A DESIGN AND DEVELOPMENT OF CLASSROOM SCHEDULING AND RESERVATION SYSTEM FOR TEACHING AND LEARNING CASE STUDY OF THE PUBLIC HEALTH FACULTY, MAHIDOL UNIVERSITY

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THE PUBLIC HEALTH FACULTY, MAHIDOL UNIVERSITY

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Finally, the love and encouragement I received from my parents and family have been an important source of inspiration to me.

Poramin Nuyongpuck
The purpose of this study is to design and develop a client-server computerized classroom scheduling and reservation system for teaching and learning, which can overcome the problems of the current system and can be used as a tool to support education as one of the resource management tools.

The analysis and the design are based on the object-oriented technique. Data is stored in a relational database using Microsoft SQL Server version 7.0 database management system and was programmed using Microsoft Visual Basic version 6.0 on a microcomputer with Microsoft Windows NT version 4.0 as the operating system. The system was developed from the procedures and the data was collected from the Public Health faculty at Mahidol University.

This study resulted in a client-server computerized classroom scheduling and reservation system, which was divided into 2 main sections: an administration section and user sections. The developed system eliminated the complexity of data storage, could access data quickly, and completed desired reports easily. All computers in the system were linked together to provide flexible processing.

The Public Health faculty can use this system as a tool to support the classroom scheduling and reservation's operations, which minimize the disadvantages of the conventional one by minimizing the time for operation for both administrator of the system and academic staffs, maximizing room utilization, generating report easily and quickly.
DESIGN AND DEVELOPMENT OF CLASSROOM SCHEDULING AND RESERVATION SYSTEM FOR TEACHING AND LEARNING CASE STUDY OF THE PUBLIC HEALTH FACULTY, MAHIDOL UNIVERSITY

วิทยานิพนธ์ฉบับนี้จุดประสงค์เพื่อออกแบบและพัฒนาระบบการจัดและจองห้องเรียนสำหรับเรียนและการสอนด้วยคอมพิวเตอร์ ซึ่งสามารถแก้ปัญหาของระบบการจัดและจองห้องเรียนในแบบเดิมได้ และสามารถใช้เป็นเครื่องมือในการสนับสนุนการปฏิบัติงานของระบบการเรียนการสอนเสมือนหนึ่งจริงเสมือนในการบริหารจัดการทรัพยากร

การวิเคราะห์และออกแบบระบบใช้เทคนิคแบบ Object-Oriented โดยใช้ฐานข้อมูลและหลักการออกแบบฐานข้อมูลเชิงพื้นฐาน Microsoft SQL Server 7.0 พัฒนาไปโปรแกรมโดย Microsoft Visual Basic 6.0 บนเครื่องไมโครแอมพิวเตอร์ และใช้ระบบปฏิบัติการ Microsoft Windows NT 4.0 Server โปรแกรมที่พัฒนาขึ้นอาทิเช่นการดำเนินงานและข้อมูลต่าง ๆ จากคณะกรรมการสุขศาสตร์ มหาวิทยาลัยหิ اليตต์

ผลที่ได้จากการศึกษาทั้งหมด ระบบการจัดและจองห้องเรียนและเอกสารสำหรับการเรียนและการสอนโดยแบ่งเป็น 2 กลุ่มสำคัญ ได้แก่ การดำเนินงานสำหรับผู้บริหารระบบ และส่วนใช้งานสำหรับผู้ใช้งานทั่วไป ระบบของโปรแกรมสามารถถอดความเข้าใจของการทำงานข้อมูล สามารถเข้าถึงข้อมูลได้อย่างรวดเร็ว และออกรายงานตามที่ต้องการได้อย่างง่ายดาย รวมทั้งคอมพิวเตอร์ทุกตัวในระบบได้ถูกเชื่อมโยงกันเพื่อให้สามารถปฏิบัติงานได้อย่างคล่องตัว

คณะกรรมการสุขศาสตร์สามารถใช้ระบบนี้เป็นเครื่องมือในการจัดตารางเรียนและการจองห้องเรียน ซึ่งสามารถจัดสรรข้อต่าง ๆ ของระบบได้โดยการเคลื่อนไหวในระบบปฏิบัติการสำหรับการจัดและจองห้องเรียน สำหรับผู้บริหารระบบและผู้ใช้ เพื่อประสิทธิภาพในการใช้ห้องเรียน รวมทั้งออกรายงานได้อย่างง่ายและรวดเร็ว
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CHAPTER I
INTRODUCTION

1.1 Background and Statement of Problem

The Faculty of Public Health of Mahidol university is an academic institute aiming to provide higher level of public health education, conduct research to promote health and participate in community health service for needy population. Within the context of this mission, its function include the development of new public health technologies, the dissemination of knowledge and skill and maintenance of highest level of professional standards appropriate to the achievement of optimal health of Thai population. The Faculty now has academic programs in all levels of tertiary education i.e. bachelor's, master's graduate diploma and doctoral degree in 126 courses for both 1,400 Thai and international students with 13 departments and 165 teaching staff. (1)

At present, there are seven buildings with 125 rooms. They are used as classrooms, laboratory rooms, and head office of the department rooms teaching staff rooms and stock rooms. All departments have their own classrooms, which usually locate at the same building of department head office. They manage their rooms with the commitment of their committee. By the way, each department has less room than their subject and central classrooms have been required.

There are 123 classrooms in three buildings; building no. 3, building no. 4 and building no. 6, are under-control of the Academic Affairs Service Unit, which manages the scheduling of all classrooms for all departments. Classrooms are requested from all departments for their students before the beginning of the semester.
and the extra classrooms also requested for extra classrooms from the teacher staffs, during the semester (2).

Up until now, the Academic Affairs Service Unit schedule all the classrooms before the beginning of the semester for all the departments by copying the last old one and manage the reservation for extra classrooms from the teaching staffs by manual. The problem in scheduling the classroom is that there is no exact criteria for the officers of Academic Affairs Service Unit, so that they take more times to do and often scheduling the unsuitable classroom with the amount of the students in each courses. For the classroom reservation from the teaching staff, which is about 15-20 requisitions per weeks, has a trouble in finding the suitable vacancy classrooms by the officers in Academic Affairs Service Unit and sometimes has a redundant classroom reservation for each department.

The Academic Affairs Service Unit has been agreed with Management Information System unit of the Faculty of Public Health to use the Intranet application for managing these problems. By using the existing infrastructure technology of information, Mahidol University Campus Network (MUC Net), which already link among every departments in the Faculty of the Public Health, and also link to every faculties in the university and connected to outside via Internet.

Classroom scheduling software package help the offices in the Academic Affairs Service Unit of the Faculty of Public Health in scheduling and reservation the classroom more quickly, accurately and easily by supporting users can access at anytime and anywhere. It also can reduce paper works that have been take more time and reduce the mistake. In addition, it can generate valuable information for the executive in decision making for improving academic resource service system.
1.2 Objective

The objective of this study is to develop a microcomputer software package for classroom scheduling that can help the academic staffs achieve the most efficient schedule for classrooms operation in the Faculty of Public Health, Mahidol University.

1.3 Scope of Work

This study is scope for the 123 central classrooms in three buildings for scheduling at the beginning of the every semester and reservation during the semester, through Intranet application, by 13 departments in the Faculty of Public Health, Mahidol University.

1.4 Expectation of Study

The expectation of study is implementation an application software to

1. Schedule the central classrooms more convenient, more accurately and easier than the manual.

2. Efficiently utilize the central classrooms.

3. Reduce time and paper works in scheduling and reservation for central classrooms.

4. Generate useful reports for the executive in controlling the central classrooms.
CHAPTER II
LITERATURE REVIEW

2.1 Resource Allocation Management

There is no need for a resource allocation in a system that consists of an infinite number of resources. But almost every system has a finite number of resources, so that the resource allocation management is needed to utilize existing resource as much as possible. The resources are partitioned into several types, each consists of some number of identical instances. If a job requests an instance of a resource type, the allocation of any instance of the type will satisfy the request. If it will not, then the instance are not identical, and the resource type class have not been defined properly.

A job must request a resource before using it, and must release the resource after using it. One job may requests as many resource as it requires to carry out its designated task. By the way the number of resources requested may not exceeded the total number of resources available in the system. Under the normal mode of operation, a process may utilize a resource in only the following sequence.

1) Request: If a request can not be granted immediately, requesting job must be waited until it can acquire the resource or another appropriate resource could be requested.

2) Use: After the job has been getting the requested resource, the job can operate without interrupting.
3) **Release**: After the job has been using the resource, the resource must be released to the system.

Under the normal job operation, with request only a resource, there is no problem in management. But if a number of jobs request many resources, with the same one, at the same time, the problem will occur. The system can not give the resources to all jobs requesting that we call “deadlock situation”. The system record table records must be used to monitor each resource is free or allocated, and, if a resource is allocated. (3).

### 2.2 Scheduling

Scheduling is a fundamental operation system function. Almost all resources are schedule before use by the scheduler. The operating system select one of the processes in the ready queue to be executes. The scheduler selects from among the processes in memory that are ready that are ready to execute and allocate the resource to one on them. There are various scheduling algorithms, but none is best solution for every works (3,4).

1) **First-Come, First Serve Scheduling (FCFS)**

The process those requests the resource first is allocate the resource first. The implementation of FCFS policy is easily managed with First In First Out (FIFO) queue.

2) **Shortest-Job-First Scheduling (SJF)**

The shortest job in the queue will be assign to allocate the resource. If there are more than one shortest job in the queue, the FCFS is applied.
3) Priority scheduling (PS)

A priority is associated with process, the resource is allocated to the job with the highest priority. If there are more than one priority job in the queue, the FCFS is applied.

4) Round-Robin Scheduling (RRS)

This scheduling is designed especially for the time-sharing systems. It is like FCFS scheduling, but preemption is added to switch between processes. A small unit of time, call time slice, is defined. Each job will be allocating the resource for a time slice and turn around the queue until the process is finished.

5) Multilevel Queue Scheduling (MQS)

All of the jobs will be classified into different groups by several separate priority queues. Each job will be assign to the queue base on some property of the job. In addition the scheduling among the queues must be considered. The resource will be allocated for the higher priority queue first and then change the lower queue consequence.

6) Multilevel Feedback Queue Scheduling (MFQS)

All of the job will be classified into different groups by several separate priority queues. Each job will be assigned to the queue base on some property of the job, which can not change the queue during the process.

2.2.1 Scheduling Criteria

The different resource scheduling algorithms have different properties and many favor one class or process over another. Many criteria have been suggested for comparing resource-scheduling algorithms
1) Resource utilization

We want to keep the resource as busy as possible. The resource utilization may range from 0 to 100 percent.

2) Throughput

A measurement of the works is the number of process that are completed per time unit.

3) Turnaround time

From the point of view of a particular process, the important criterion is how long it takes to execute that process.

4) Waiting time

The time is the sum of the periods spent waiting in the ready queue.

5) Response time

The time from submission of a request until the first response is processed, it's the time that takes to output that response (3).

2.3 Operations Research (OR)

Many definitions of the operation research have been suggested from time to time. Some of the different definitions suggest are:

1) OR is a scientific method of providing executive departments with a quantitative basic for decisions regarding the operation under control. (5)

2) OR is the application of the modern methods of mathematical science to complex problem involving management of large systems of men, machines, materials and money in industry, business, government and defense. (6)
2.3.1 Operation Research Process

1) Definition the problem

Should yield a statement of the problem's elements. These include the decision variables, the uncontrollable variables, the restriction or constraint, on the variables and the objective for defining a good or improved solution.

2) Building a mathematical model

It is must decided on the proper data inputs and decide the appropriate information output, identified the static and dynamic structure elements and devise mathematical formula to represent the relationships among these elements.

3) Solving a mathematical model

Given the models with its variables is specified by historical, technological and judgmental data, we calculate the mathematical solution.

4) Monitoring and implementation the results

After the report has been submitted, management will be responsible for implementation of the results and recommendation

2.3.2 Linear Programming

Linear programming is one type of mathematical programming that deals with solving optimization problems, which we would like to maximize or minimize the function, usually in a constraint environment. Linear programming compose of three components

1) A set of decision variables that can be control or determined by the decision-maker.

2) An objective function that is to be maximized or minimized
3) A set of constraints that describe the restrictive set of the conditions that must be satisfied by any solution to the model.

2.3.3 Allocation Models

The allocation model is used when there is a number of activities to be performed, alternative ways of doing them and limited resources or facilities for performing each activity in the most effective way. There is an allocation problem of these scarce resources. The problem is to combine activities and resources in an optimal manner so that overall efficiency is maximized, that is, the profit is maximized and the cost is minimized. (5,6,7)

2.4 Computer Networks System

The computer network system is a system composed by the connection among computers with the variety type of medias, The network size can be varied by the objective of the network. There are two main types of network, peer-to-peer networking and client/server networking.

2.4.1 Peer-to-Peer Networking

Peer-to-peer networking is a networking that all the computers in the network have the equivalent in priority. File sharing and print sharing operate the same as workgroups.

2.4.2 Client and Server Networking

Computer network system is connection among client computer and host computer. The host computer is a center computer that has function for management the network such as storage and processing (8).
The Internet can be defined as a collection or interconnection of many different networks of computer hosts, clients, and servers that collectively provide and use information and connection services. This "network of computer networks" now includes a community that literally spans that globe and counts among its members nearly every country in the world.

Computers with access to the Internet come in all sorts of makes and models and run a variety of operating systems and applications. Strictly speaking, computers connected to the Internet are using the Transport Control Protocol/Internet Protocol (TCP/IP) suite, which is a common set of rules that allow a variety of systems to communicate. Computers on non-TCP/IP networks, however, can access the Internet through gateways that perform the necessary protocol translations and allow appropriate communications.
The Internet, also known as the Net, provides many standards, services, and protocols that allow the individuals to access the huge number of resources available on the Net.

TCP/IP: The Transmission Control Protocol / Internet Protocol is the basic collection of protocols that computers, servers, and clients use to communicate over the Internet.

FTP: The Transfer Protocol is an Internet protocol and service that enables users to transfer files between computers on a network. FTP servers are among the most common information services on the Internet.

Telnet: A client application for providing remote, character-based terminal access to a remote host (for example, VT 100 emulation).

Gopher: A program for browsing files and directories of hosts (running Gopher servers) connected to the Internet. It's a simple menu-based system, but the items on the menu can be pointers to files or directories on other Gopher servers, FTP servers, Telnet services, and so on.

HTTP: The Hypertext Transport Protocol is a TCP/IP-based protocol used by Web servers and browsers that define the manner in which they communicate over the Web.

Web servers: A program that provides services to Web clients. These services generally are HTTP services that provide access to HTML document repositories or CGI applications. They also can be pass-through services such as FTP, Gopher, or Telnet.

Web browsers: Programs such as Netscape Navigator, Mosaic, and Internet Explorer are among the dozens of the available browsers (that is, Web clients) that allow easy navigation of the web sites on the Internet and display documents written in HTML.

Most of the popular commercial browsers are graphical-based, and many use
extensions that allow inline images, as well as some audio and video capabilities, to be integrated.

**CGI:** The common gateway interface is a means by which Web servers can interface with other application programs and extend the services available from the Web servers. You can make an access to databases and applications via CGI programs, for example.

**HTML:** The Hypertext Markup Language is the primary language of the documents served by the web servers. It provides a rich and growing set of tags that are embedded in documents to specify how the contents should be formatted on a page. These tags also enable you to establish hypertext links from content in one document to content in other documents, which can be local or on a server anywhere in the world. HTML also provides mechanisms for invoking programs and services on Web server (9).

### 2.6 Database

For a simple meaning of a database is a collection of related data, that can be of any size and of varying complexity. However, the common use of term database is usually more restricted. A database has the following implicit properties.

- A database represents some aspect or the real world.

- A database in a logically coherent collection of data with some inherent meaning.

- A database is designed, built, and populated with data for a specific purpose. It has an intended group of users and some preconceived applications in which these users are interested.
2.6.1 Architecture of Database Management System

Three important characteristics of the database approach are a) insulation of programs and data; b) support of multiple users views; and c) use of catalogue to store database description (10).

1) **Internal Schema**: describes the physical storage structure of the database.
   
   The internal level uses a physical data model and describes the complete details of data storage and access path.

2) **Conceptual Schema**: describes the whole database for a community of users. The conceptual level hides the details of physical storage structure and concentrate on describing entities, data types, relationship, user operations, and constraints.

3) **External Schema**: describes the part of the database that a particular user group is interested in and hide the rest of the database from that user group.

2.6.2 Relational Database

Database is a centralized storage area for the collection and querying of the data. Databases are typically organized into logical business components that contain one or more tables. “The relational model represents the databases as a collection of relations. Informally, each relation resembles a table or, to some extent, a simple file.” (11).
2.6.3 Relational Model Terminology

<table>
<thead>
<tr>
<th>Technical Name</th>
<th>General Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relation</td>
<td>Table</td>
</tr>
<tr>
<td>Tuple</td>
<td>Row or Record</td>
</tr>
<tr>
<td>Attribute</td>
<td>Column or Field</td>
</tr>
<tr>
<td>Cardinality</td>
<td>Number of Rows</td>
</tr>
<tr>
<td>Primary Key</td>
<td>Unique Identifier</td>
</tr>
<tr>
<td>Domain</td>
<td>Data Type</td>
</tr>
</tbody>
</table>

Table 2.1: Relational model terminology
Table is used to store data. It is organized in a row/column manner that data can be retrieved, modified, and removed from a table by using the SQL language. "All values in a column are of the same data type."

Relationship is a link between tables. Relationships allow flexibility of the presentation and manipulation of data. Data is structured using relationships among data items.

Index is a separate physical database structure created on a table that facilitates faster data retrieval when searching on an indexed column.

Primary key is a single column or the combination of multiple columns that uniquely identifies the row in the table.

Foreign key is a single column or multiple columns that relate to the primary key in another table. This primary/foreign key relationship is how data is linked among multiple tables.

Normalization of data can be looked on as a process during which unsatisfactory relation schemas are decomposed by breaking up their attributes into smaller relation schemas that possess desirable property. Three objectives of normalization process is following

1) To minimize the storage space the base relations occupy.
2) To reduce inconsistency problem of data because data is not redundant in relation. So, data modification in a tuple does not make error against the other tuple.
3) To ensure the update anomalies do not occur. These anomalies can be classified into insert anomalies, delete anomalies, and modification anomalies.
2.6.4 Type of Normal Form

First Normal Form (1NF): disallows "relations within relations" or "relations as attributes of tuples". The only attribute values permitted by 1NF are single atomic (or indivisible) values.

Secondary Normal Form (2NF): If every nonprime attribute in relation is fully functionally dependent on the primary key, that relation is 2NF.

Third Normal Form (3NF): If relation is in 2NF and no nonprime attribute of the relation is transitively dependent on the primary key, it is in 3NF. (13)

2.7 Web Database

Web database is a way of holding World Wide Web content, in a structured or usable format. These tools, with the help of the Internet, enable you to build Wide Area Database. Such a database lets you publish or collect information, from anywhere in the world. The database can be accessed via a query language or programming API. Web databases are accessed via other Web applications-specifically, forms that are developed using standardized HTML tags, Active X controls, and client-side scripts using VB Script and J Script. Using facilities available in HTML, applications programs on the Web server are accessed through server-side programs via CGI. HTML form interfaces enable to create applications that integrate database functionality and provide access to organizational data repositories on behalf of the Web clients. The application also can use information pulled from a database to support more applications. This capability to integrate a database into applications that can be accessed by users utilizing a Web browser is what makes a database a Web database.
2.7.1 Advantage of Web Database Transferring

Although World Wide Web is not the first technology of the information transferring via network system that is basic feature of Client/Server such as Oracle, Lotus Notes. But these programs have not the following ability:

Enable to use computer hardware in different environment because Web Browser is designed to be cross platform compatibility. HTML and JavaScript have not to compile but browser will be interpreter commands so, they are independent from hardware that they can send program to every computer in network immediately.

Enable to use unlimited size of organization. Users can use any computer from everywhere network and unlimited number. Connect to the users with the same standard. Every feature will use Graphic User interface of browser that is easy for the user to work without training. In the side of the Security, Web Server can protect the system appropriately because users can connect to Web Server but they can not access Database directly.

2.8 Intranet

An Intranet is a private corporate or educational network that uses the Internet's TCP/IP protocols for its underlying transport. The protocols can run on a variety of network hardware, and can also co-exist with other network protocols, such as IPX. People from inside an Intranet can get at the larger Internet resources, but those on the Internet cannot access into the Intranet, which allows only restricted access from the Internet. (14)

2.8.1 Intranet Component

There are 3 main components that must be use for Intranet.
1) TCP/IP Protocol

The Intranet use TCP/IP protocol in a network and must be set unique IP address for each computer that is connecting to the Intranet. And we always use private address for avoiding confusion when we want the Intranet connection to Internet. By the way if the networks has an automatic IP address assigning, we do not need to do this.

2) Web Browser

Programs that function for displaying the content information from Web Server for the user in the client side. There are many Web Browser that is popular e.g. Internet Explorer, Netscape Navigator, Opera, Mosaic etc. It’s function is 1) connecting to the web server according to URL code; 2) transfer data files from web server to the computer that running the web browser and; 3) display the result of the data files in the HTML language.

3) Web Server

Management application program for the client for accessing in the content. It’s function is to be management the user and its contents. There are still added component that can be add into intranet that can be increasing the efficiency of its such as database system, the security system. (15)
2.8.2 Peer-to-Peer and Client/Server Intranet

<table>
<thead>
<tr>
<th>Operating system</th>
<th>Peer to Peer Intranet</th>
<th>Client/Server Intranet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Windows 95</td>
<td>Windows NT server</td>
<td></td>
</tr>
<tr>
<td>Web Server</td>
<td>Personal Web Server</td>
<td>Internet Information Server</td>
</tr>
<tr>
<td>Organization</td>
<td>Small</td>
<td>Medium, Large</td>
</tr>
<tr>
<td>IP Address</td>
<td>Must be fixed IP Address by manual</td>
<td>Can be use DHCP for automatic IP address assigning</td>
</tr>
<tr>
<td>Security</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Flexible in accessing the data</td>
<td>Only accessing permission</td>
<td>Can determine the drive, folder and file for accessing in each group</td>
</tr>
<tr>
<td>Connecting from outside</td>
<td>Utility can not specify the user so it is not suitable for outside connection.</td>
<td>RAS Server can specify the log in user.</td>
</tr>
</tbody>
</table>

Table 2.2: Characterization comparison between Peer-to-Peer Intranet and Client/Server Intranet

2.8.3 Web Page

Web page is the HTML file that appears on the web browser. HTML document can link to another web pages with hyperlink and link to picture file, sound file with hypermedia function.
1) Static Web Page

The content in static web page is suitable for the information which do not need to update often.

2) Dynamic Web Page

The content in dynamic web page should be update very often, especially for the information that must be change every day, every month or when the users requested the data in the web database. So that the dynamic web page is designed for automatic response to the requesting from the user with CGI technology. (16)

2.8.4 Active Server Page (ASP)

The Microsoft program for Internet application develops active server page. ASP will translate the documents, which are written with VB script or J script language, and execute in the server side and create HTML document for sending to the browser. (16,17,18)

![Active Server Page diagram](image)

Web Browser \[\text{Request}\] Web Server + ASP \[\text{Response}\]

Figure 2.3: Active Server Page diagram

ASP is the program that working with the web server from Microsoft Company which has

Personal Web Server (PWS) for Microsoft Windows 95 and Microsoft Windows 98 operating system
Personal Peer Web Server (PPWS) for Microsoft Windows NT Workstation operating system.

Internet Information Server (IIS) for Microsoft Windows NT Server operating system (17)

2.9 Client – Server Architecture and Database system

Khoshofian (21) has an opinion that a major requirement of a corporation’s database system today is to provide users with access to data from one or more remote sites. This need is addressed by the client/server computing environment. The responsibility of the data representation and access is divided between the client and the server.

![Client/Server Computing Environment](image)

Figure 2.4: Client/server computing environment

Steps in client/server architecture protocol.

User queries database.

Client computer presents query to the server machine.

Database system

- Accepts queries
- Compiles query
- Selects best optimization strategies
Database management system
- Collects the result of query
- Transfers to client computer

![Client/Server Architecture Protocol](image)

Figure 2.5: Client/server architecture protocol

Most database systems provide an application interface (API), which is used by client application to access database stored on a remote server. The typical protocol followed by a client machine and database server providing the API is summarized in figure

2.10 Software Reviews

2.10.1 Microsoft SQL Server

Khoshofian(21) has described that SQL Server is a relational database system supporting client/server architecture. It provides very good coverage of client/server architecture through SQL language and programming interface extension.

Banthit Jamomphut(22) had described that Microsoft SQL Server is a relational database management system product of Microsoft Corporation. It supports ‘Two-phase commit/Tight consistency’ to keep situation of data between servers in the system by using ‘commit’ for transaction of data (which is sent and received between servers) must be recorded in database of both servers correctly and concurrency, or...
‘roll back’ back to the same situation. SQL Server is composed of the following components:

**ISQL/W (Interactive SQL):** is used for writing statement transact-SQL. It is able to be fun on both server and client.

**SQL Enterprise Manager:** is used to create devices, objects, configuration, grant users.

**ODBC (Open database connectivity):** is used to replicate data to other database system, for example, ORACLE, Access.

**MS DTC (MS distributed transaction coordinator):** is used to manage routine of transact-SQL in updating data of servers within a same transaction.

### 2.10.2 Microsoft Windows NT

Banthit Jamornphut (23) had described that Microsoft Windows NT is a network operating system product of Microsoft Corporation. The architecture of Windows NT is composed of client/server architecture and layer architecture, which is divide into 2 modes.

**Kernel mode (NT Executive)**

is the mode of system working. It is divided into 4 parts:

1. **System service:** is composed of 5 components.

   **1.1 Security reference monitor (SRM):** for managing security

   **1.2 Object manager (OM):** for creating and deleting objects: files, devices, share memory.

   **1.3 Local procedure call (LPC):** for managing communication between application (clients) and protected system (Server).
1.4 Process manager (PM): for managing process (application in execution) and threads (sub-components of application) to run into processor for SMP (Symmetric multiple processing).

2. Virtual memory manager (VMM): for protecting memory one process from the other and managing requirements for memory in parts of excess of RAM of the system by swapping to hard disk.

3. Input/Output (I/O) manager: manages file system, network equipment. It is composed of 4 components.
   3.1 File system: for supporting operation with file system: FAT < NTFS.
   3.2 Cache manager: for managing cache: improve access to disk, CD-ROM efficiently.
   3.3 Network driver: for managing input/output of network.
   3.4 Device drivers: is composed of 32-bit code used to manage hardware – interface between hardware and other component call for using hardware.

4. Kernel: is a lover component, used for managing interrupt, exception handling, execution of threads, and processing.

Hardware abstraction layer: is a code between processor and kernel. The function is changing code from kernel to order processors to run operations, for example, manage input/output, manage stack, and control interrupt.

User mode (Protected subsystems)

Is an interface between application program and subsystems (DOS, Windows 16 bit & 32 bit, OS/2, POSIX/UNIX) and kernel mode. Each subsystem has application program interface. Windows NT has environment subsystem for applications in different environments.
2.10.3 Microsoft Visual Basic

Is a product of Microsoft Corporation (24), which is designed for teams of developers creating distributed client/server or internet/intranet application. Microsoft Visual Basic can be used to operate with other database management system (DBMS), for example, ORACLE, SQL Server, Informix. A program, which is created for operating in a kind of database can be changed to use another kind of, databases conveniently because database is separated from commands of methods for using database. Microsoft Visual basic can be used for developing object-oriented programming because it separates designing of user-interface from set of commands for processing.

Thatin Sithithammasharee, Tananchai Jammongphakdee (24) had described that using Microsoft Visual Basic, which basic language is used, for creating application is followed the steps:

1) Design user interface by choosing control which response desired using application on the screen. Set position and size of the control.

2) Write programming commands response to event happening. For example, response to user, this is call ‘Event-driven programming’

2.11 Related works

In 1997, Piyavit, Pulchal and Panawat Thitrawee and Supachai Ratsiri develop production scheduling software to search of suitable scheduling from 7 scheduling heuristic for spring production. The result from computer show that Longest Processing Time (LPT) and Minimum Slack Time is appropriate for sample plant operation. (19)
In 1991, Sirinuch Tienrungrote develops a classroom database for administration of the Srinakarinwirote University. She develops an application on the super mini computer with DMS/32 database program with COBOL language. The capability of this application is accessing from anywhere in university through the network of the university. (20)

University of North Colorina, which teaching of Graphic multimedia, constructed web for distance learning education. Graphic workstation computer is an important equipment for using in learning, practice for entire students. There are not enough graphic workstation for students so that students who want to use on extra time can reserve via web. Student must input his username and password to reserve the graphic workstation. The First Come First Serve technique is used for resource allocation(26)

MineMax is a software for mine optimization scheduling. It is a product of Combinatoric company in 1998. This software is a powerful computer-base tool, that is designed to assist mine manager and engineers in achieving an optimal extraction of mine's resource. It is a dynamic resource allocation, which can be response day to day task by changing of competition business environment. Resource optimization is a technique for resource allocation with both blending constraints. (27)

In 1999, Timedomain Inc. develops a software package for allocate employee and resources by using attributes relation to attributes such as: employee jobs class, business location, resource feature or combine all of it. This software can do both manual and automatic scheduling for best of both approaches. This software can print report and table of usage cost of all employees. (28)
CHAPTER III

RESEARCH METHODOLOGY

Steps of work in this study base on the System Development Life Cycle (SDLC). Prototype technique applied in the interface design.

3.1 Step of Works

3.1.1 Preliminary Investigation

3.1.1.1 Request Clarification

Requesting of the system must be clarification, from the executives by interviewing, for what system will be developing and the merit by the executive of the Faculty of Public Health.

3.1.1.2 Feasibility Study

- Technical Feasibility

Current infrastructure, hardware status, software status and capability of the officers in the faculty are evaluated.

- Economical Feasibility

Cost benefit analysis is used for evaluated the financial investigation for the system and return valued.

- Operational Feasibility

Some users in the Faculty are evaluated for their acceptance of the system.
3.1.2 System Analysis

3.1.2.1 Data Collection

All the important facets of the developing system requirements, problems, process in the workflow of the system, the data used and information report, volume of transaction and the control of the data from the person who involves in that data with interviewing technique.

Data list Collection

- Organization Chart
- Courses and their properties
- Timetable of learning
- Reports for the executive
- Job descriptions
- Room and their properties
- Requested and responded form
- Departments and teaching staffs

Entity Relationship Diagram (ERD) is used to show all the entities that related to the system. Data Flow Diagram (DFD) with Yourdon is used for describing and analyzing the process, entity and the movement of the data through the system. Data Dictionary also used for showing a list of all elements composing the data flowing through the process, entity, storing in the system. Enterprise rule is collected by the interviewing.

3.1.3 System Design

3.1.3.1 Database Designing

Database is designed by transform from the component in Entity Relation Diagram (ERD). All the tables are created with normalization technique.

3.1.3.2 Model Designing

1) Classrooms Scheduling
2) Classroom Reservation: First Come First Serve scheduling is used in reservation.

3.2.3.3 Module Designing

Structure Chart Diagram used for describing the relation between module processing in the system.

3.2.3.4 Network designing

A new Intranet server will be link to the existing network, which the entire major component for Intranet is already for using.

3.1.4 System Development

3.1.4.1 Coding or Programming

Coding are separated into two parts, One for the Academic Affairs Service Unit officers as the system administrator, the other for the officers from the departments.

3.1.5 Testing

Unit testing, integrated testing and system testing technique with bottom-up approach are used for testing modules for accuracy of system by the program.

3.1.6 Implementation and Evaluation

3.1.6.1 Implementation

New application is linked to the current system of Intranet. Parallel transforming technique is used for converting to the new one.

3.1.6.2 Evaluation
Questionnaire is used for acceptance test of the application about the system in the accuracy, response time, information's format and system function.

3.1.6.3 Training

Two groups of the users will be trained separately. One is the Academic Affair Service Unit officers are trained as database system administrator and the other, officers from the departments, as the end users.

3.1.7 Documentation

System documentation and user manual is written for the Faculty of Public Health including the recommendation for improving the system in the future.

3.2 Tools Used for Research

3.2.1 Hardware

Server

- Central Processing Unit (CPU) speed at least 11 350
- Memory at least128 Megabytes
- Hard Disk at least 6.4 Gigabytes
- Floppy Disk Drive (3.5 inch, 1.44 Megabytes)
- Compact Disk Drive speed 40 X
- Monitor SVGA 15 inch
- Keyboard
- Mouse
Client

- CPU Pentium
- Memory at least 32 Megabytes
- Hard Disk at least 4 Gigabytes
- Floppy Disk Drive (3.5 inch, 1.44 Megabytes)
- Monitor SVGA 15 inch
- Keyboard
- Mouse

3.2.2 Software

Server

<table>
<thead>
<tr>
<th>Responsibility</th>
<th>Software</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating System</td>
<td>Microsoft Windows NT 4.0 Server</td>
</tr>
<tr>
<td>Relational DBMS</td>
<td>Microsoft SQL 7.0</td>
</tr>
<tr>
<td>Web Server</td>
<td>Information Internet Services(IIS)</td>
</tr>
<tr>
<td>Report Generator</td>
<td>Crystal Report 7.0</td>
</tr>
</tbody>
</table>
### Client

<table>
<thead>
<tr>
<th>Responsibility</th>
<th>Software</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating System</td>
<td>Microsoft Windows 95, 98</td>
</tr>
<tr>
<td>Web Browser</td>
<td>Internet Explorer 4.0</td>
</tr>
</tbody>
</table>
CHAPTER IV

RESULT

4.1 Preliminary Investigation

4.1.1 Requests

The executives of The Public Health Faculty have a policy of using information technology to support all activities in the Faculty. One policy is about teaching and studying system such as resources management. Rooms is one of the important resources that being use everyday. So that, scheduling rooms by suitable application software will help them to utilize all the rooms as efficiency as possible. Three important specifications are:

1. Software for room scheduling which can have many constraints before operation.

2. Vacancy rooms after scheduling can be reserved by academic staffs through internal networking and external networking.

3. Room utilization reports must be generated to evaluate the room occupied.

4.2 Feasibility Study

4.2.1 Technical Feasibility

The Public Health Faculty of Mahidol University has Intranet networking which is a part of Mahidol University Campus (MUC-net) that can get through Internet by gateway of Mahidol University Computer Center.
Hardware - There are enough computers for all of the academic staffs for accessing the room reservation system. But new computer must be prepared for installing the room reservation applications.

Software - Software must be developing for 2 section. One for a group of persons, who operate this system as the system administrators. The other is for general users, the academic staffs, via Intranet.

Peopleware - The officers of Academic Affairs Service Unit has enough skill to operate system with friendly interface of the application, for all both the officers and academic staffs have enough skill to use the system which is friendly user interface.

4.2.2 Economical Feasibility

<table>
<thead>
<tr>
<th>Item</th>
<th>Manual Operation</th>
<th>Computer Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Scheduling</td>
<td>7 days</td>
<td>1-2 days</td>
</tr>
<tr>
<td>2. Reserving</td>
<td>1 days</td>
<td>Immediately</td>
</tr>
<tr>
<td>3. Reporting</td>
<td>7 days</td>
<td>1 days</td>
</tr>
</tbody>
</table>

Table 4.1: Cost benefit analysis

By the cost benefit, we evaluate by the times for operating in each process of the systems, which also related to hidden costs in managing it. The staffs at the Academic Affair Service Unit can reduce times in every process of room reservation operation.
4.2.3 Operational Feasibility

The questionnaire with closed end and opened end used for evaluating. Almost 85% have satisfied with using this application because room reservation system which response for the results of requesting immediately and can access at any times from anywhere.

4.3 System Analysis

4.3.1 General information

Course and Branch

There are 13 courses with 126 majors, which has unique sorting date and ending date. The Public Health Faculty has academic programs for bachelor's degree, master's degree, doctoral degree and graduated diploma for both Thai and International students.

Room

There are 7 Buildings and 125 rooms, which divided into 6 main type: Classroom, Department Room, Office Room, Conference Room, Laboratory Room and Stock Room.

Subject

One subject is responsible by one department. But subject can be a different type. They change by the major and course outline.

Day and Period

Open free for 7 days and in one day separate into an hour per period.
Timetable

More than one branch can be joined in the same class with same the subject, although it it not the same subject type.

Room

Classroom and laboratory room can be scheduled by the administrator and reserve by the teaching staffs.

Academic staff

One academic staff must work in only one department.

4.3.2 Data Flow Diagram

Data Flow Diagram (DFD) with Yourdon is used to analyze the process and the movement of data through the system.

4.3.2.1 Physical DFD

![Physical Data Flow Diagram]

Copyright by Mahidol University
4.3.2.2 Logical DFD

Physical data flow diagram are transformed into logical data flow diagram to see only real flow of work in the system without interfering of the places, person, time or others.
Figure 4.2: Entity Relationship Diagram (ERD)
Figure 4.3: Data Flow Diagram (Context Diagram)
Figure 4.4: Data Flow Diagram (First Level)
Figure 4.6: Data Flow Diagram (Second Level: Process 1)
Figure 4.6: Data Flow Diagram (Second Level: Process 2)
4.3.3 Data Dictionary

**Course Entity**

1. **CourseId**
   Identification for opening course with compose of three parts: level identification, type identification and spec identification

2. **CourseName**
   Name of opening course

3. **CoursePeriod**
   Period for studying the course

4. **CourseStudent**
   Amount of the student in the course

5. **CourseTotalcredit**
   Total all credit of the course

6. **CourseCoreCredit**
   Total credit for core subject of opening course

7. **CourseElecCredit**
   Total credit for elective subject of opening course

8. **CoursePreCredit**
   Total credit for pre requisition subject of opening course

9. **CourseReqCredit**
   Total credit for required subject of opening course

10. **CourseResponser**
    Responder for opening course

**Branch Entity**

1. **BranchId**
   Identification for branch of opening course with compose of course identification and branch number

2. **BranchName**
   Name of branch of opening course

3. **BranchStudent**
   Amount of student of branch

4. **BranchResponser**
   Responder for branch
**Department Entity**

1. DepartmentId  
   Identification of Department

2. DepartmentName  
   Name of department

**Teacher Entity**

1. TeacherId  
   Identification of teacher

2. PreName  
   Type of pre name

3. TeacherName  
   Name of teacher

4. TeacherSurname  
   Surname of teacher

5. Sex  
   Type of sex

6. TeacherStatus  
   Status of teacher

7. TeacherUsername  
   Username for login the application

8. TeacherPassword  
   Password for login the application

**Subject Entity**

1. SubjectId  
   Identification of subject with compose of department identification and Subject number

2. SubjectName  
   Name of subject

3. SubjectCredit  
   Amount of subject credit

4. SubjectLecture  
   Amount of Lecture credit

5. SubjectPrac  
   Amount of Lecture credit

6. SubjectRem  
   Remark for special note of subject

**SubjectTypeEntity**

1. SubjectTypeId  
   Identification of subject type

2. SubjectTypeName  
   Name of subject type

**MajorOutline Entity**
1. **BranchId**  
   Identification of branch in the outline

2. **SubjectId**  
   Identification of subject in the outline

3. **SubjectTypeId**  
   Identification of subject type in the outline

**Day Entity**

1. **DayId**  
   Identification of day

2. **DayName**  
   Name of day

**Period Entity**

1. **PeriodId**  
   Identification of period

2. **PeriodName**  
   Name of period

**Room Entity**

1. **RoomId**  
   Identification of room with compost of building number, floor number, room number

2. **RoomType**  
   Type of room

3. **RoomFac**  
   Facilitator of room

4. **RoomProp**  
   Property of room

5. **RoomCapMin**  
   Minimum capacity of room

6. **RoomCapMax**  
   Maximum capacity of room

**Timetable Entity**

1. **NoteDate**  
   Date of booking

2. **BookDate**  
   Date required for booking the room

3. **BranchId**  
   Identification of branch

4. **SubjectId**  
   Identification of subject

5. **SubjectTypeId**  
   Type of subject in the branch outline

6. **Year**  
   Year
7. Term  
   Semester
8. StudentYear  
   Level of student year
9. RoomId  
   Identification of room
10. DayId  
   Identification of day
11. PeriodId  
   Identification of period
12. BookStatus  
   Status of timetable booking
13. BookOwner  
   Owner of timetable booking
14. BookPassword  
   Password of timetable booking

4.4 System Design

4.4.1 Database Design

Database for the application is created by transform the Entity Relationship Diagram (ERD). The entire table is created from the entities in ERD by normalized technique.

![Figure 4.7: Course table](https://example.com/figure4_7.png)
### Branch Table

<table>
<thead>
<tr>
<th>Column Name</th>
<th>Datatype</th>
<th>Length</th>
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<th>Scale</th>
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**Figure 4.8: Branch table**

### Department Table

<table>
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**Figure 4.9: Department table**

### Teacher Table

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<thead>
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**Figure 4.10: Teacher table**
### Subject Table

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<th>Column Name</th>
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</tbody>
</table>

**Figure 4.11: Subject table**

### Room Table

<table>
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</tbody>
</table>

**Figure 4.12: Room table**

### Branch Outline Table

<table>
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<tr>
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<th>Data Type</th>
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<th>Precision</th>
<th>Scale</th>
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<td></td>
</tr>
</tbody>
</table>

**Figure 4.13: Branch Outline table**
4.4.2 Model Design

4.2.2.1 Scheduling

This model is one module in this application, we set 3 constraints: subject type, room facility, and room capacity for automatic room scheduling by linear programming technique. Although automatic room scheduling can reduce more time in managing, but we found that it is not completely working. Because of some other constraint such as: some branch must be scheduled in the same time and room for studying the core subject together. So that we must have a manual module to edit the timetable in addition to edit, add or delete item in the future. For this model, the system is generated timetable by algorithm that set subject type is important. The results are not satisfied, because of the scheduled rooms of one branch are spread out from in the same room. In addition, we can not cut off or reduce some item in the system.
Figure 4.15: Room scheduling diagram
4.2.2.2 Reservation

This module is generated after the scheduling process, because of the vacancy room will be know and all of the teaching staffs have and authorized permission, by unique name and password to reserved these rooms. First Come First Server technique is used for this module.

![Reservation Diagram](image)

Figure 4.16: Reservation diagram.

4.4.3 Interface Design

4.4.3.1 Scheduling Interface

Scheduling interface is designed for administrator in order to operate the application by Microsoft Visual Basic.

For first time in using the application, the administrator must input the basic information that necessary for the system such as faculty
information, number of building, floor, room, department, teacher, subject, course, day and period. As the figure below:

![Faculty system diagram](image)

Figure 4.17: Faculty system diagram

1) General information

The Public Health Faculty general information is input as the title of the system and report heading.
Administrator can edit all details item for the faculty by faculty information in editing menu.

2) Room

This module must be done in order to prepare room for scheduling. System administrator must input some necessary data such as, number of building, number of floor in each building, number of rooms in each floor. The system will generate standard vacancy room. System administrator can change all the properties of the rooms.
3) Department

The system administrator must generate the departments and their details. In addition, the system administrator must generate the department elements: Teacher and Subject.
4) Course and Major details

After that the system must generate all of the courses and major in each course and theirs details.
5) Day and Period

Day and period must be set for using in the timetable.
After the all basic information are input into the database, the administrator start creating major outline and timetable.

6) Branch outline

Each major must be set subject for studying in various type: core subject, case attention subject, elective subject, pre requisition subject and required subject, depend on the major purpose.

7) Timetable

Each year, term and student year must be set with major details, room, day and period.
Figure 4.29: Timetable generator form

8) Security Interface

Figure 4.30: Security Interface form

9) Main menu Interface

Figure 4.31: Main menu interface Form
4.4.3.2 Reservation Interface

For general user, academic staffs, do not necessary for installing any interface application. They have only Web browser such as Internet Explorer, Netscape Navigator etc. The academic staffs can access the reservation system application via Intranet network that already running in the Public Health all the time. Teaching staffs must know where is the starting homepage for reservation system application, which is more convenience for all the users by putting title as one choice in the main homepage of Public Health Faculty. By the way, all general user must pass a security system by using username and password the formulated by the system administrator of classroom reservation system.

![Login the system web interface page](image)

Figure 4.32: Login the system web interface page

If the teaching staff can log in the application. The system will show the welcome web page. But if not the system will give you the error web page.
Figure 4.33: Login error web interface page

After that the system will show the requesting web page that the user can select item they want or search for many specific requirement such as day, room, size, room facilitate or mix all of it together.

Figure 4.34: Main menu for reservation selection web interface page

If the user requirement is found, the system will show all of the data that matching your requirement. So that you can select one they want by clicking the item. All of the details
In case of cancellation, the teaching staffs can use the interface web page for searching by his username and password that system has been recorded in the database when teaching staffs reserving the room at the first time. The teaching staffs can cancel only theirs reserved room. For the common timetable can be cancelled by administrator of the reservation system.
By the way, the administrator has an authority over general user to cancel all reservation.

Figure 4.37: Cancel the reserving the room web interface page

Figure 4.38: Confirmation for room cancellation web interface page

Teaching staffs can track the scheduling of the student by selection the items they want.
4.7.1 Networking Design

4.4.4.1 Hardware Installation

A new computer must be installed with Microsoft Windows NT 4.0 as an operation system. In addition, Microsoft SQL 7.0 is also installed into the server as database server. Then the database for classroom reservation application is installed by restoring tools of Microsoft SQL 7.0. All of the table for classroom database has been added to the database system.

For the administrator of classroom application. He has two choices for install interface application. First, the interface application is installed into the server who is installing Microsoft Windows NT 4.0 and Microsoft SQL 7.0. Already. Another, the interface application is installed into general computer which using Microsoft Windows 98 operation system. The first one is easier and cheaper but not suitable
using the server, which has so many powers for serving another work such as other database and other application.

4.5 Testing

4.5.1 Unit testing

All modules from are testing by input the value through interface form. Accuracy of the data is checked for the purpose of no errors. In addition to, the extra value is also testing to prevent error for the system.

4.5.2 Integrated Testing

Data passing between module are testing by input value in one module. All of them are checking by the other module for accuracy. The program was tested by focusing on design and software architecture.

4.5.3 System Testing

A small computer network is generated for testing. It is composed of a server, that acting as database server and web sever, and five clients. All data
are input step by step until the end. The administrator and five users operate
the application by adding, editing, and deleting data at the same time. In
addition the efficacy and effectiveness of the application are checked for
purpose of the performance of the application.

4.6 Report

The report for the executive is generated by Crystal Report software, which
separate into two groups. One is the already prepared by the application that usually
the report for all data in the system. They set into link which report item in main
menu. Administrator can see and also print them for the executives of academy. The
other is specific report that the administrator can input the requirement value for it.

4.6.1 General Report

![General course and branch Report](image-url)

Figure 4.41: General course and branch Report

This general report show all and theirs branches in the Public Health faculty.
This general report shows all the timetable in the Public Health faculty.

4.6.2 Specific Report

Figure 4.42: General timetable report

Figure 4.43: Timetable of specific room report
This specific report shows details of timetable for room number 1101 in second semester. Administrator can input specific room number to see the report for that room.

Figure 4.44: Subject in specific department report

This specific report shows details of subject in the department of Health Education and Behavioral Science. Administrator can input specific department to see the subject report for that department.
CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

In the last, this classroom scheduling and reservation system is useful as the following:

5.1 Using for the operation in classroom scheduling system which had been develop to minimize the disadvantages of the conventional one by

5.1.1 Minimize time for operating in scheduling and reservation process.

Because this system, the administrator has a major role in the management of scheduling with helping of the other environments such as room type, room facilitator. In addition, the administrator are easily in scheduling with the restricted rules that are applied in the system such as room capacity, unique timetable for each transaction. For the reservation section, the administrator can serve the user while he is not in the office. Moreover the administrator can reduce so much time in report generating, so that he will have a lot of time to do any works.

5.1.2 Improve the utilization of the room.

Because of room utilization is never been reported. By this classroom scheduling and reservation system, the information from room utilization has been seen clearly for the executives for a decision for any useful works.

5.1.3 More convenience for general users.
They do not call the staffs of the Academic Affair Unit for asking which room is vacant on specific requirement. All users are feel free to select the rooms, as they want at anytime from anywhere. Sometime there is more one choice for them to select. In addition for the students whom want the teaching staffs to review their lesson, They can find out the suitable room before have an appointment with the teaching staffs. And the last, the system can reduce the redundant reserving room among the teaching staffs.

5.2 Recommendation

5.2.1 The classroom scheduling and reservation system is not developed with the concept of office automation. It was developed separately as a close system that can not link to the other software applications in the Faculty of Public Health. So that some tasks, which is not in responsibility, in this system must be done again with the Academic Affair Unit and may cause some error in the whole system. Such as there is a new academic staff, the administrator of the system must input his data for the system. In the fact that the role for this tasks is responsible by personnel unit.

5.2.2 The Academic Affair Unit did not manage all the rooms in the faculty, only the central rooms are under control. Some rooms are depended on the department management. The Academic Affair Unit can not utilize all the rooms as much as possible. The executive of the academy must have an exactly policy for resources management including all equipment for teaching and learning such as: projector, computer, and wireless microphone.

5.2.3 Interface of administrator is developing for exactly client computer. It safes for the system. But if the security of the system is good enough for, the
classroom scheduling and reservation system should be modified for the administrator who can remote from the other place via web browser, remote application.

5.2.4 The information technology is moving more rapidly, the system which has develop with Microsoft Windows NT 4.0 and Microsoft SQL 7.0 is out of date. New operation system, database system come out all the time. The administrator must look for a new technology with compatible with for migration database and application.

5.2.5 This system is using only a tool for operation in classroom scheduling and reservation system. Although this system did not covered for all the procedure of the system. Coding for this application can be modified or added to improve the performance of the system and other module in the future.
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