2.

Process Name:	Inquiry Patient Profile
Data In:	Inquiry Request Patient Profile
Data Out:	Inquiry Response to Patient Profile
Process:	(1) Receive inquiry from others (2) Retrieve information from Patient database and Patient Medical Record database (3) Respond to inquiry
Attachment:	(1) Others (2) Data Store D2

Table C.13. Process Specification of Process 4.1.1.

Process Name:	Check Availability
Data In:	Appointment Requirement Doctor's Schedule
Data Out:	Appointed Date
Process:	(1) Receive requirement for appointment from Patient and doctor (2) Retrieve doctor's schedule from Doctor Schedule database (3) Check available time (4) Send to the next process
Attachment:	(1) Patient (2) Doctor (3) Data Store D

Table C.14. Process Specification of Process 4.1.2.

Process Name:	Record Appointment
Data In:	Appointed Date
Data Out:	Appointment No. Appointment Information
Process:	(1) Receive appointment information (2) Record the appointment into Appointment Database, and assign Appointment No. (3) Update available doctor's schedule (4) Inform Appointment No. to Patient
Attachment:	(1) Patient (2) Data Store D5

Table C.15. Process Specification of Process 4.1.3.

Process Name:	Cancel Appointment
Data In:	Requirement Appointment No.
Data Out:	Requirement Updated Appointment
Process:	(1) Receive the requirement to cancel appointment from patient (2) Get appointment No. (3) Cancel appointment (4) Update appointment information into Appointment database
Attachment:	(1) Patient (2) Data Store D5

Table C.16. Process Specification of Process 4.2.

Process Name:	Generate Appointment List
Data In:	Appointment Information
Data Out:	Appointment List
Process:	(1) Retrieve appointment information from Appointment database (2) Generate appointment list to doctor
Attachment:	(1) Doctor (2) Data Store D5

Table C.17. Process Specification of Process 5.1.1.

Process Name:	Change Patient Information
Data In:	Requirement Patient Information
Data Out:	Requirement Patient Information
Process:	(1) Receive the requirement to change information from patient (2) Change patient information (3) Update patient information into Patient database
Attachment:	(1) Patient (2) Data Store D1

Table C.18. Process Specification of Process 5.1.2.

Process Name:	Record Diagnosis
Data In:	Doctor's diagnosis Patient Medical Record
Data Out:	Doctor's diagnosis Patient Medical Record
Process:	(1) Receive diagnosis from doctor (2) Record diagnosis into Patient Medical Record database (3) Inform diagnosis result to patient
Attachment:	(1) Patient (2) Doctor (3) Data Store D2

Table C.19. Process Specification of Process 5.1.3.

Process Name:	Delete Patient
Data In:	Patient Information Patient Medical Record
Data Out:	Patient Information Patient Medical Record
Process:	(1) Get patient information, and patient medical Record (2) Remove patient information from Patient database and patient medical record from Patient Medical Record database
Attachment:	(1) Data Store D1 (2) Data Store D2

Table C.20. Process Specification of Process 5.2.1.

Process Name:	Generate Patient List Report
Data In:	Patient by Department
Data Out:	Patient List
Process:	(1) Get patient info from Department database (2) Generate patient list (3) Send report to director
Attachment:	(1) Director (2) Data Store D1

Table C.21. Process Specification of Process 5.2.2.

Process Name:	Generate Statistics Report
Data In:	Disease Code Patient Medical Information
Data Out:	Patient Load Statistics Report Disease Code Report
Process:	(1) Get disease code and patient medical information from Patient Medical Record database (2) Generate disease code report to Ministry of Health (3) Generate patient load statistics report to director
Attachment:	(1) Director (2) Ministry of Health (3) Data Store D2

APPENDIX D

STRUCTURE CHART

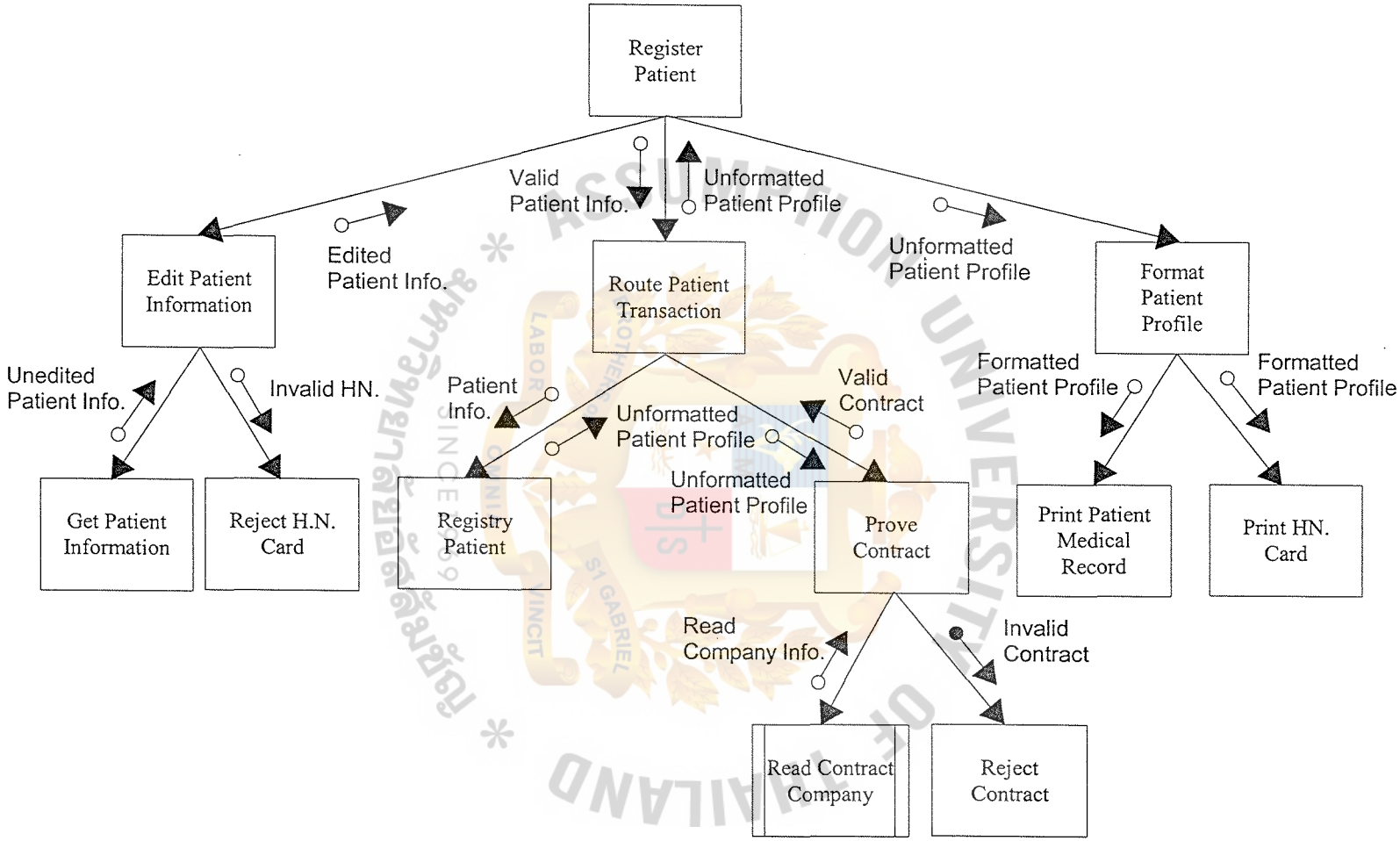

Figure D.1. Structure Chart from Register Patient of Patient Registration Information System.

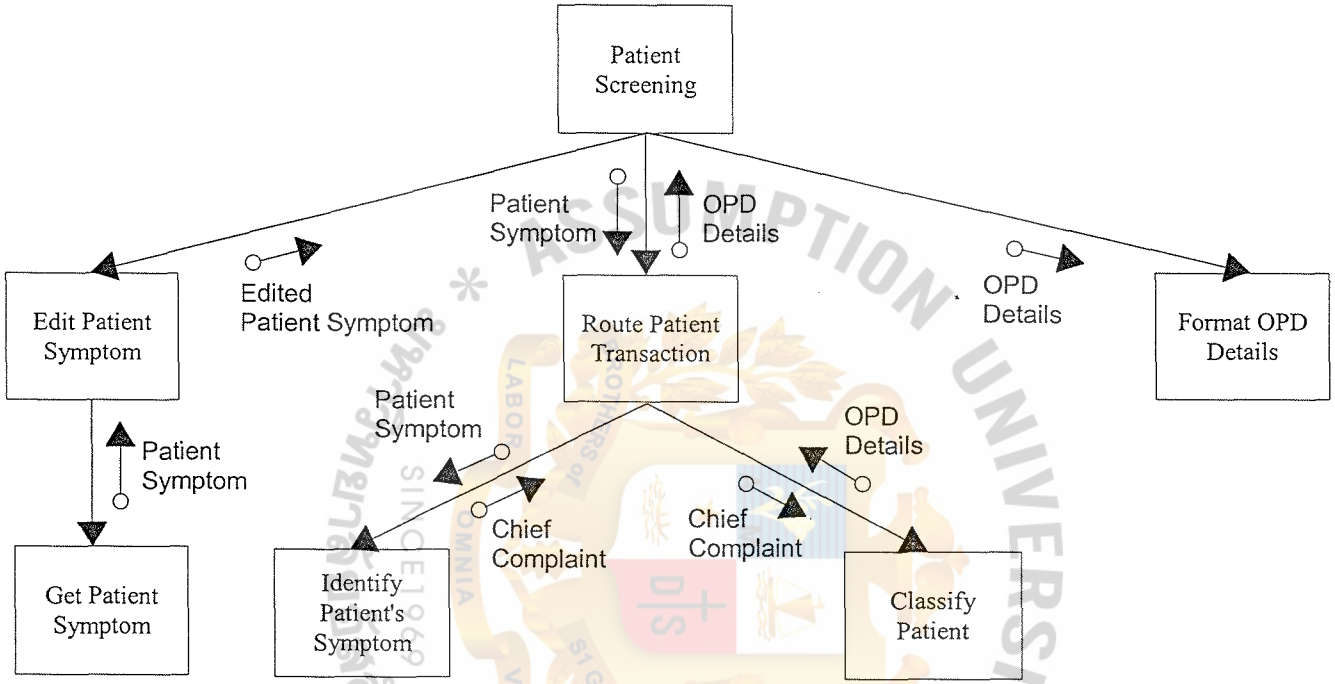

Figure D.2. Structure Chart from Patient Screening of Patient Registration Information System.

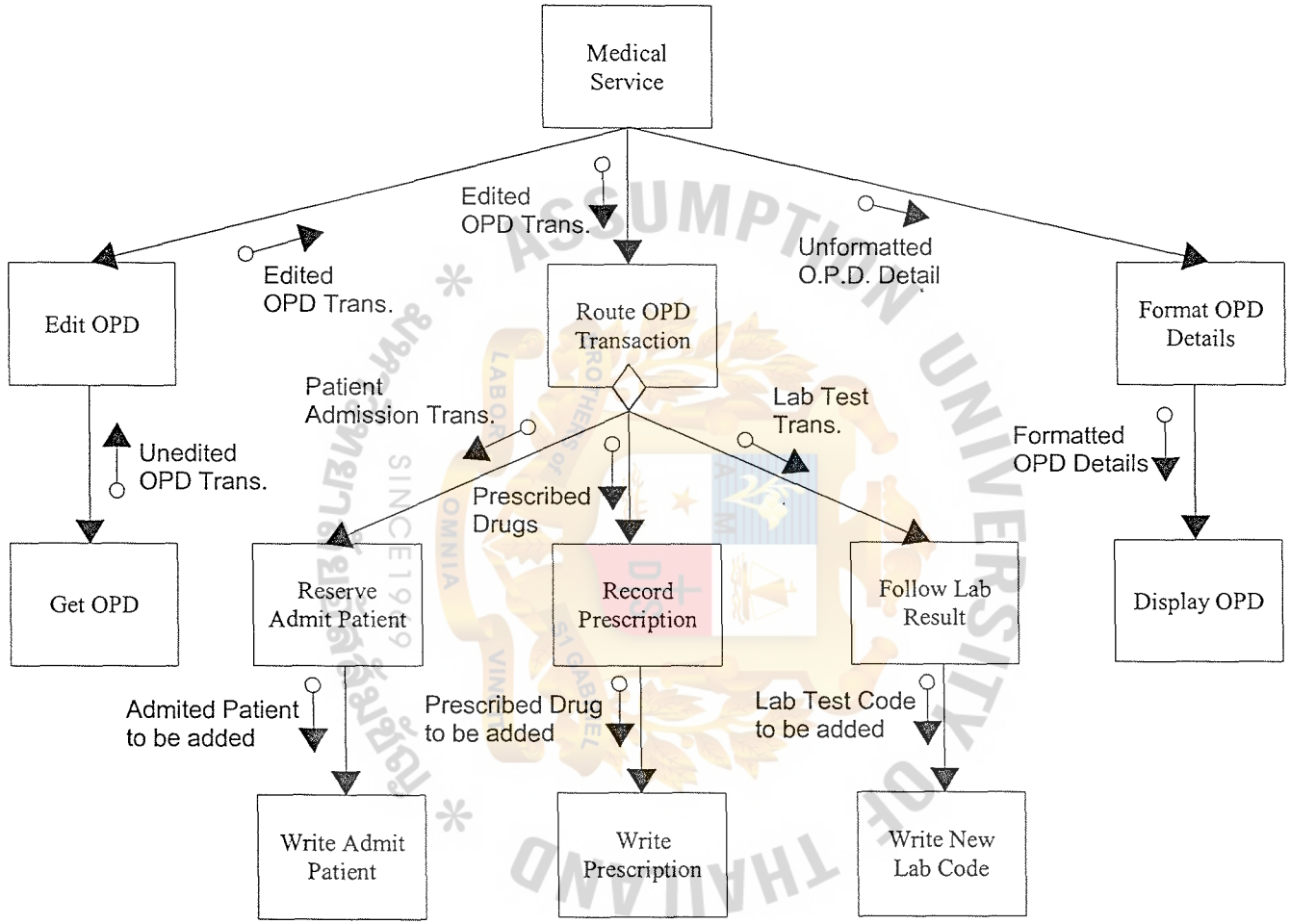

Figure D.3. Structure Chart from Medical Service of Patient Registration Information System.

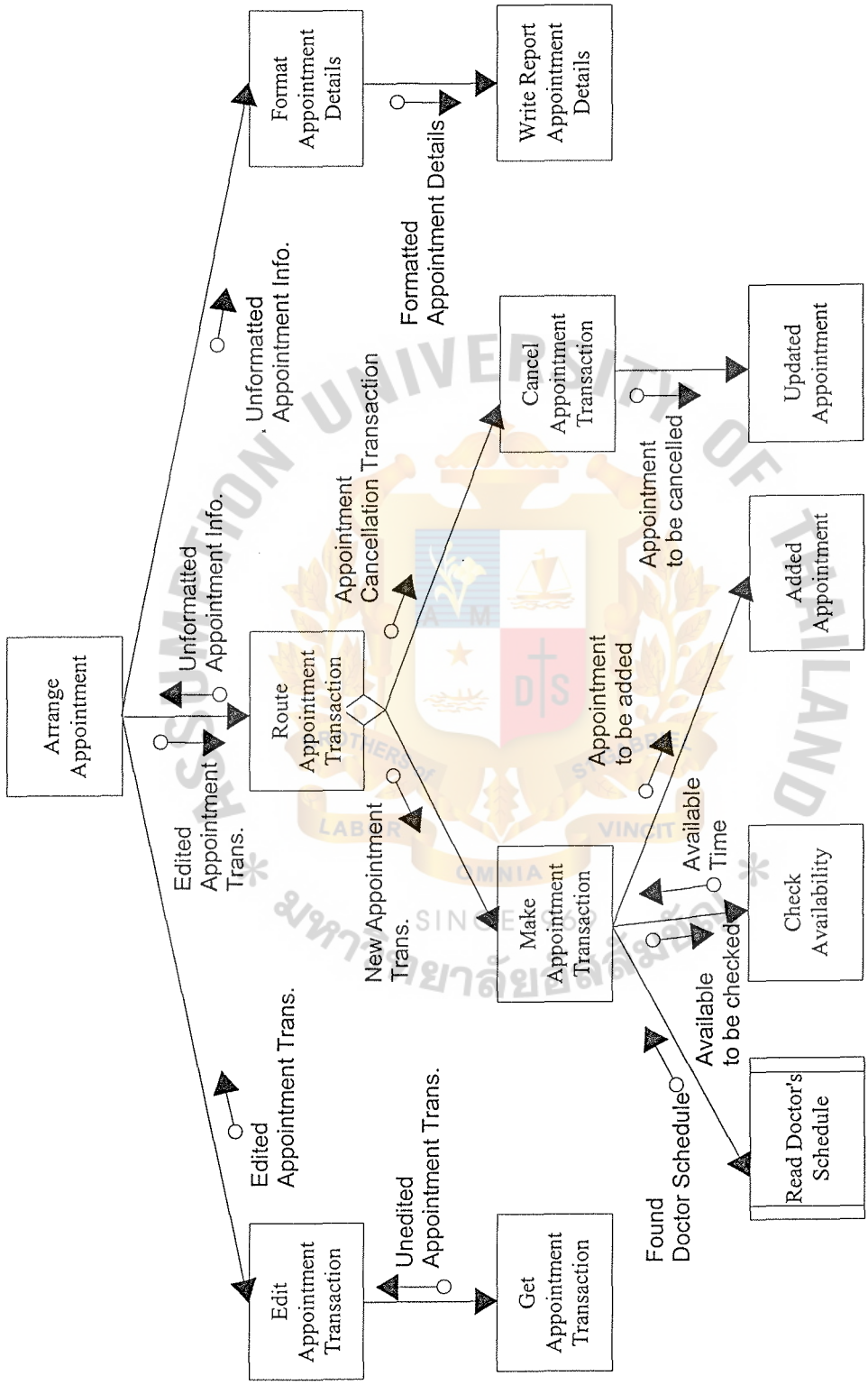

Figure D.4. Structure Chart from Arrange Appointment of Patient Registration Information System.

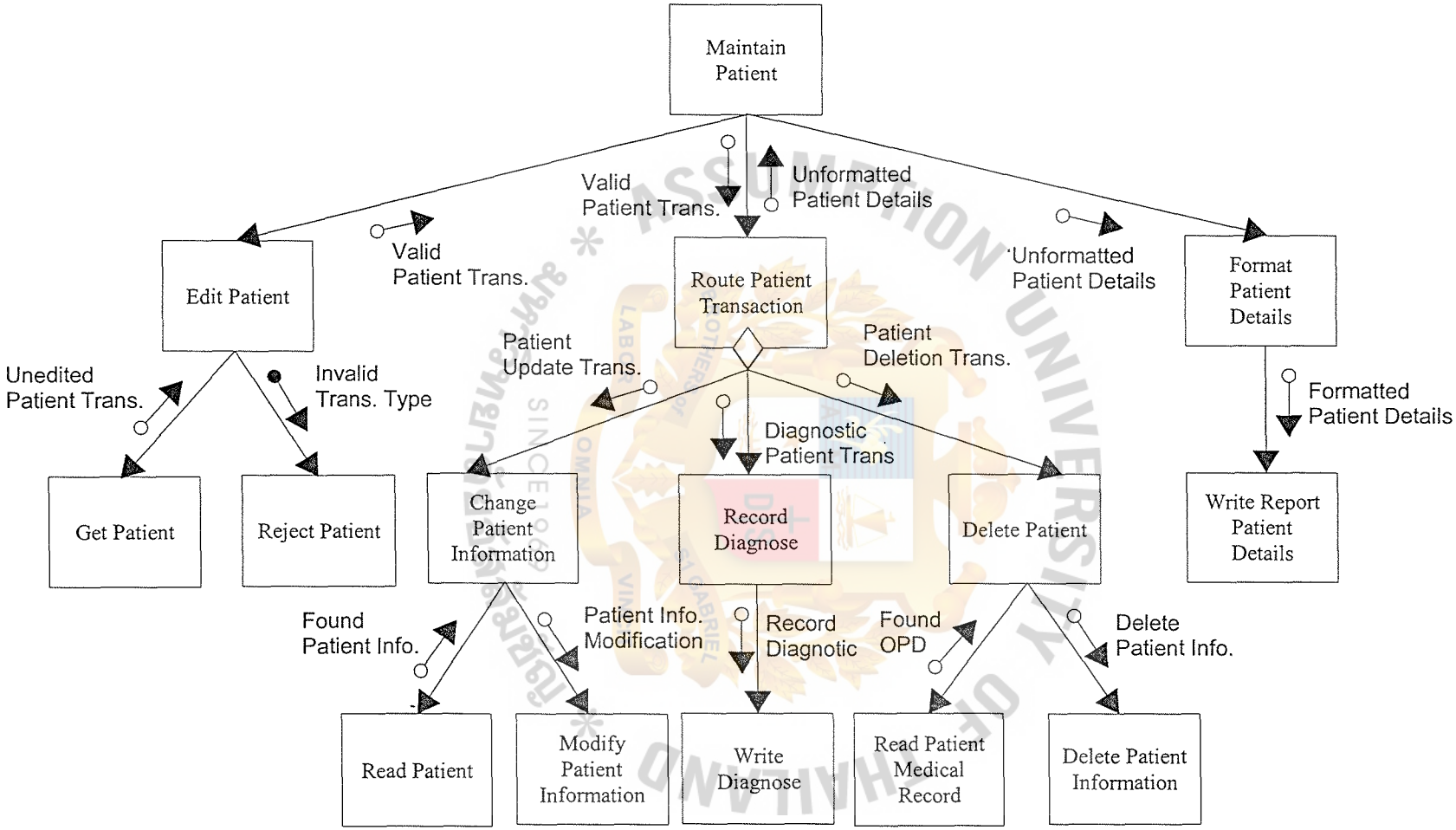

Figure D.5. Structure Chart from Maintain Patient of Patient Registration Information System.

APPENDIX E

DATA DICTIONARY

DATA DICTIONARY

ADMISSION Entity

Description: The database that records information about admission including discharging to the hospital for any surgery.

Composition:

AN. :	Integer 4
Admit Date :	Date
Discharge Date :	Date
Room No. :	Integer 4
Building :	VarChar
HN. :	Integer 4
Discharge Status :	VarChar

Primary Key:

Index Name:	Generated by VAW
Column(s):	AN. [ASC]

Location:

A Fully Attributed Data Model

Attached relationships on A Fully Attributed Data Model:

admits to MIN: 0 MAX: 1

PATIENT TREATMENT RECORD

Admit Date Data Element

Description: The date when patient is admitted to the hospital.

ADMISSION::Admit Date

Data element attributes

Storage Type: Date

Null Type: NotNull

Location:

Entity --> ADMISSION

admits to Relationship

Attached Entities:

ADMISSION

admits to MIN: 0 MAX: 1

PATIENT TREATMENT RECORD

[admits to] MIN: 1 MAX: 1

Location:

A Fully Attributed Data Model

AN. Data Element

Description: The patient admission number issued by the hospital.

ADMISSION::AN.

Data element attributes

Storage Type: Integer 4

Length: 5

Null Type: NotNull

Location:

Entity --> ADMISSION

Associative Entity --> PATIENT TREATMENT RECORD

Appoint Date Data Element

Description: The date when doctor needs to appoint patient.

APPOINTMENT::Appoint Date

Data element attributes

Storage Type: Date

Null Type: NotNull

Location:

Associative Entity --> APPOINTMENT

Appoint No. Data Element

Description: The appointed identification number.

APPOINTMENT::Appoint No.

Data element attributes

Storage Type: Integer 4

Length: 5

Null Type: NotNull

Location:

Associative Entity --> APPOINTMENT

Appoint Time Data Element

Description: The specified time when doctor needs to appoint patient.

APPOINTMENT::Appoint Time

Data element attributes

Storage Type: Time

Null Type: NotNull

Location:

Associative Entity --> APPOINTMENT

APPOINTMENT Associative Entity

Description: The database that records information about making appointment to follow up progression of treatment of patient.

Composition:

Patient-H.N. : Integer 4

Appoint Date : Date

Appoint Time : Time

Remark : Long VarChar

Appoint No. : Integer 4

Dr.ID : Integer 4

Primary Key:

Index Name: Generated by VAW

Column(s): Appoint No. [ASC]

Foreign Key(s):

PATIENT 'requests'

On Delete Restrict

On Update Restrict

On Insert of Child Row Restrict

PATIENT 'appoints'

On Delete Restrict

On Update Restrict

On Insert of Child Row Restrict

DOCTOR 'makes'

On Delete Restrict

On Update Restrict

On Insert of Child Row Restrict

Location:

A Fully Attributed Data Model

Attached relationships on A Fully Attributed Data Model:

[makes] MIN: 1 MAX: 1

DOCTOR

[requests] MIN: 1 MAX: 1

PATIENT

belongs to Relationship

Attached Entities:

INSURANCE COMPANY

belongs to MIN: 0 MAX: 1

PATIENT

[belongs to] MIN: 1 MAX: 1

Location:

A Fully Attributed Data Model

belongs to Relationship

Attached Entities:

DEPARTMENT

belongs to MIN: 0 MAX: many

PATIENT TREATMENT RECORD

[belongs to] MIN: 1 MAX: 1

Location:

A Fully Attributed Data Model

Building Data Element

Description: The place where patient is admitted.

ADMISSION::Building

Data element attributes

Storage Type: VarChar

Length: 20

Null Type: NotNull

Location:

Entity --> ADMISSION

Chief-Complaints Data Element

Description: The details about symptom of patient.

PATIENT TREATMENT RECORD::Chief-Complaints

Data element attributes

Storage Type: VarChar

Length: 50

Null Type: NotNull

Location:

Associative Entity --> PATIENT TREATMENT RECORD

DEPARTMENT Entity

Description: The database that records information about department where patient is screened following symptom.

Composition:

Department Code : Integer 4

Department Name : Char

HN. : Integer 4

Primary Key:

Index Name: Generated by VAW

Column(s): Department Code [ASC]

Location:

A Fully Attributed Data Model

Attached relationships on A Fully Attributed Data Model:

belongs to MIN: 0 MAX: many

PATIENT TREATMENT RECORD

Department Code Data Element

Description: The identification number of department.

DEPARTMENT::Department Code

Data element attributes

Storage Type: Integer 4

Length: 5

Null Type: NotNull

Location:

Entity --> DEPARTMENT

Department Name Data Element

Description: The name of department.

DEPARTMENT::Department Name

Data element attributes

Storage Type: Char

Length: 20

Null Type: NotNull

Location:

Entity --> DEPARTMENT

Diagnosis Data Element

Description: The results of physician examination.

PATIENT TREATMENT RECORD::Diagnosis

Data element attributes

Storage Type: VarChar

Length: 100

Null Type: NotNull

Location:

Associative Entity --> PATIENT TREATMENT RECORD

Discharge Date Data Element

Description: The date when patient leaves the hospital.

ADMISSION::Discharge Date

Data element attributes

Storage Type: Date

Null Type: NotNull

Location:

Entity --> ADMISSION

Discharge Status Data Element

Description: The flag that determines whether admit or discharge.

ADMISSION::Discharge Status

Data element attributes

Storage Type: VarChar

Null Type: Not Null With Default

Location:

Entity --> ADMISSION

DOCTOR Entity

Description: The database contains about information of doctor.

Composition:

Dr.ID : Integer 4

Dr.Name : Char

Dr.Telephone : VarChar

Department Code : Integer 4

Primary Key:

Index Name: Generated by VAW

Column(s): Dr.ID [ASC]

Location:

A Fully Attributed Data Model

Attached relationships on A Fully Attributed Data Model:

makes MIN: 0 MAX: many

APPOINTMENT

records diagnose to MIN: 1 MAX: many

PATIENT TREATMENT RECORD

issues MIN: 1 MAX: many

PRESCRIPTION

Dr.ID Data Element

Description: The doctor identification number.

Data element attributes

Storage Type: Integer 4

Length: 5

Null Type: NotNull

Location:

Entity --> DOCTOR

Dr.Name Data Element

Description: The name of physician.

DOCTOR::Dr.Name

Data element attributes

Storage Type: Char

Length: 30

Null Type: NotNull

Location:

Entity --> DOCTOR

Dr.Telephone Data Element

Description: The contact number of physician.

DOCTOR::Dr.Telephone

Data element attributes

Storage Type: VarChar

Length: 10

Null Type: NotNull

Location:

Entity --> DOCTOR

Drug Allergy Data Element

Description: Drug that patient is unusually sensitive to something eaten.

PATIENT::Drug Allergy

Data element attributes

Storage Type: VarChar

Length: 50

Null Type: NotNull

Location:

Entity --> PATIENT

Drug Name Data Element

Description: Drug lists that physician prescribes after the diagnosis is made.

PRESCRIPTION::Drug Name

Data element attributes

Storage Type: VarChar

Length: 50

Null Type: NotNull

Location:

Entity --> PRESCRIPTION

E-mail Data Element

Description: The electronic mail of patient.

PATIENT::E-mail

Data element attributes

Storage Type: Long VarChar

Length: 30

Null Type: Null

Location:

Entity --> PATIENT

has Relationship

Attached Entities:

LABORATORY

has MIN: 0 MAX: many

PATIENT TREATMENT RECORD

[has] MIN: 1 MAX: 1

Location:

A Fully Attributed Data Model

has Relationship

Attached Entities:

PRESCRIPTION

has MIN: 1 MAX: 1

PATIENT TREATMENT RECORD

[has] MIN: 1 MAX: 1

Location:

A Fully Attributed Data Model

Home Phone Data Element

Description: The patient's home telephone number.

PATIENT::Home Phone

Data element attributes

Storage Type: VarChar

Length: 10

Null Type: Null

Location:

Entity --> PATIENT

Insurance Address Data Element

Description: The company no., street name, and district of company.

INSURANCE COMPANY::Insurance Address

Data element attributes

Storage Type: VarChar

Length: 70

Null Type: NotNull

Location:

Entity --> INSURANCE COMPANY

Insurance Code Data Element

Description: The identification number of insurance company.

INSURANCE COMPANY::Insurance Code

Data element attributes

Storage Type: Integer 4

Length: 5

Null Type: NotNull

Location:

Entity --> INSURANCE COMPANY

INSURANCE COMPANY Entity

Description: The database that records information about the insurance company, which has a contract with the hospital.

Composition:

Insurance Code : Integer 4

Insurance Name : VarChar

Insurance Address : VarChar

Insurance Phone : VarChar

ID.Card : Integer 4

Primary Key:

Index Name: Generated by VAW

Column(s): Insurance Code [ASC]

Location:

A Fully Attributed Data Model

Attached relationships on A Fully Attributed Data Model:

belongs to MIN: 0 MAX: 1

PATIENT

Insurance Name Data Element

Description: The name of insurance company.

INSURANCE COMPANY::Insurance Name

Data element attributes

Storage Type: VarChar

Length: 30

Null Type: NotNull

Location:

Entity --> INSURANCE COMPANY

Insurance Phone Data Element

Description: The telephone of insurance company.

INSURANCE COMPANY::Insurance Phone

Data element attributes

Storage Type: VarChar

Length: 10

Null Type: NotNull

Location:

Entity --> INSURANCE COMPANY

is in Relationship

Attached Entities:

DEPARTMENT

is in MIN: 1 MAX: many

PATIENT

[is in] MIN: 1 MAX: 1

Location:

A Context Data Model

A Key-Based Data Model

is recorded in Relationship

Attached Entities:

PATIENT

is recorded in MIN: 1 MAX: many

PATIENT TREATMENT RECORD

[is recorded in] MIN: 1 MAX: 1

Location:

A Context Data Model

issues Relationship

Attached Entities:

DOCTOR

issues MIN: 1 MAX: many

PRESCRIPTION

[issues] MIN: 1 MAX: 1

Location:

A Fully Attributed Data Model

Lab Code Data Element

Description: Laboratory results identification number.

LABORATORY::Lab Code

Data element attributes

Storage Type: VarChar

Length: 6

Null Type: NotNull

Location:

Entity --> LABORATORY

Lab Detail Data Element

Description: Laboratory results.

LABORATORY::Lab Detail

Data element attributes

Storage Type: Long VarChar

Null Type: NotNull

Location:

Entity --> LABORATORY

LABORATORY Entity

Description: The database that records information about laboratory

Composition:

Lab Code : VarChar

Lab Detail : Long VarChar

HN. : Integer 4

Primary Key:

Index Name: Generated by VAW

Column(s): Lab Code [ASC]

Location:

A Fully Attributed Data Model

Attached relationships on A Fully Attributed Data Model:

has MIN: 0 MAX: many

PATIENT TREATMENT RECORD

makes Relationship

Attached Entities:

DOCTOR

makes MIN: 0 MAX: many

APPOINTMENT

[makes] MIN: 1 MAX: 1

Location:

A Context Data Model

Mobile Phone Data Element

Description: The mobile telephone of patient.

PATIENT::Mobile Phone

Data element attributes

Storage Type: Integer 4

Length: 7

Null Type: Null

Location:

Entity --> PATIENT

PATIENT Entity

Description: The database contains the general information of patient himself.

Composition:

Patient-H.N. : Integer 4

Patient-Name : VarChar

Patient-Surname :	VarChar
Patient-ID-Card :	Integer 4
Patient-Gender :	VarChar
Patient-Date-of-Birth :	Date
Patient-Age :	Integer 4
Patient-Marital-Status :	VarChar
Patient Nationality :	VarChar
Patient-Address :	Long VarChar
Insurance Name :	VarChar
Patient-Zipcode :	Integer 4
Home Phone :	VarChar
E-mail :	Long VarChar
Mobile Phone :	Integer 4
Drug Allergy :	VarChar

Primary Key:

Index Name:	Generated by VAW
Column(s):	Patient-H.N. [ASC]
	Patient-ID-Card [ASC]

Alternate Key 1:

Index Name:	Generated by VAW
Column(s):	Patient-ID-Card [ASC]

Foreign Key(s):

DEPARTMENT 'is in'

On Delete Restrict

On Update Restrict

On Insert of Child Row Restrict

INSURANCE COMPANY 'belongs to'

On Delete Restrict

On Update Restrict

On Insert of Child Row Restrict

Location:

A Fully Attributed Data Model

Attached relationships on A Fully Attributed Data Model:

is recorded in MIN: 1 MAX: many

PATIENT TREATMENT RECORD

[belongs to] MIN: 1 MAX: 1

INSURANCE COMPANY

requests MIN: 1 MAX: many

APPOINTMENT

Patient-Address Data Element

Description: The home no., street name, and district of patient.

PATIENT::Patient-Address

Data element attributes

Storage Type: Long VarChar

Length: 70

Null Type: NotNull

Location:

Entity --> PATIENT

Patient-Age Data Element

Description: The age of patient.

PATIENT::Patient-Age

Data element attributes

Storage Type: Integer 4

Null Type: NotNull

Location:

Entity --> PATIENT

Patient-Date-of-Birth Data Element

Description: The birthday of patient.

PATIENT::Patient-Date-of-Birth

Data element attributes

Storage Type: Date

Null Type: NotNull

Location:

Entity --> PATIENT

Patient-Gender Data Element

Description: The sex of patient.

PATIENT::Patient-Gender

Data element attributes

Storage Type: VarChar

Null Type: NotNull

Location:

Entity --> PATIENT

Patient-H.N. Data Element

Description: The patient identification number issued by the hospital. It uses for all contact with the hospital.

PATIENT::Patient-H.N.

Data element attributes

Storage Type: Integer 4

Length: 10

Null Type: NotNull

Location:

Entity --> PATIENT

Associative Entity --> APPOINTMENT

Patient-ID-Card Data Element

Description: The identity card.

PATIENT::Patient-ID-Card

Data element attributes

Storage Type: Integer 4

Length: 13

Null Type: NotNull

Location:

Entity --> PATIENT

Patient-Marital-Status Data Element

Description: The marital status of patient.

Data element attributes

Storage Type: Char

Null Type: NotNull

Location:

Entity --> PATIENT

Patient-Name Data Element

Description: The name of patient.

PATIENT::Patient-Name

Data element attributes

Storage Type: VarChar

Length: 30

Null Type: NotNull

Location:

Entity --> PATIENT

Patient-Surname Data Element

Description: The surname of patient.

PATIENT::Patient-Surname

Data element attributes

Storage Type: VarChar

Length: 50

Null Type: NotNull

Location:

Entity --> PATIENT

Patient-Zipcode Data Element

Description: The postal code of patient.

PATIENT::Patient-Zipcode

Data element attributes

Storage Type: Integer 4

Null Type: NotNull

Location:

Entity --> PATIENT

Patient Nationality Data Element

Description: The nationality of patient.

PATIENT::Patient Nationality

Data element attributes

Storage Type: VarChar

Null Type: NotNull

Location:

Entity --> PATIENT

PATIENT TREATMENT RECORD Associative Entity

Description: The database contains the patient history, diagnosis, and treatment.

Composition:

Prescript No. : Integer 4

AN. : Integer 4

Dr.ID : Integer 4

H.N. : Integer 4

Registered Date : Date

Registered Time : Time

Chief-Complaints : VarChar

Lab Code : VarChar

X-Ray No. : Dr.ID

Diagnosis : VarChar

Prescription No. : Dr.ID

Department Code : Integer 4

Primary Key:

Index Name: Generated by VAW

Column(s): Registered Date [ASC]

H.N. [ASC]

Foreign Key(s):

DOCTOR 'treats'

On Delete Restrict

On Update Restrict

On Insert of Child Row Restrict

PATIENT 'is recorded in'

On Delete Restrict

On Update Restrict

On Insert of Child Row Restrict

DOCTOR 'records diagnose to'

On Delete Restrict

On Update Restrict

On Insert of Child Row Restrict

PRESCRIPTION 'has'

On Delete Restrict

On Update Restrict

On Insert of Child Row Restrict

LABORATORY 'has'

On Delete Restrict

On Update Restrict

On Insert of Child Row Restrict

DEPARTMENT 'belongs to'

On Delete Restrict

On Update Restrict

On Insert of Child Row Restrict

ADMISSION 'admits to'

On Delete Restrict

On Update Restrict

On Insert of Child Row Restrict

Location:

A Fully Attributed Data Model

Attached relationships on A Fully Attributed Data Model:

[is recorded in] MIN: 1 MAX: 1

PATIENT

[admits to] MIN: 1 MAX: 1

ADMISSION

[belongs to] MIN: 1 MAX: 1

DEPARTMENT

[has] MIN: 1 MAX: 1

LABORATORY

[has] MIN: 1 MAX: 1

PRESCRIPTION

[records diagnose to] MIN: 1 MAX: 1

DOCTOR

Prescript No. Data Element

Description: Prescription identification number.

PRESCRIPTION::Prescript No.

Data element attributes

Storage Type: Integer 4

Length: 4

Null Type: NotNull

Location:

Entity --> PRESCRIPTION

Associative Entity --> PATIENT TREATMENT RECORD

PRESCRIPTION Entity

Description: The database contains the drug list that is issued by physician.

Composition:

Prescript No. : Integer 4

Dr.ID : Integer 4

HN. : Integer 4

Drug Name : VarChar

Qty : VarChar

Receive Status : Char

Primary Key:

Index Name: Generated by VAW

Column(s): Prescript No. [ASC]

Foreign Key(s):

DOCTOR 'issues'

On Delete Restrict

On Update Restrict

On Insert of Child Row Restrict

Location:

A Fully Attributed Data Model

Attached relationships on A Fully Attributed Data Model:

has MIN: 1 MAX: 1

PATIENT TREATMENT RECORD

[issues] MIN: 1 MAX: 1

DOCTOR

Qty Data Element

Description: The number of drug in prescription.

PRESCRIPTION::Qty

Data element attributes

Storage Type: VarChar

Length: 10

Null Type: NotNull

Location:

Entity --> PRESCRIPTION

Receive Status Data Element

Description: The flag that checks receiving payment of patient.

PRESCRIPTION::Receive Status

Data element attributes

Storage Type: Char

Null Type: Not Null With Default

Location:

Entity --> PRESCRIPTION

records diagnose to Relationship

Attached Entities:

DOCTOR

records diagnose to MIN: 1 MAX: many

PATIENT TREATMENT RECORD

[records diagnose to] MIN: 1 MAX: 1

Location:

A Fully Attributed Data Model

Registered Date Data Element

Description: The date when patient visits each time.

PATIENT TREATMENT RECORD::Registered Date

Data element attributes

Storage Type: Date

Null Type: NotNull

Location:

Associative Entity --> PATIENT TREATMENT RECORD

Registered Time Data Element

Description: The specified time when patient visits.

PATIENT TREATMENT RECORD::Registered Time

Data element attributes

Storage Type: Time

Null Type: NotNull

Location:

Associative Entity --> PATIENT TREATMENT RECORD

requests Relationship

Attached Entities:

PATIENT

requests MIN: 1 MAX: many

APPOINTMENT

[requests] MIN: 1 MAX: 1

Location:

A Fully Attributed Data Model

Room No. Data Element

Description: The room number where patient is admitted.

ADMISSION::Room No.

Data element attributes

Storage Type: Integer 4

Length: 3

Null Type: NotNull

Location:

Entity --> ADMISSION

X-Ray No. Data Element

Description: The identification number of film x-ray.

PATIENT TREATMENT RECORD::X-Ray No.

Data element attributes

Domain: Dr.ID

Storage Type: Integer 4

Length: 5

Null Type: Null

Location:

Associative Entity --> PATIENT TREATMENT RECORD

APPENDIX F

INTERFACE DESIGN

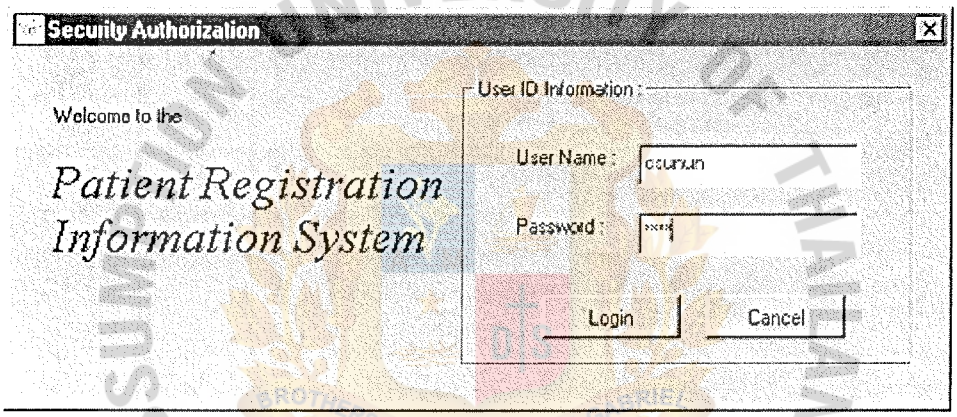

Figure F.1. Login System Form.

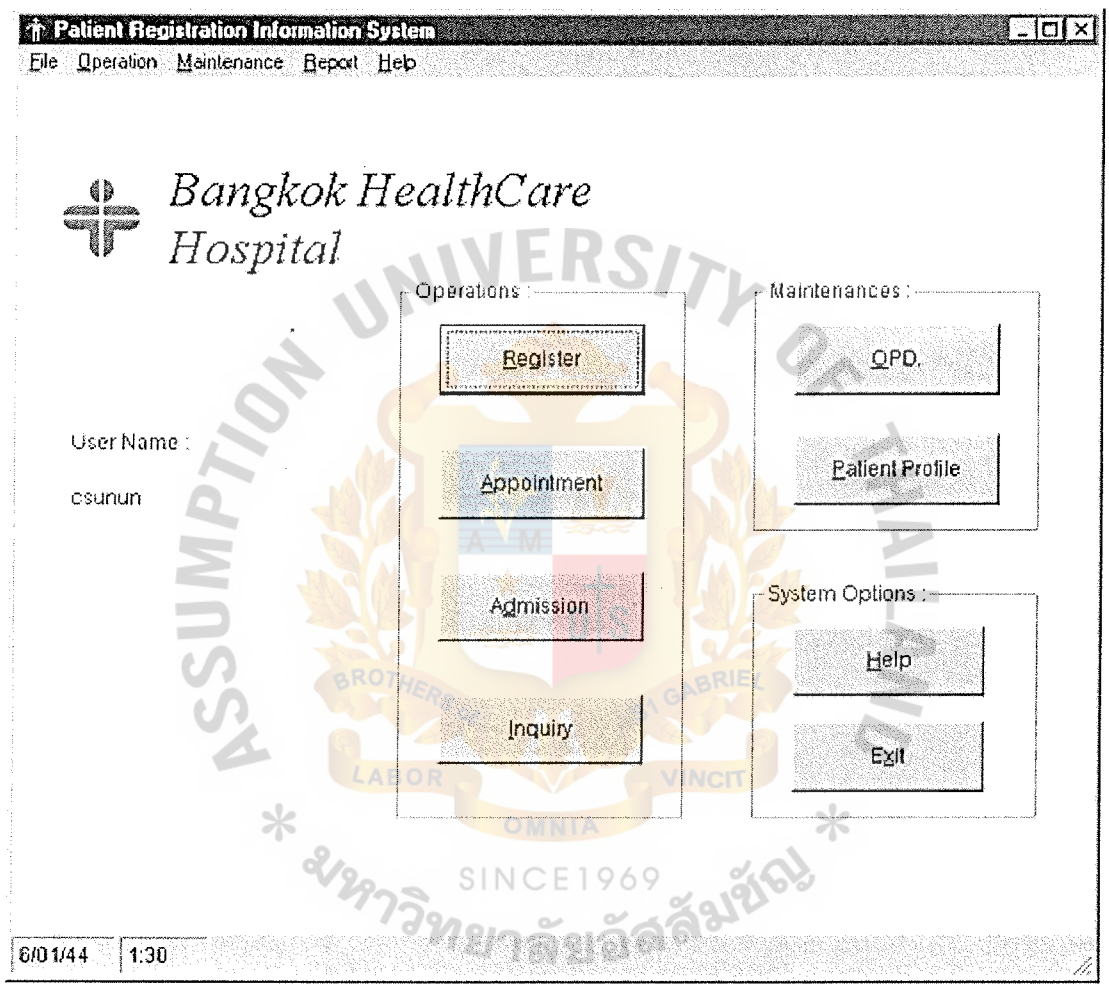

Figure F.2. Main Menu Form.

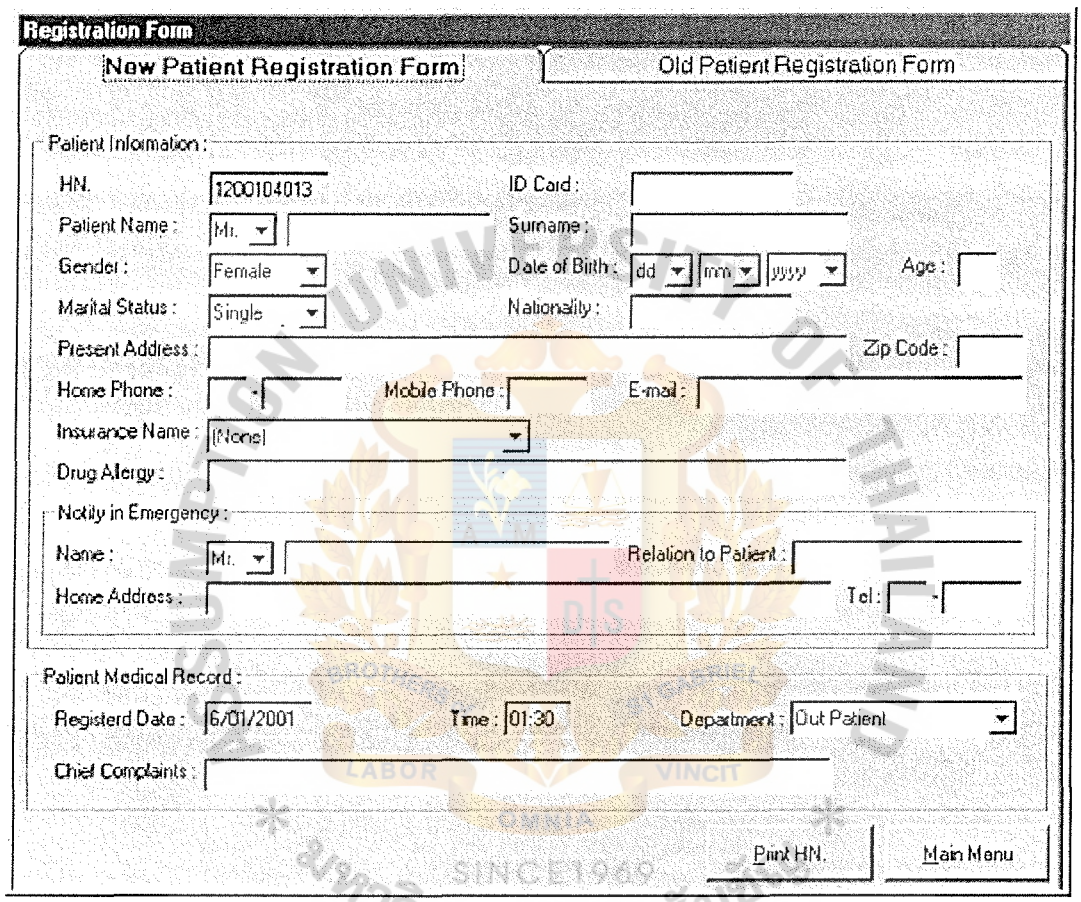

Figure F.3. New Patient Registration Form.

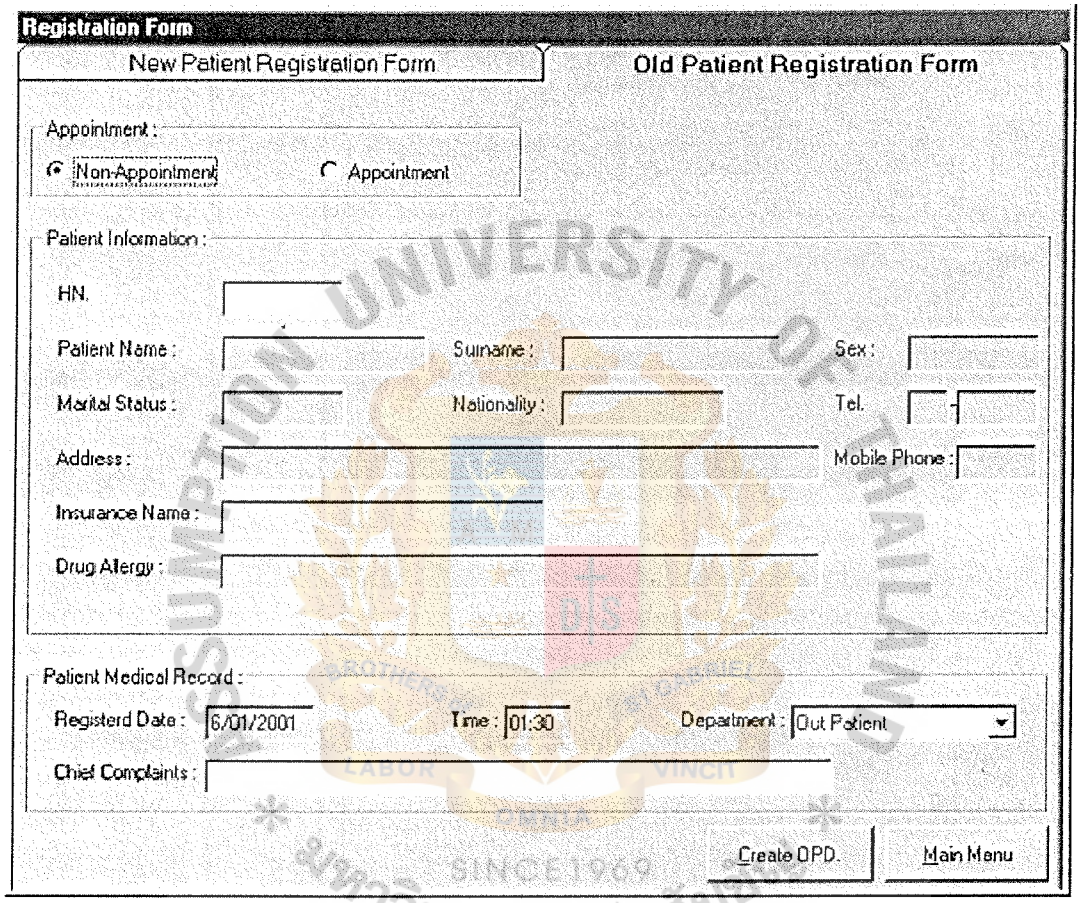

Figure F.4. Current Patient Registration Form.

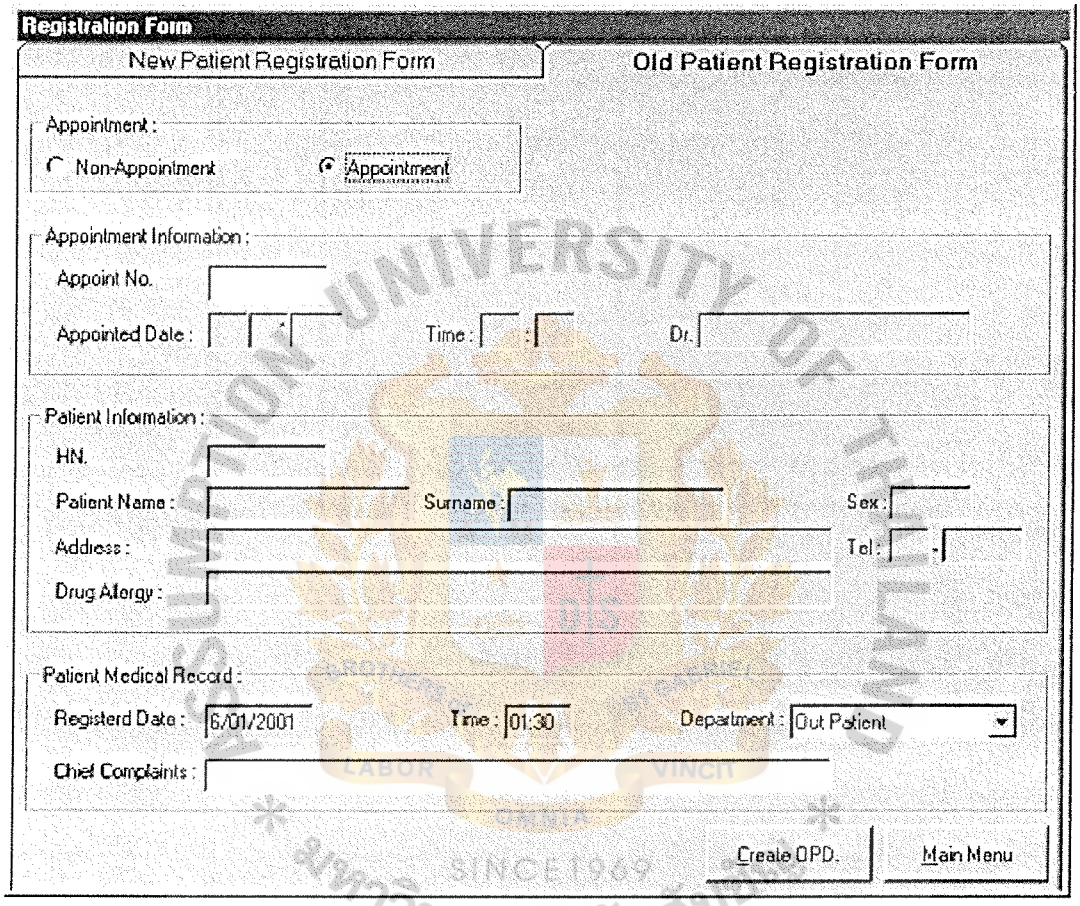

Figure F.5. Appointed Patient Registration Form.

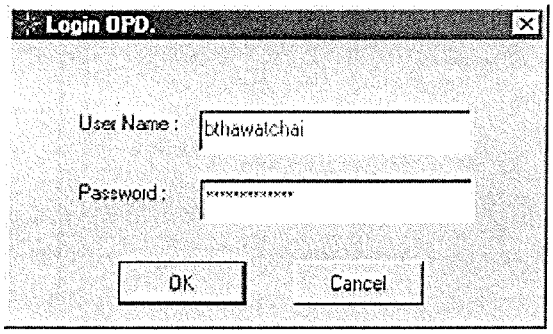

Figure F.6. Login OPD Form.

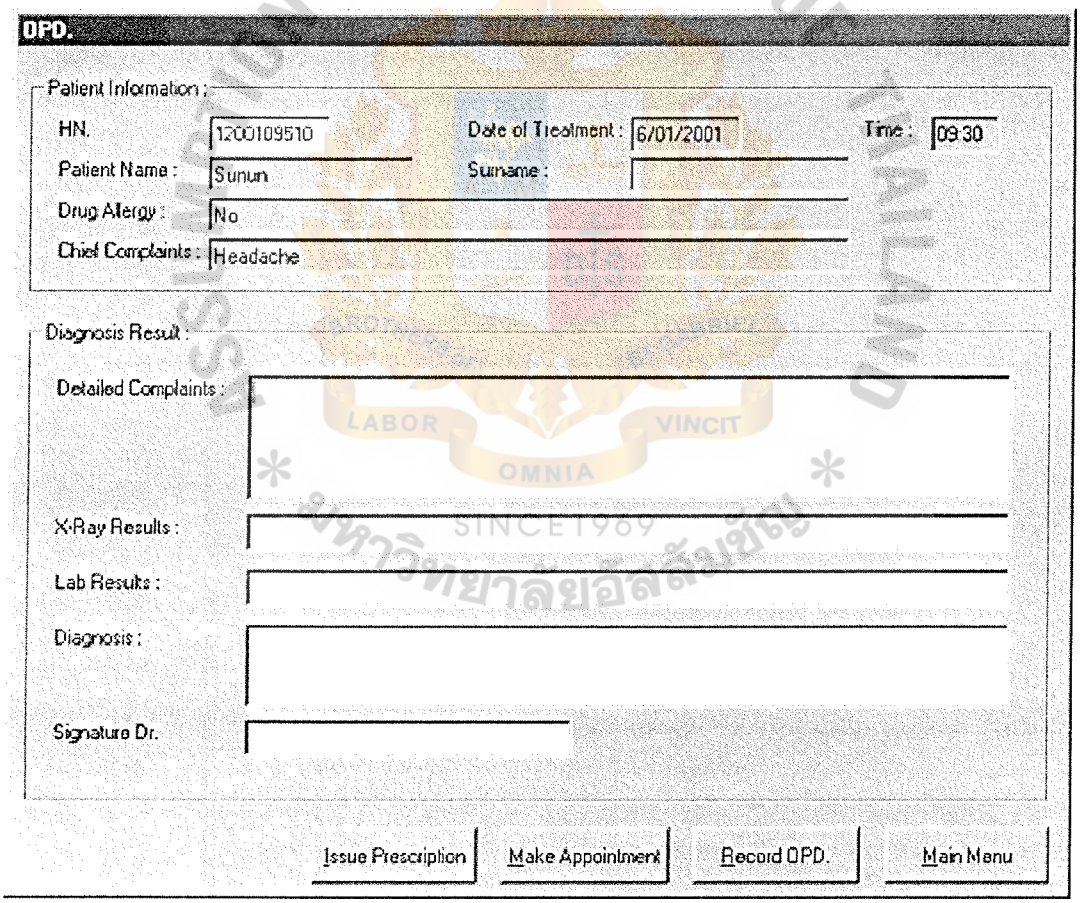

Figure F.7. OPD Form.

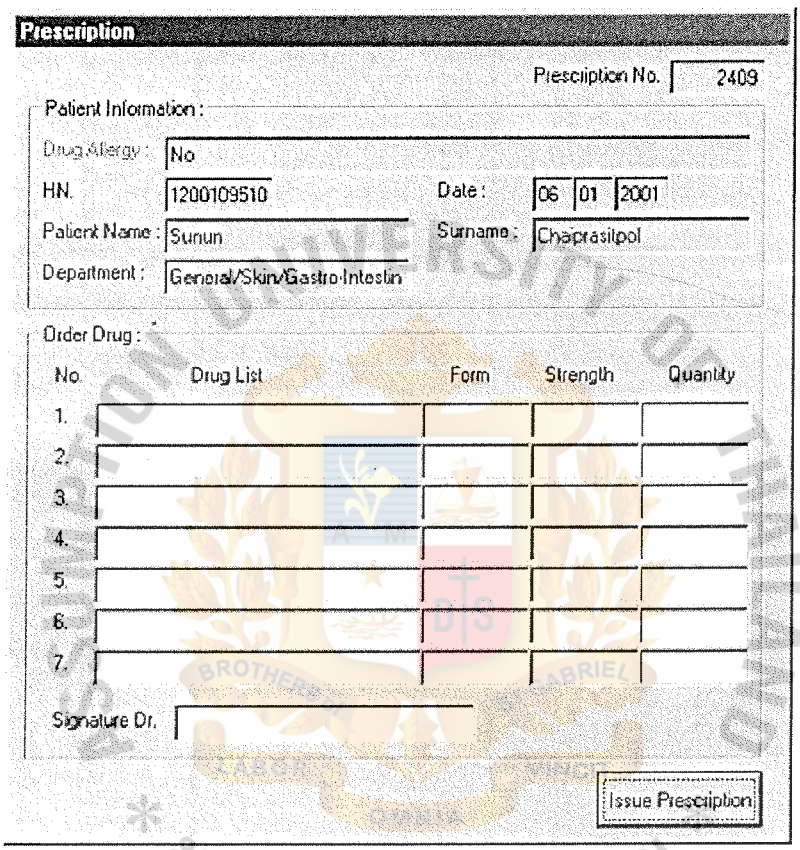

Figure F.8. Prescription Form.

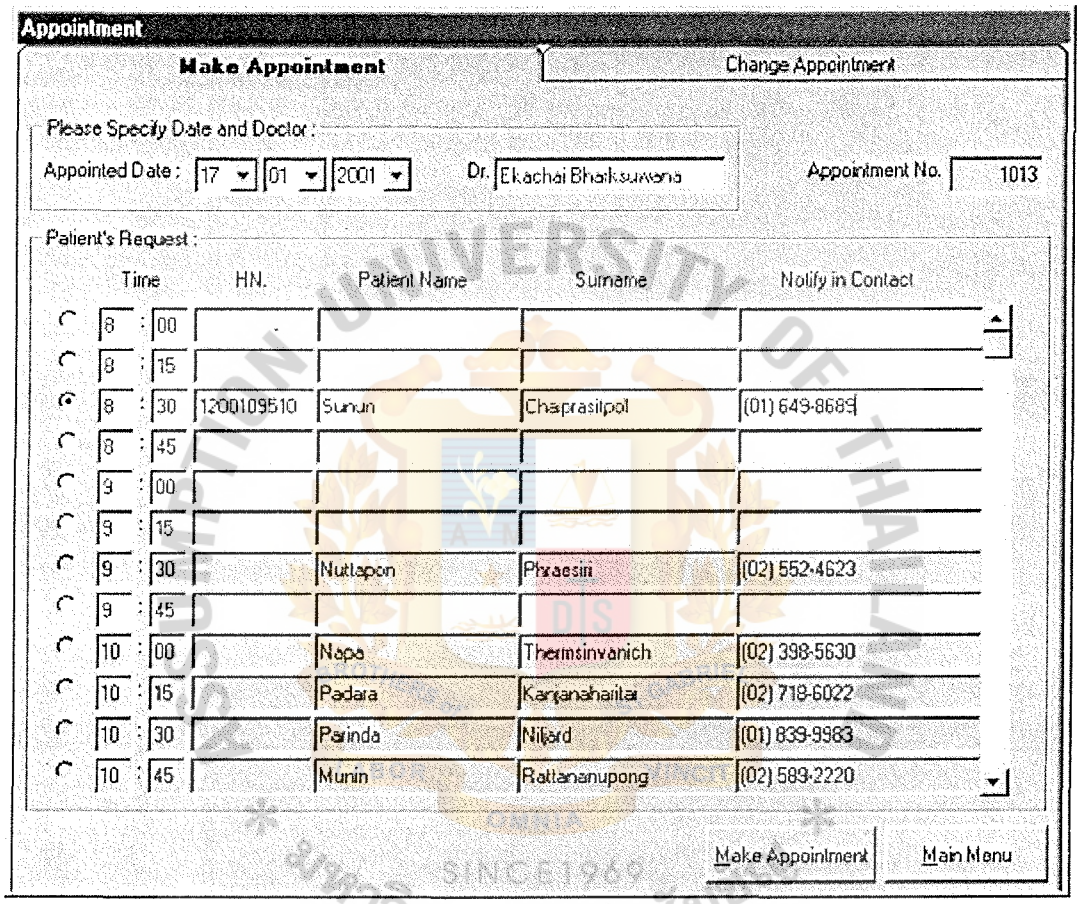

Figure F.9. Making Appointment Form.

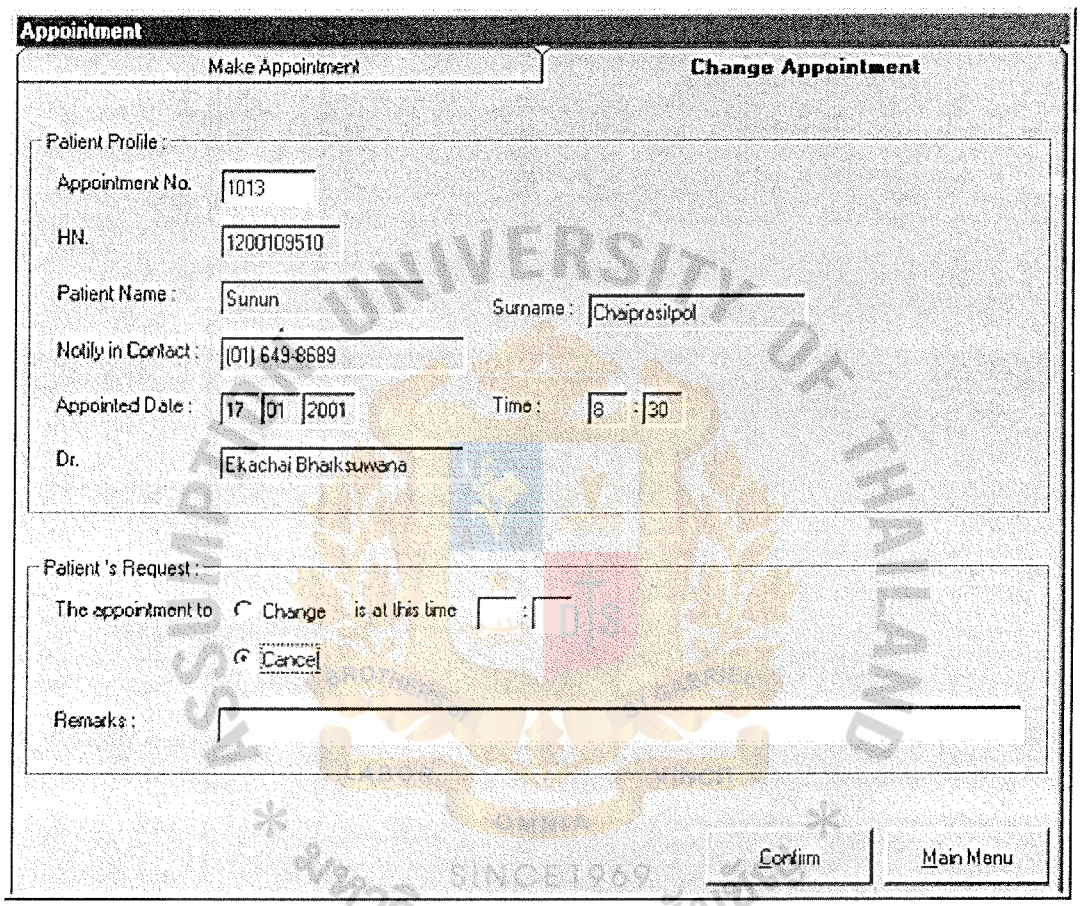

Figure F.10. Changing Appointment Form.

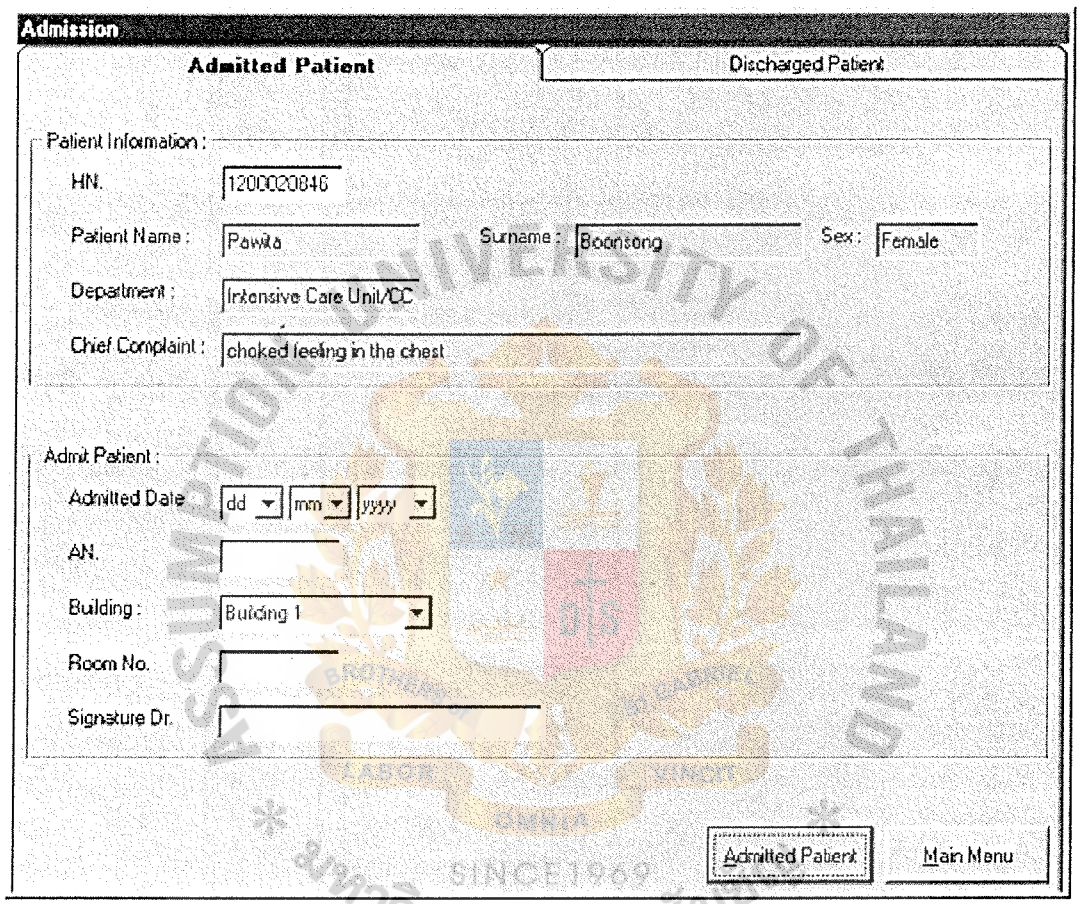

Figure F.11. Admitted Patient Form.

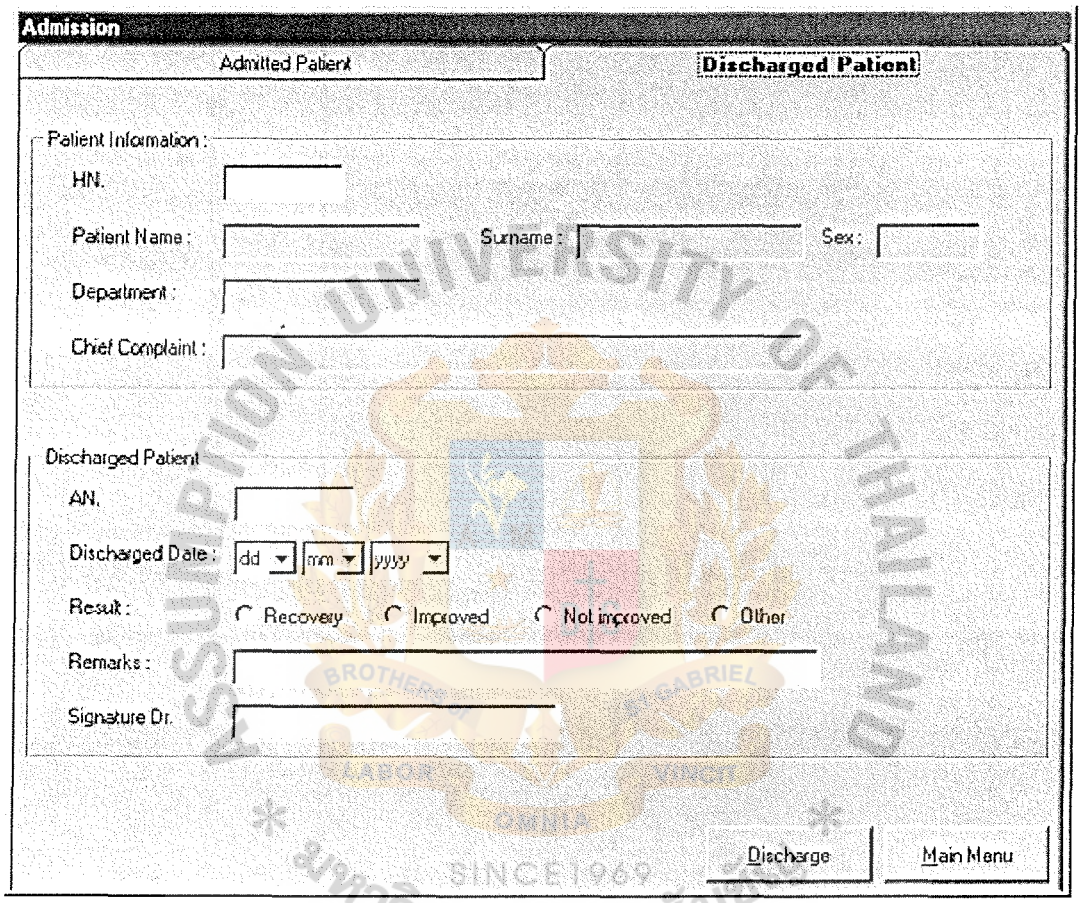

Figure F.12. Discharged Patient Form.

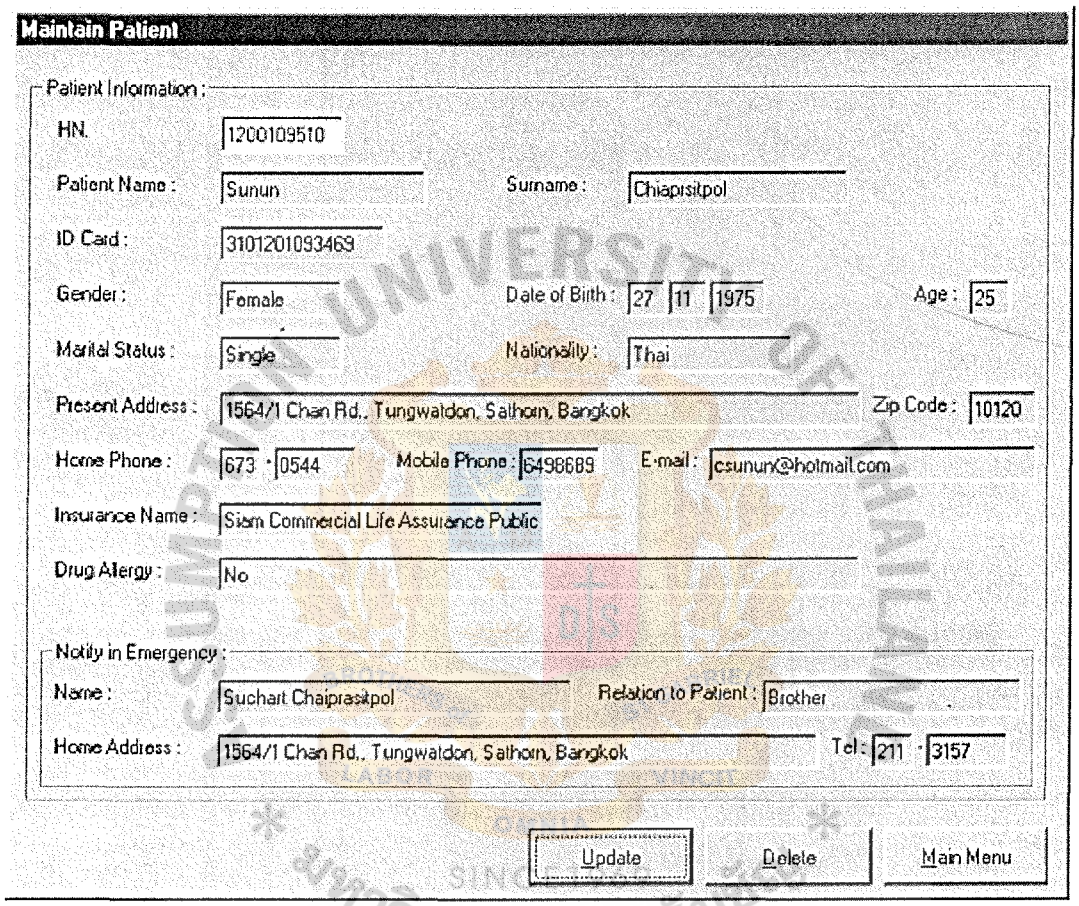

Figure F.13. Maintain Patient Form.

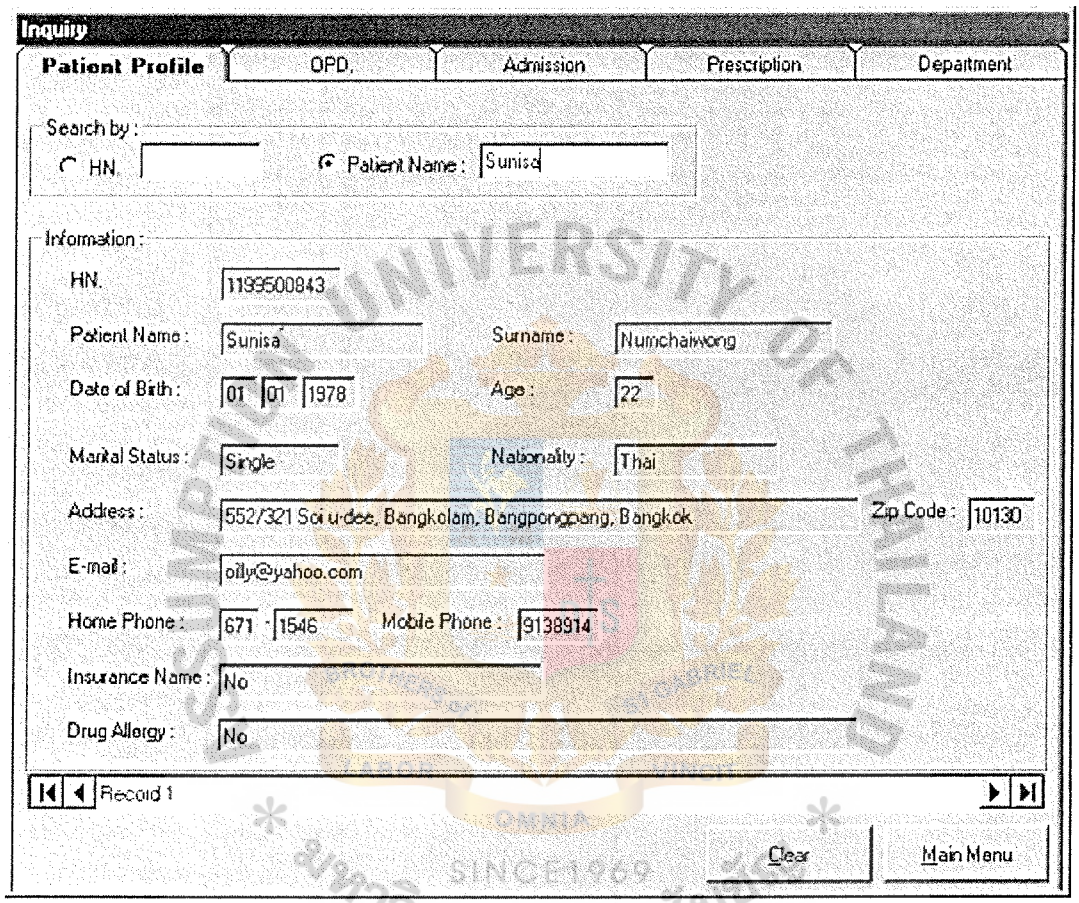

Figure F.14. Inquiry Patient Profile Form.

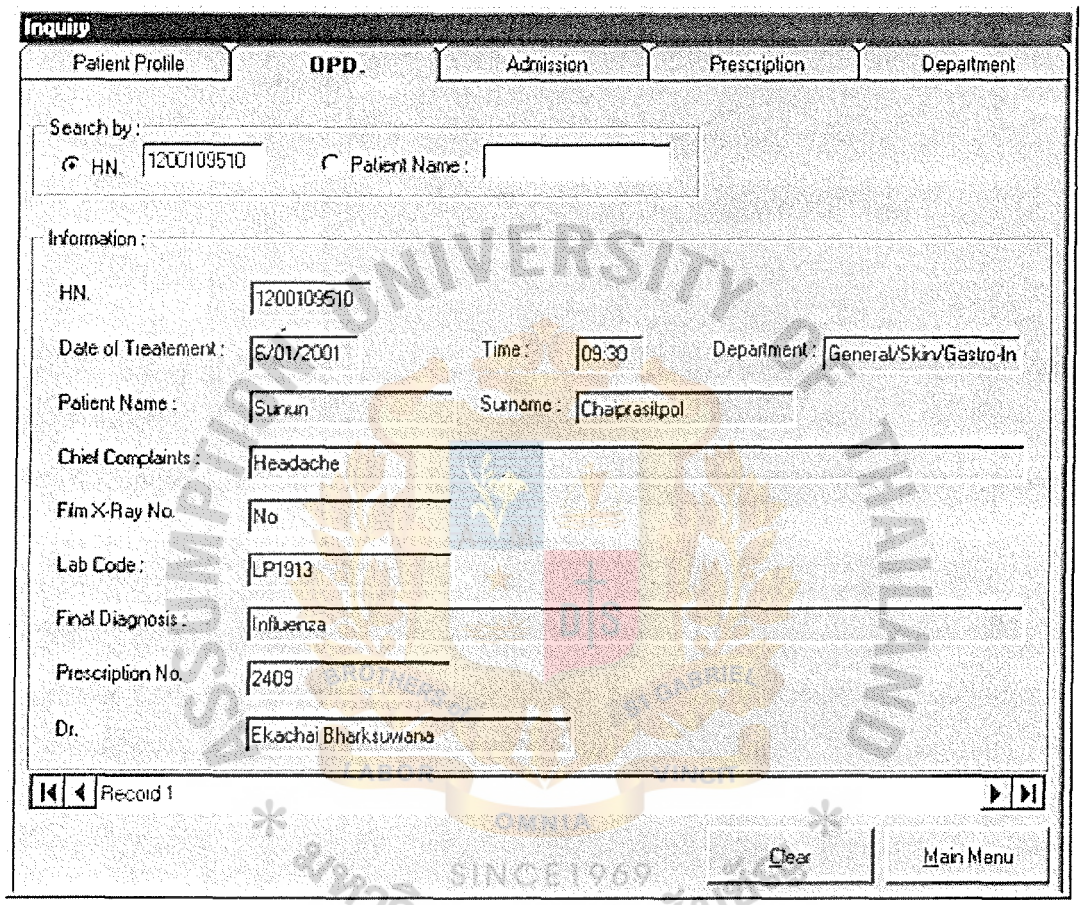

Figure F.15. Inquiry OPD. Form.

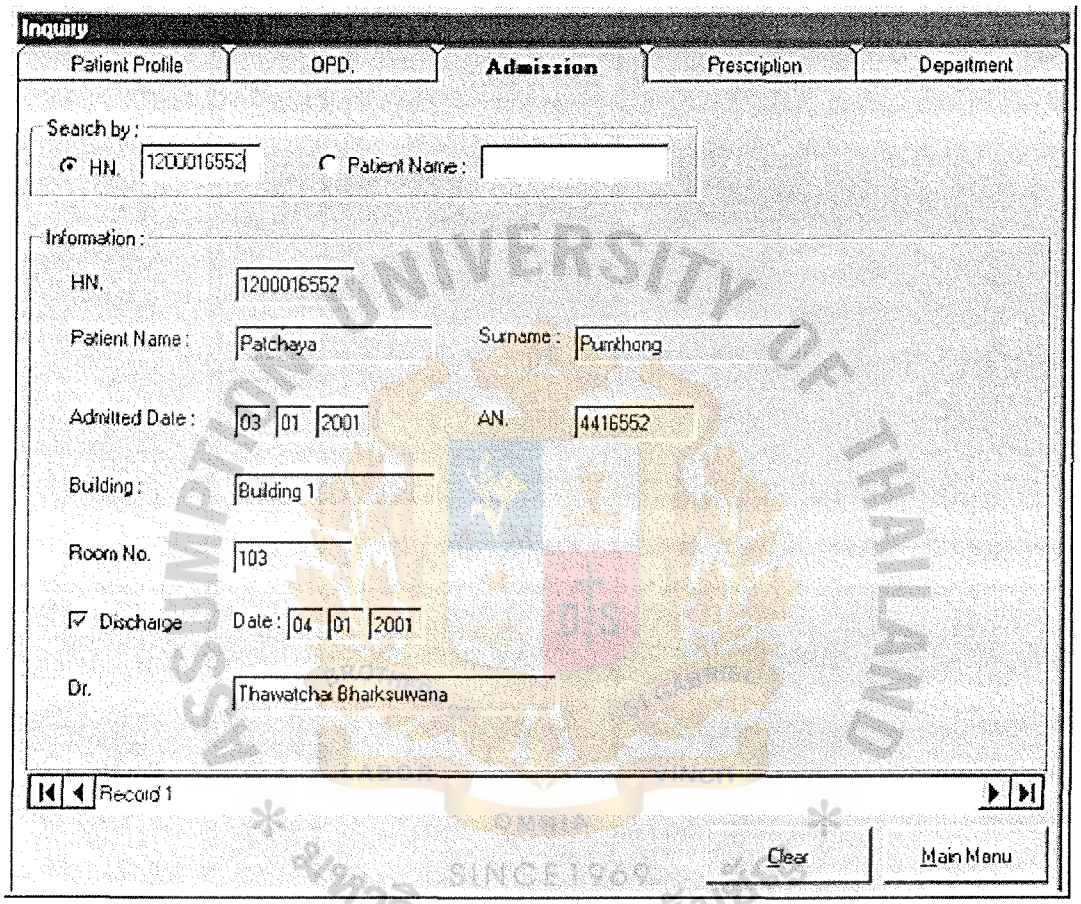

Figure F.16. Inquiry Admission Form.

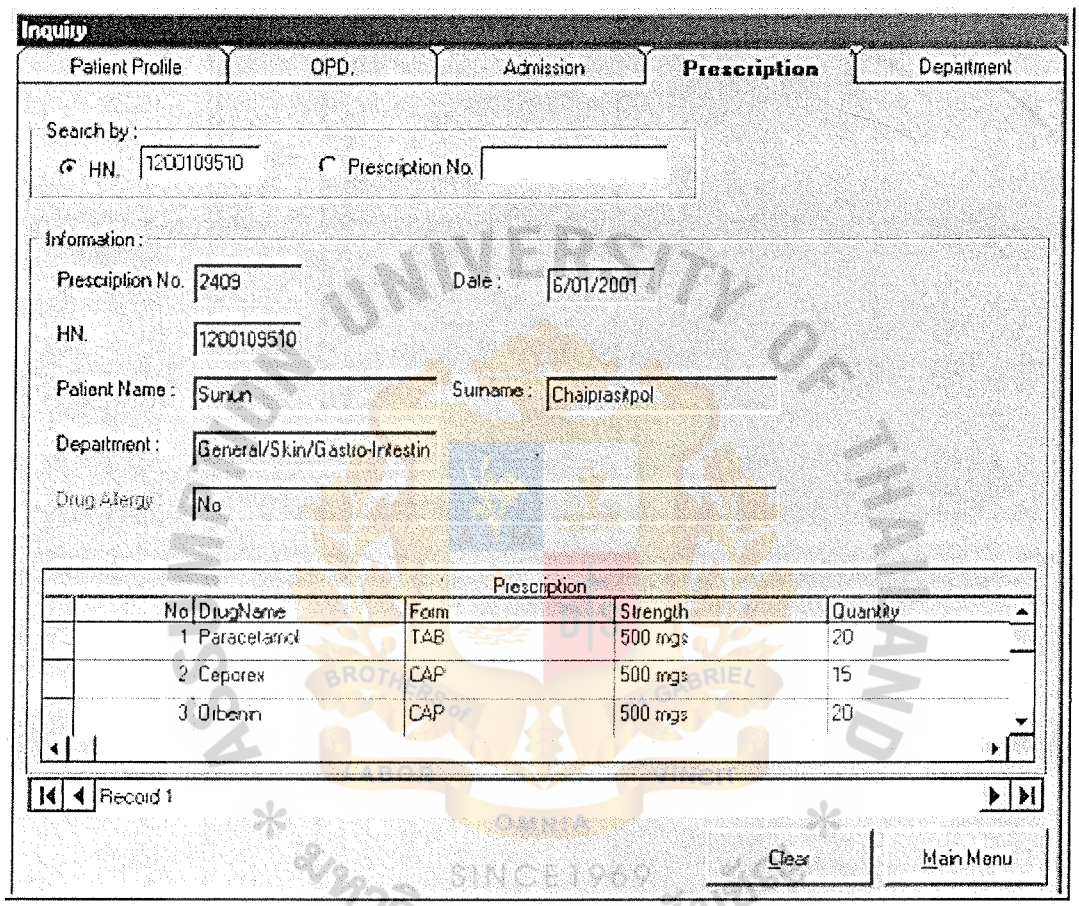

Figure F.17. Inquiry Prescription Form.

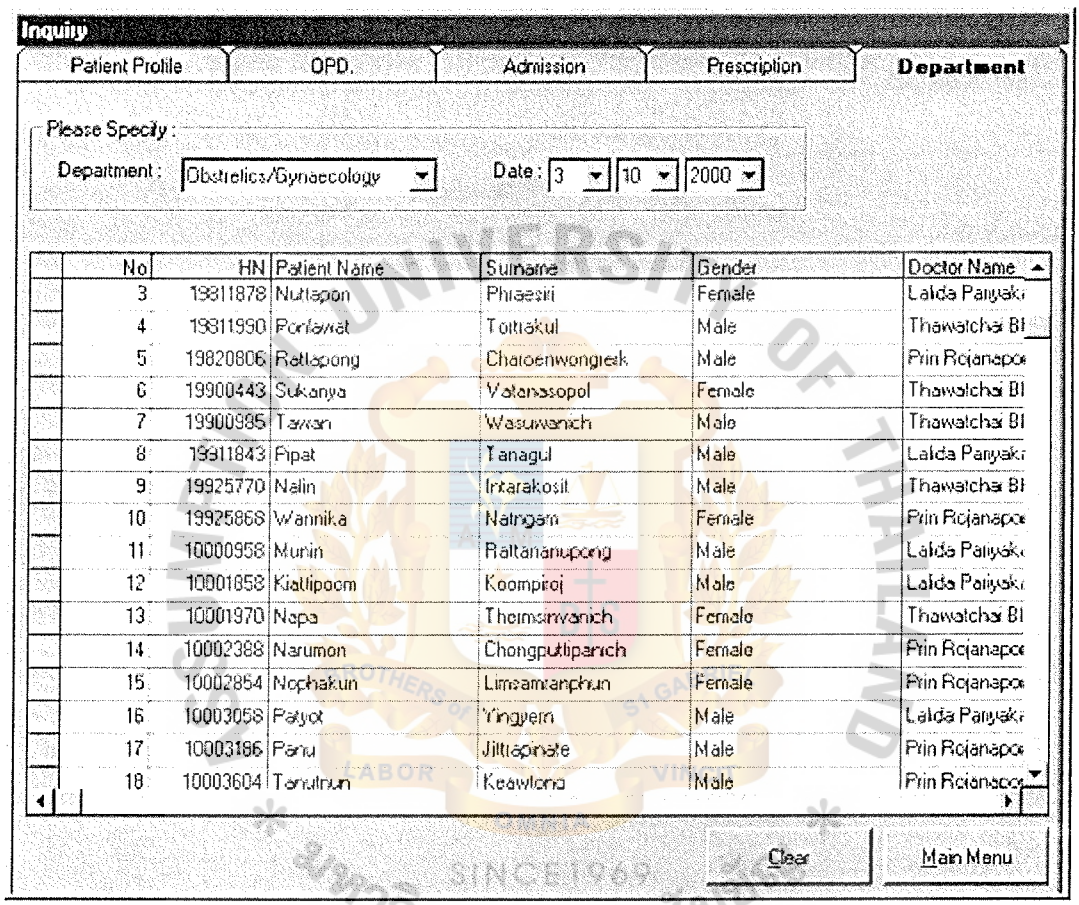

Figure F.18. Inquiry Patient by Department Form.

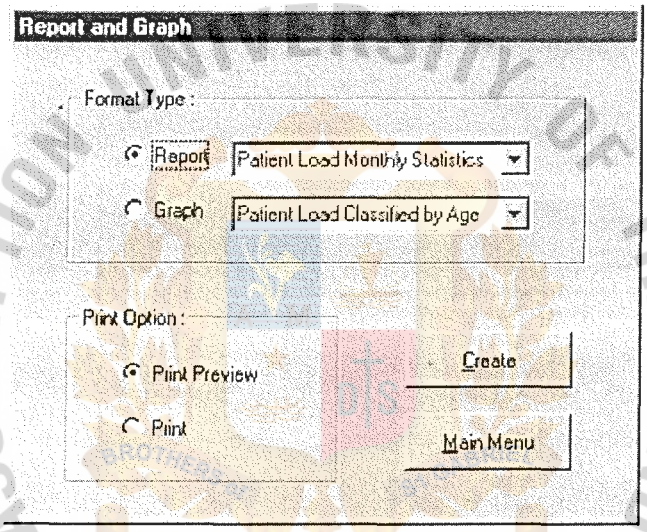

Figure F.19. Report and Graph Option Form.

APPENDIX G

REPORT DESIGN

Table G.1. Patient List Report.

HN.	Name	Surname	Home Phone	Mobile Phone	Contract Company
1200029510	Sunun	Chaiprasitpol	02-6730544	6498689	Siam Commercial Life Assurance Public Co.,Ltd.
1200029511	Patchaliya	Chavananikul	02-5422773	6890175	Siam Commercial Life Assurance Public Co.,Ltd.
1200029512	Kanlaya	Sattumvilai	02-6763577	-	Bangkok Insurance Public Co.,Ltd.
1200029513	Aungkana	Vanitchapreuk	035-409301	-	-
1200029514	Lamud	Chinphun	-	8232988	Bangkok Insurance Public Co.,Ltd.
1200029515	Sunisa	Numchaiwong	02-6711546	9138914	Thai Reinsurance Public Co.,Ltd.

Table G.2. Patient Medical Record (OPD) List Report.

Registered Date	Chief Complaint	Film X-Ray No.	Lab Code	Prescription No.	Final Diagnosis
13/05/1999	Chocked feeling in the chest	FR1085	LP7030	1590	Inflammation of the lungs

BANGKOK HEALTHCARE HOSPITAL

Patient Profile Report

End of Date 13/01/2001

Registered Date :	13/1/01		
H.N.	10100510		
Patient's Name :	Sunun	**Surname :** Chaiprasitpol	
ID Card	3101201093469		
Gender :	Female		
Date of Birth :	27/11/1975	**Age :** 25	
Marital Status :	Single		
Address	1564/1 Chan Rd., Tungwatdon, Sathorn, Bangkok		**Zip Code :** 10120
Home Phone :	673-0544	**Mobile Phone :** 649-8689	
E-mail :	csunun@hotmail.com		
Insurance Name:	Siam Commercial Life Assurance Public Company		
Drug Allergy :	No		

Figure G.1. Patient Profile Report.

BANGKOK HEALTHCARE HOSPITAL

OPD. Summary Report

as of January 9,2001

Date of Treatment	1/7/01	**Time :** 10:45	
H.N.	10009013		
Patient's Name :	Nalin	**Surname :**	Intarakosit
Department :	Pediatrics		
Chief Complaints :	Headache, Nausea, Vomiting		
Lab Code :	LP1913		
Film X-Ray No :	XR02711		
Final Diagnosis :	Infulenza		
Prescription No :	2419		
Doctor's Name :	Rungroj Lerdvitayasakul		

Figure G.2. OPD. Summary Report.

BANGKOK HEALTHCARE HOSPITAL

Weekly Appointment Report

15/01/01-21/01/01

Doctor Name	Appointed Date	Time	Patient Name	Surname	Notify in Contact
Dr. Chate Kietrsunthorn					
	15/1/01	8:00	Sukanya	Vatanasopol	(01) 681-6521
	15/1/01	9:15	Kiattipoom	Koompiroj	(02) 754-0594
	16/1/01	9:15	Tanutnun	Keawtong	(02) 277-7798
	16/1/01	10:30	Pipat	Tanagul	(02) 215-1210
	16/1/01	10:45	Vachara	Ratanasupakorn	(01) 643-4334
	17/1/01	14:00	Tawan	Wasuwanich	(02) 951-9519
	17/1/01	15:45	Patyot	Yingyern	(01) 856-1260
	17/1/01	16:00	Ponlawat	Tortrakul	(02) 314-7092
	17/1/01	16:30	Pornphet	Prasertchaiyakul	(02) 278-5801
	19/1/01	8:00	Patchaliya	Chavananikul	(02) 542-2773
	19/1/01	8:30	Nitipon	Wityatem	(02) 355-2097
Dr. Ekachai Bharksuwana					
	17/1/01	9:30	Nuttapon	Phraesiri	(02) 552-4623
	17/1/01	10:00	Napa	Thermsinvanich	(02) 398-5630
	17/1/01	10:15	Padara	Kanjanaharitai	(02) 718-6022
	17/1/01	10:30	Parinda	Niljard	(01) 839-9983
	17/1/01	10:45	Munin	Rattananupong	(02) 589-2220
	18/1/01	10:00	Rattapong	Charoenwongrerk	(01) 682-2552
	18/1/01	10:30	Orunut	Boonyachai	(02) 221-2239

Figure G.3. Weekly Appointment Report.

BANGKOK HEALTHCARE HOSPITAL

Patient Load Monthly Statistics Report

(Classified by Gender)

as of December 31, 2000

Department	Male	Female	Total
Dental	1,023	1,457	2,480
Emergency	744	1,023	1,767
Eye/Ear/Throat/Nose	1,147	1,333	2,480
General/Skin/Gastro-Intestinal	2,139	2,387	4,526
Intensive Care Unit/CCU	589	868	1,457
Medicine/Other Specialty	744	527	1,271
Neuro Medicine	806	465	1,271
Obstretics/Gynaecology	-	1,643	1,643
Orthopedics	930	713	1,643
Pediatrics	1,178	992	2,170
Surgery	341	713	1,054
Urology	372	434	806
Ward	620	837	1,457
Net Total	**10,633**	**13,392**	**24,025**

Figure G.4. Patient Load Monthly Statistics Report.

BANGKOK HEALTHCARE HOSPITAL

Patient Load Quarterly Statistics Report

as of December 31, 2000

Department	2000 Mar 31	2000 Jun 30	2000 Sep 30	2000 Dec 31
Dental	4,904	4,766	4,686	6,315
Emergency	5,592	4,818	4,139	5,945
Eye/Ear/Throat/Nose	5,255	5,667	6,158	6,718
General/Skin/Gastro-Intestinal	12,632	11,548	9,818	11,760
Intensive Care Unit/CCU	4,035	2,966	2,878	3,832
Medicine/Other Specialty	2,213	1,944	2,597	3,733
Neuro Medicine	2,951	3,456	3,934	3,749
Obstretics/Gynaecology	4,228	3,345	4,449	4,422
Orthopedics	3,007	4,219	4,321	5,170
Pediatrics	5,824	5,397	5,294	5,987
Surgery	1,363	756	492	1,257
Urology	1,994	1,908	2,736	2,024
Ward	6,351	6,278	5,516	4,566
Net Total	**60,349**	**57,068**	**57,018**	**65,478**

Figure G.5. Patient Load Quarterly Statistics Report.

BANGKOK HEALTHCARE HOSPITAL

Patient Load Yearly Statistics Report

as of December 31, 2000

Patient Load	Jan-Dec 2000	Jan-Dec Daily Average
Out-Patient Attendances		
-Dental	20,671	56
-Emergency	20,494	56
-Eye/Ear/Throat/Nose	23,798	65
-General/Skin/Gastro-Intestinal	45,758	125
-Medicine/Other Specialty	10,487	29
-Neuro Medicine	14,090	38
-Obstretics/Gynaecology	16,444	45
-Orthopedics	16,717	46
-Pediatrics	22,502	61
-Urology	8,662	24
Total	**199,623**	**545**
Admissions		
-Intensive Care Unit/CCU	13,711	37
-In Patient Ward	22,711	62
Total	**36,422**	**100**
Surgical Operations		
-Brain Surgery	429	1
-Total Knee Replacement	368	1
-Cosmetic Surgery	1,331	4
-Nerve	42	0
-Gastro Intestinal Tract	813	2
-Appendectomy	885	2
Total	**3,868**	**11**
Net Total	**239,913**	**656**

Figure G.6. Patient Load Yearly Statistics Report.

BANGKOK HEALTHCARE HOSPITAL

Five Years of Patient Load Comparison Report

from 1996 to 2000

Patient Load	1996	1997		1998		1999		2000	
	Amount	% Change	Amount	% Change	Amount	% Change	Amount	% Change	Amount
Out-Patient Attendances									
-Dental	23,823	-1.0	23,580	-4.2	22,587	-6.8	21,044	-0.8	20,671
-Emergency	18,346	1.2	18,560	6.3	19,737	-4.8	18,797	9.0	20,494
-Eye/Ear/Throat/Nose	25,050	-4.0	24,053	-1.1	23,800	-1.0	23,552	1.0	23,798
-General/Skin/Gastro-Intestinal	32,500	2.9	33,440	7.8	36,055	8.4	39,085	17.1	45,758
-Medicine/Other Specialty	8,359	6.4	8,890	6.9	9,504	-4.8	9,046	15.9	10,487
-Neuro Medicine	13,565	9.9	14,904	-7.4	13,800	-3.3	13,344	5.6	14,090
-Obstretics/Gynaecology	11,588	-4.3	11,088	-4.3	10,608	10.2	11,689	40.7	16,444
-Orthopedics	15,688	1.1	15,865	-1.3	15,654	1.6	15,909	5.1	16,717
-Pediatrics	20,213	0.2	20,255	0.2	20,300	3.2	20,957	7.4	22,502
-Urology	9,303	-2.7	9,048	-0.9	8,970	5.6	9,474	-8.6	8,662
Total	**178,435**	**0.7**	**179,683**	**0.7**	**181,015**	**1.0**	**182,897**	**9.1**	**199,623**
Admissions									
-Intensive Care Unit/CCU	11,805	1.6	11,989	0.7	12,068	7.3	12,954	5.8	13,711
-In Patient Ward	20,408	0.3	20,464	0.6	20,584	1.5	20,890	8.7	22,711
Total	**32,213**	**0.7**	**32,453**	**0.6**	**32,652**	**3.7**	**33,844**	**7.6**	**36,422**
Surgical Operations									
-Brain Surgery	150	36.7	205	74.6	358	8.4	388	10.6	429
-Total Knee Replacement	180	18.3	213	17.4	250	15.6	289	27.3	368
-Cosmetic Surgery	702	7.4	754	22.0	920	19.3	1,098	21.2	1,331
-Nerve	31	9.7	34	-17.6	28	14.3	32	31.3	42
-Gastro Intestinal Tract	892	2.2	912	3.1	940	-3.8	904	-10.1	813
-Appendectomy	846	7.0	905	-3.1	877	2.4	898	-1.4	885
Total	**2,801**	**7.9**	**3,023**	**11.6**	**3,373**	**7.0**	**3,609**	**7.2**	**3,868**
Net Total	**213,449**	**0.8**	**215,159**	**0.9**	**217,040**	**1.5**	**220,350**	**8.9**	**239,913**

Figure G.7. Patient Load Comparison Report.

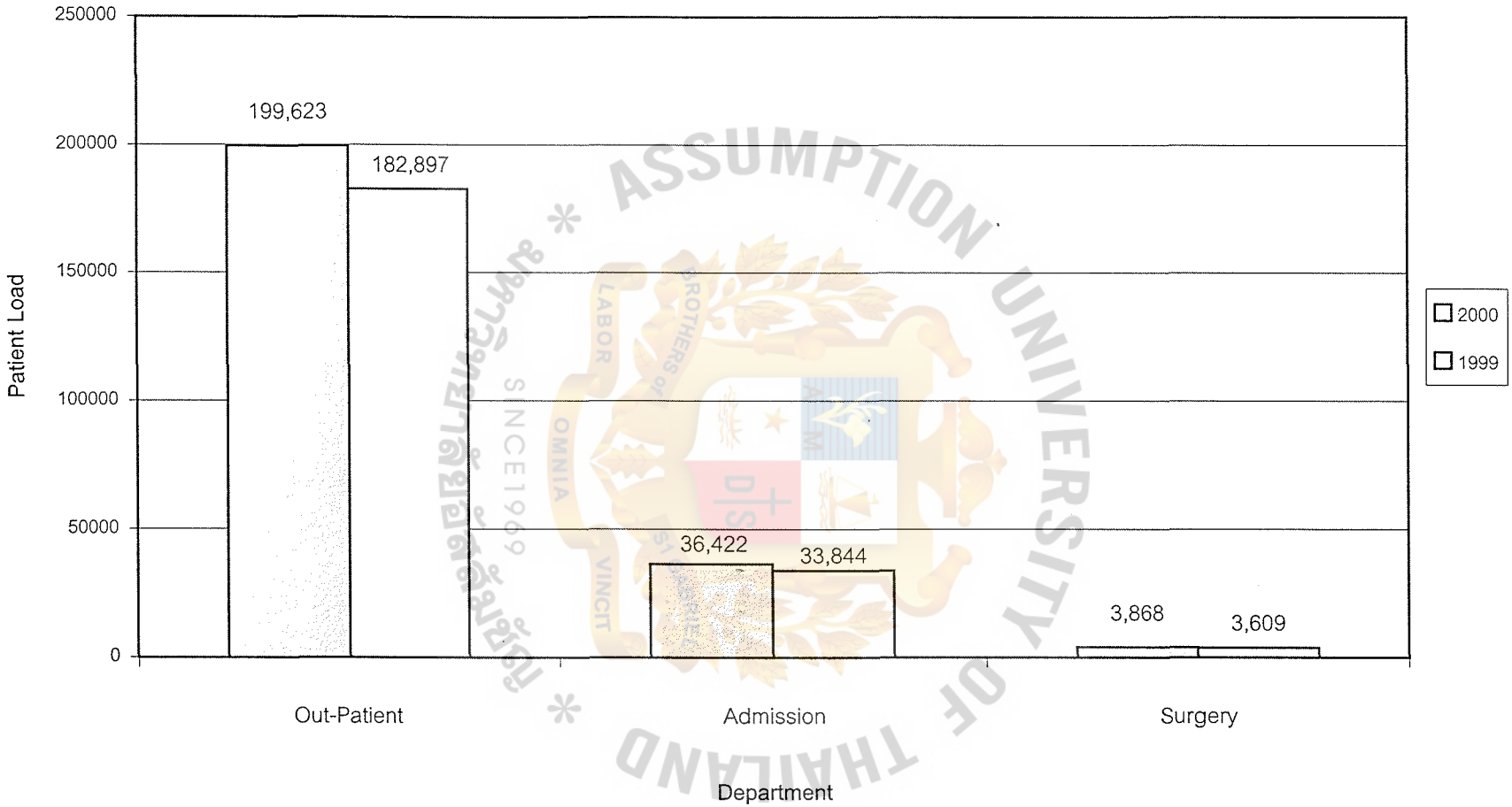

Figure G.8. Patient Load Classified by Department Comparison Graph.

APPENDIX H

PAYBACK PERIOD

PAYBACK PERIOD ANALYSIS

H.1 Payback Period Analysis of Candidate 1

Table H.1. Payback Period Analysis of Candidate 1, Baht.

Cost items	Years					
	0	1	2	3	4	5
Development Cost:	-3,193,850.00	-	-	-	-	-
Operation & Maintenance *:	-	-1,006,200.00	-1,138,320.00	-1,252,152.00	-1,377,367.20	-1,515,103.92
Discount Factors for 12%	1.00	0.89	0.80	0.71	0.64	0.57
Time-adjusted Costs (adjusted to present value):	-3,193,850.00	-898,392.86	-907,461.73	-891,257.06	-875,341.76	-859,710.65
Cumulative Time-adjusted Costs Over Lifetime:	-3,193,850.00	-4,092,242.86	-4,999,704.59	-5,890,961.65	-6,766,303.41	-7,626,014.06
* Assumption: Operating and Maintenance Cost Estimated Annual Growth Rate of 10%						
Benefits Derived from Operation of New System:	0.00	1,735,725.00	1,996,083.75	2,295,496.31	2,639,820.76	3,035,793.87
Discount Factors for 12%	1.00	0.89	0.80	0.71	0.64	0.57
Time-adjusted Benefits (adjusted to present value):	0.00	1,549,754.46	1,591,265.74	1,633,888.93	1,677,653.82	1,722,590.97
Cumulative Time-adjusted Benefits Over Lifetime:	0.00	1,549,754.46	3,141,020.21	4,774,909.14	6,452,562.96	8,175,153.93
Cumulative Lifetime Time-adjusted Costs + Benefits:	-3,193,850.00	-2,542,488.39	-1,858,684.38	-1,116,052.51	-313,740.45	549,139.87

$$\text{Payback period} = \text{Last year of negative cash flow} + \frac{\text{Cumulative difference last negative year}}{\text{Absolute value of cumulative difference (last negative plus first positive year)}}$$

$$= 4 + \frac{313{,}740.45}{313{,}740.45 + 549{,}139.87}$$

$$= 4 \text{ Years } 4 \text{ Months}$$

$$\text{Net Present Value} = \text{Cumulative Benefits} - \text{Cumulative Costs}$$

$$= 8{,}175{,}153.93 - 7{,}636{,}014.06$$

$$= 549{,}139.87 \text{ Baht}$$

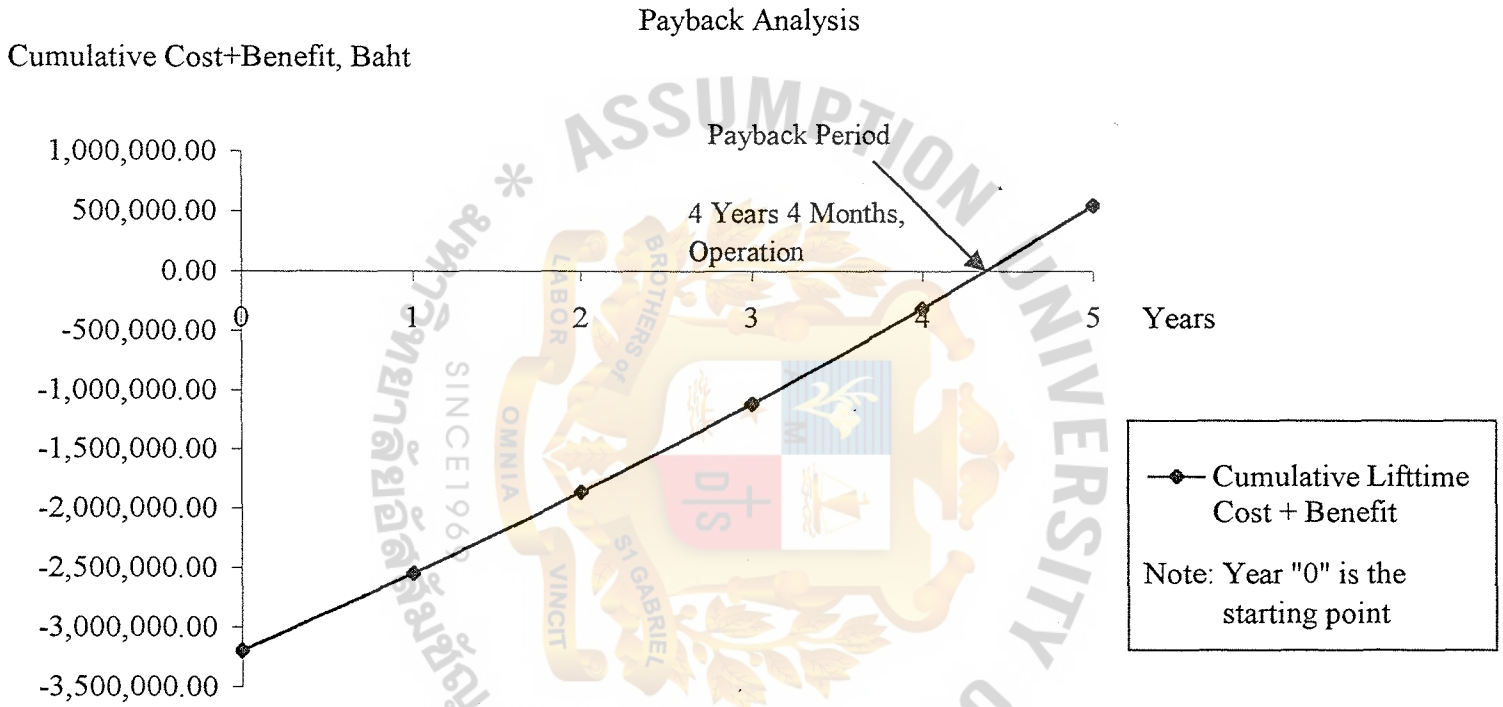

Figure H.1. Cumulative Lifetime Time-Adjusted Costs + Benefits of Candidate 1.

$$\text{ROI} = \frac{\text{(Estimated Lifetime Benefits – Estimated Lifetime Costs)}}{\text{Estimated Lifetime Costs}}$$

$$= \frac{8,175,153.93 - 7,636,014.06}{7,636,014.06}$$

$$= 0.0720 * 100$$

$$= 7.20\%$$

H.2 Payback Period Analysis of Candidate 2

Table H.2. Payback Period Analysis of Candidate 2, Baht.

Cost items	Years					
	0	1	2	3	4	5
Development Cost:	-1,847,250.00	-	-	-	-	-
Operation & Maintenance *:	-	-1,102,200.00	-1,212,420.00	-1,333,662.00	-1,467,028.20	-1,613,731.02
Discount Factors for 12%	1.00	0.89	0.80	0.71	0.64	0.57
Time-adjusted Costs (adjusted to present value):	-1,847,250.00	-984,107.14	-966,533.80	-949,274.27	-932,322.94	-915,674.32
Cumulative Time-adjusted Costs Over Lifetime:	-1,847,250.00	-2,831,357.14	-3,797,890.94	-4,747,165.21	-5,679,488.16	-6,595,162.47
* Assumption: Operating and Maintenance Cost Estimated Annual Growth Rate of 10%						
Benefits Derived from Operation of New System:	0.00	1,530,500.00	1,760,075.00	2,024,086.25	2,327,699.19	2,676,854.07
Discount Factors for 12%	1.00	0.89	0.80	0.71	0.64	0.57
Time-adjusted Benefits (adjusted to present value):	0.00	1,366,517.86	1,403,121.01	1,440,704.61	1,479,294.91	1,518,918.89
Cumulative Time-adjusted Benefits Over Lifetime:	0.00	1,366,517.86	2,769,638.87	4,210,343.48	5,689,638.40	7,208,557.28
Cumulative Lifetime Time-adjusted Costs + Benefits:	-1,847,250.00	-1,464,839.29	-1,028,252.07	-536,821.73	10,150.24	613,394.81

$$\text{Payback period} = 3 + \frac{536,821.73}{536,821.73 + 10,150.24}$$

$$= 3 \text{ Years } 11 \text{ Months}$$

$$\text{Net Present Value} = 7,208,557.28 - 6,595,162.47$$

$$= 613,394.81 \text{ Baht}$$

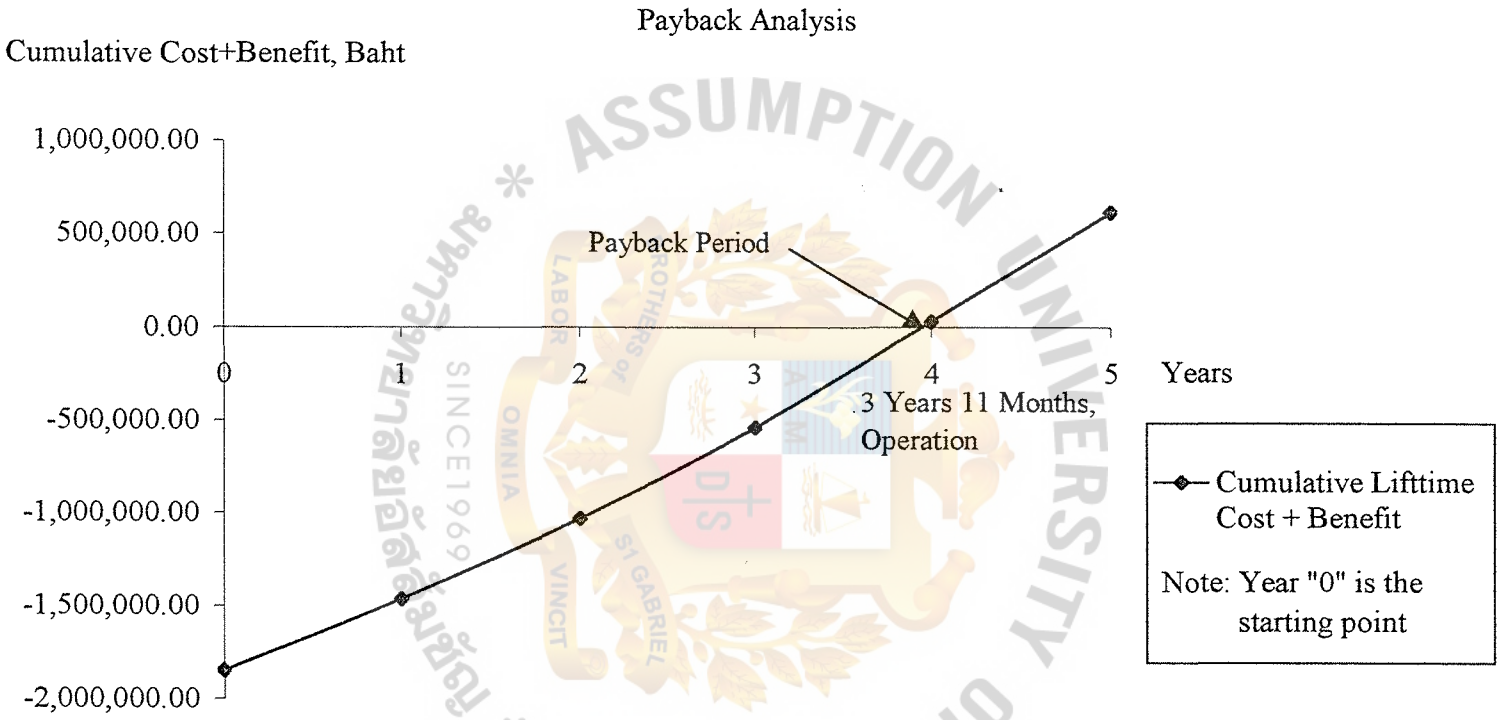

Figure H.2. Cumulative Lifetime Time-Adjusted Costs + Benefits of Candidate 2.

$$ROI = \frac{7{,}208{,}557.28 - 6{,}595{,}162.47}{6{,}595{,}162.47}$$

$$= 0.0930 * 100$$

$$= 9.30\%$$

H.3 Payback Period Analysis of Candidate 3

Table H.3. Payback Period Analysis of Candidate 3, Baht.

Cost items	Years					
	0	1	2	3	4	5
Development Cost:	-1,057,100.00	-	-	-	-	-
Operation & Maintenance *:	- -	-1,006,200.00	-1,138,320.00	-1,252,152.00	-1,377,367.20	-1,515,103.92
Discount Factors for 12%	1.00	0.89	0.80	0.71	0.64	0.57
Time-adjusted Costs (adjusted to present value):	-1,057,100.00	-898,392.86	-907,461.73	-891,257.06	-875,341.76	-859,710.65
Cumulative Time-adjusted Costs Over Lifetime:	-1,057,100.00	-1,955,492.86	-2,862,954.59	-3,754,211.65	-4,629,553.41	-5,489,264.06
* Assumption: Operating and Maintenance Cost Estimated Annual Growth Rate of 10%						
Benefits Derived from Operation of New System:	0.00	1,273,035.00	1,463,990.25	1,683,588.79	1,936,127.11	2,226,546.17
Discount Factors for 12%	1.00	0.89	0.80	0.71	0.64	0.57
Time-adjusted Benefits (adjusted to present value):	0.00	1,136,638.39	1,167,084.06	1,198,345.24	1,230,443.78	1,263,402.09
Cumulative Time-adjusted Benefits Over Lifetime:	0.00	1,136,638.39	2,303,722.46	3,502,067.70	4,732,511.48	5,995,913.57
Cumulative Lifetime Time-adjusted Costs + Benefits:	-1,057,100.00	-818,854.46	-559,232.13	-252,143.95	102,958.07	506,649.51

$$\text{Payback period} = 3 + \frac{252{,}143.95}{252{,}143.95 + 102{,}958.07}$$

$$= 3 \text{ Years } 9\text{Months}$$

$$\text{Net Present Value} = 5{,}995{,}913.57 - 5{,}489{,}264.06$$

$$= 506{,}649.51 \text{ Baht}$$

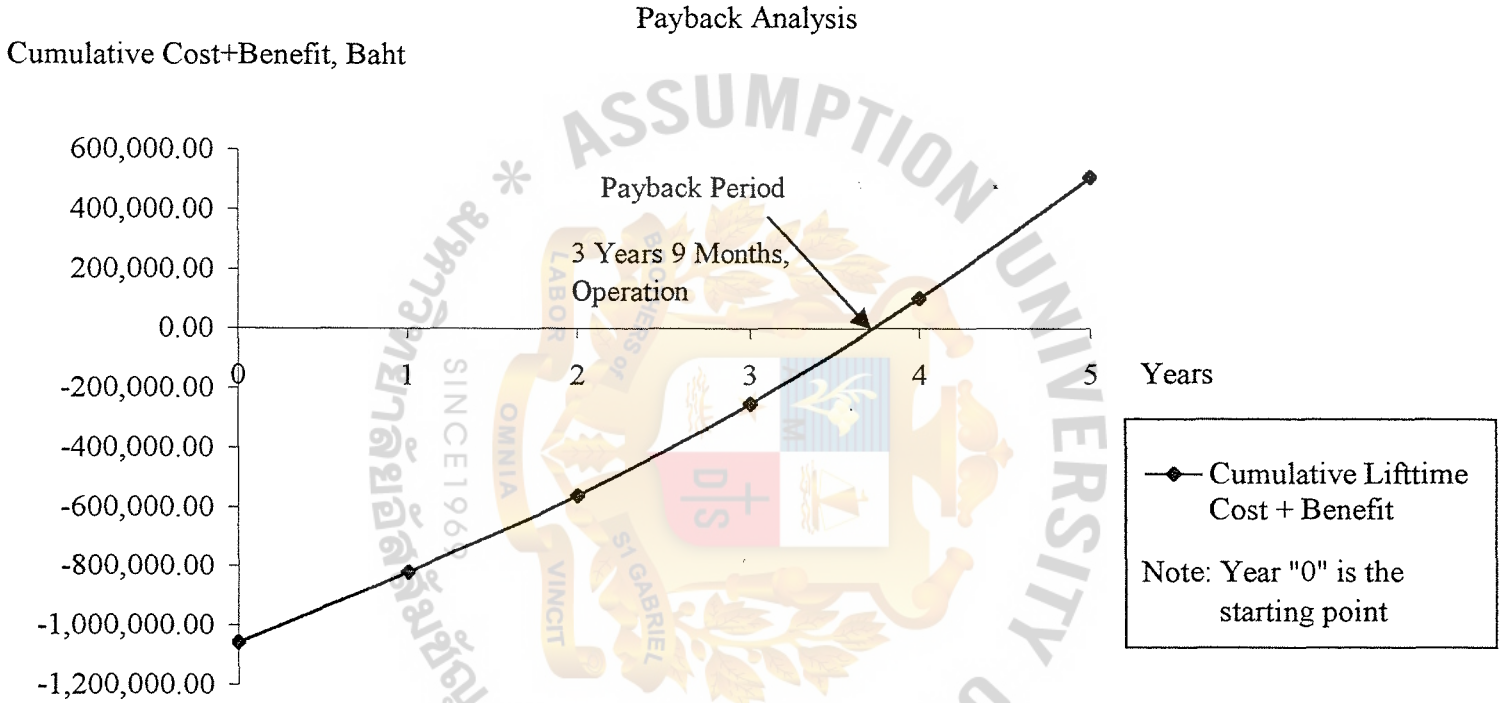

Figure H.3. Cumulative Lifetime Time-Adjusted Costs + Benefits of Candidate 3.

$$\text{ROI} = \frac{7{,}015{,}629.11 - 6{,}386{,}014.06}{6{,}386{,}014.06}$$

$$= 0.0923 * 100$$

$$= 9.23\%$$

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