PROCUREMENT SYSTEM
FOR A CLINIC GROUP

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ABSTRACT

Procurement System For A Clinic Group (PSCG) is a web-based application that provides an online procurement service for vendors of clinic group. This PSCG will be combined with Medical Record Management System, which done by my partner. This is a group project that aims to develop a medical records management and procurement system for aiding managing patient records and procurement process for a group of clinics.

Literature review has been carried out on the information that is related to present online procurement system. PSCG will be developed using Active Server Pages .NET (ASP.NET) with VBSricpt as scripting language, HTML as markup language and Internet Information Server 5.0 as Web server. Microsoft Windows 2000 Server is being chosen as the system development platform, and using database created by Microsoft SQL 2000. The Unified Process will be the project development methodology, which is the object-oriented approach. Almost seven month is allocated to complete the project.

PSCG is divided into three major modules. They are vendor module, procurement staff module and administrator module. The system has some security features, efficiency in computer technology, expendability, user friendly interface a reasonable response time. The system will be developed using object-oriented approach.

ACKNOWLEDGEMENT

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CHAPTER 1   INTRODUCTION

1.1 PROJECT DEFINITION

Medical Records Management System and Procurement System for a Clinic Group is a healthcare management tool specially designed to implement efficiency in clinic groups. The system utilizes the latest Information Technology to simplify day to day task running a modern clinic group at the same time provide management with the necessary information to make strategic decisions. It serves essentially as a medium for communication between the diverse collaborating functional sun-system in a group of medical centers.

This is a group project that aims to develop a medical records management and procurement system for aiding managing patient records and procurement process for a group of clinics. In this project, we have divided into two sub-systems. There are:

1) Medical Records Management System

   - Management of patient records, billings, report generation, etc.

2) **Procurement System**

   - Procurement of medications and other clinic utilities.

Nowadays a lot of online transaction is available on the web. Online procurement is not a strange but a familiar web application to customer anymore. Online procurement system is a high technology and services. This sophisticated procure transaction can be implemented all over the world through Internet or Intranet. A reliable and secure database is demanded to support the web enabled database application for the purpose of development and implementation.

Procurement System for A Clinic Group (PSCG) is designed to function as an online database system, which displays all the types of bid inventory, such as medication and other clinic utilities, which are being purchased by the clinic group. Suppliers or vendors can view the list of bid items. Beside that, they also can get the detail information.

In the meantime, Procurement System let the suppliers to make a tender online. Before they can do this, they should have to login to the system first by input their own identification as well as keyword. It is an easy way in their daily work and does not have to go through the traditional or manual tender process.

A simple registration procedure is required for the suppliers to get an account from the system. After logging in to the system, registered vendor may have a look on the up-to-dated bid board, then make the online tendering, by sending online quotation, receiving online purchase order and generating online delivery order.

1.2 PROJECT MOTIVATION

World Wide Web is a vast collection of information that is spread across hundreds of thousands of computers around the world. The Web has become the avenue of choice for people who need to travel on the information superhighway. This popularity results from the ease with which information can be obtained on the Web.

Actually, the dot-com world is awakening to the hundreds of billions of dollars in supplies that hospitals and other large healthcare providers represent. Companies are sprouting up on the Web that aim to join buyers, distributors and manufacturers in vast online marts that stand to lower prices, raise profits and generally usher in a golden age of procurement.

At present, hospitals may have contracts with group purchasing organizations and other large suppliers for their daily needs. Of course, it does no good for a hospital or clinic group to gain Internet access if suppliers can be handled only phone or fax orders. Clinic group or hospital must have item information online in real-time, with inventory, pricing, quotation and all the trimmings, where the suppliers access the information and make the procurement transaction easily.

Real-time inventories and prices would allow purchasing departments to plan buying and compare prices. Precise pricing information could flow from online

sources to hospital systems. Online tracking of orders would allow better planning of inventories and support timely delivery.

Ultimately, procurement is a quality-of-care issue. If physicians don't have the proper equipment to perform necessary procedures, patients are the losers. If hospitals are wasting time and money on their method of acquiring supplies, quality of care is diminished.

1.3 PROJECT OBJECTIVES

Objectives for the development of the Procurement System For A Clinic Group:

- ➤ To create transaction procurement electronically, which containing a database management system.
- ➤ To provide a security-major consideration system.
- ➤ To provide easy access and easy retrieve data from database.
- ➤ To develop a web application for procurement to be made electronically, where allows suppliers to make online tendering.
- ➤ To provide the relevant information of available inventories efficiently.
- ➤ To manage better relationship and transaction activities with vendors.
- ➤ To create a user-friendly interface.

1.4 PROJECT SCOPE

The scopes of the Procurement System For A Clinic Group are as the below:

❖ Develop a database system to keep all records pertaining to the system.

❖ Provide efficient inventory monitoring by keep tracking the procurement and tendering transactions activities, inventory receiving and physical inventory checking.

Procurement System for a Clinic Group is divided into three major scopes according to the groups of user. The Administrative Staff of this system refers to the user that administrates the entire backend process of the system, administrates a group of the registered vendors and handles online procurement process. And the Vendor refer to the supplier who interested to become the registered vendor to use the system. Below shows that system scope of each user group:

Vendors Scope:

❖ Enable vendor to register as a registered supplier online.

❖ Enable vendor to login into system using password.

❖ Enable vendor to modify personal profile and configure personal settings.

❖ Enable vendor to receive purchase order (PO).

❖ Enable vendor to view the request for quotation on the Web Page.

❖ Enable vendor to generate quotation and invoice online.

❖ Enable vendor send quotation and invoice electronically to administrative staff.

Administrative Staffs Scope:

❖ Enable administrative staff to view all vendors' list and profile.

❖ Enable administrative staff to generate and send PO to the vendor.

❖ Enable administrative staff to add, modify and delete the details of RFQ on Web page online.

❖ Enable administrative staff to receive quotation and invoice from vendor.

❖ Enable administrative staff to add new items into inventory.

❖ Enable administrative staff to delete an existing user.

1.5 PROJECT SCHEDULE

In order to organize the development phase of the system, a schedule is essential in order to develop the system in a more proper manner where the development phase follows certain time frame allocated. Below is a Gantt Chart on the development phase scheduled along the intended time frame for each phase of the system.

		Task Name	Jun '02	Jul '02	Aug '02	Sep '02	Oct '02	Nov '02	Dec '02	Jan '03
1		Literature Review								
2		System Analysis								
3		System Design								
4		System Implementation								
5		System Testing								
6		System Maintainance								
7		Documentation								
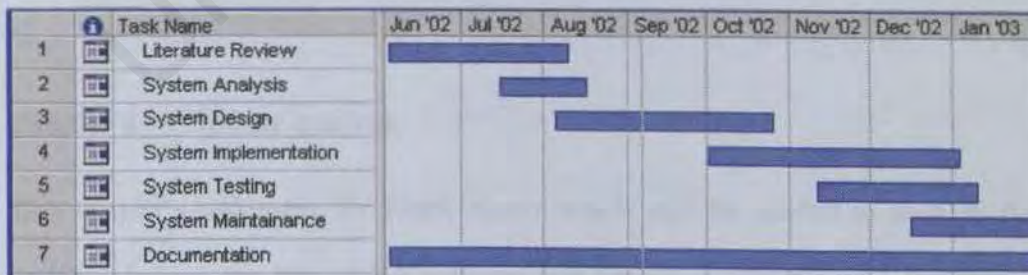
Figure 1.1 Project Schedule

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1.6 CHAPTER OVERVIEW

This report is further divided into chapter as below:

Chapter 1   Introduction

This chapter serves as an introduction to the entire project. This chapter included project definition, overview, motivation, objectives, scope, and project schedule.

Chapter 2   Literature Review

This chapter focuses on the analysis of current existing system compare to the propose system. Mainly, it consists of discussion on the World Wide Web and the analysis of existing procurement systems. It also includes the consideration of some development tools and technologies for the project.

Chapter 3   Methodology

This chapter summarizes the methodology that will be used to develop a system. It also covers the explanation about research methods and techniques that will be used for the project's problem solving.

Chapter 4   System Analysis

This chapter emphasizes the requirements which will be needed to develop the project. It includes lists of the software and hardware specifications. Functional requirements of the system are expressed in use case diagrams. Besides, non-functional requirements are also included in this chapter.

Chapter 5   System Design

This chapter explains the conceptual and technical design of the system. It covers the structure chart, class diagram, sequence diagram, database design and user interface design.

Chapter 6   System Implementation

This chapter emphasizes on writing a program that implementing the system design. This chapter includes discussion of system development, coding standard, development environment and documentations

Chapter 7   System Testing

This chapter discuss about the purpose of testing and testing strategy. In addition, this chapter explains in details about the unit testing, integration testing and system testing.

Chapter 8   System Evaluation and Conclusion

This chapter discuss in details about the evaluation of the system like system strengths, limitation, future enhancements, problems encountered and solutions for the system. Besides, this chapter also serves as a conclusion for the entire project.

CHAPTER 2   LITERATURE REVIEW

2.1 PURPOSE OF LITERATURE REVIEW

Review of literature is a background study about the knowledge and information gained to develop this project. Its' purpose is to get a better understanding on the development tools that can be used to develop a project and also to get a better knowledge on the development methodologies used while developing a project. Besides that, review of literature also enables the developers to do comparison on the past-developed projects and study the strength and weakness of it. It will also give an overview of how to improve the weakness and fulfill the requirements needed.

2.2 FACT FINDING TECHNIQUES

Several researches were being conducted in the process of collecting requirements and specifications to complete the project. Approaches that being used are as below:

> **Internet research**

Internet is a very effective and significant medium in conducting research. The World Wide Web (WWW) was used to observe on the examples and theories of the procurement system. Relevant information also gained easily through the Internet. Some useful search engines are:

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- http://www.google.com

- http://www.yahoo.search.com

- http://www.msn.com

Keywords such as "procurement system", "electronic procurement system", "clinics", "hospital", etc. were used in this searching process. Procurement System examples those being found are not able to access or demonstrate, except for the systems' brief introduction about its features and advantages. However, the ideas and features are used as the guideline in this project analysis phase. Besides, information about development software and technologies are collected for comparing purpose.

➤ **Group discussion and brainstorming sessions**

Brainstorming session among group member, course-mates, and supervisor, is a productive way in collecting ideas, suggestions, and solutions of this project.

➤ **References**

Materials such as books, magazine, journals, newspapers, and thesis were review through for making comparisons and grasp the ideas. Research is not only concentrate on procurement system topics, it also take account of the software and hardware requirements. However, information about Procurement System for A Clinic Group is not much to find through this method.

2.3 INTRODUCTION OF INTERNET, INTRANET AND EXTRANET

2.3.1 Internet

The Internet as we know it today owes its existence to the 1957 launch of a Soviet satellite called Sputnik. This event set off a chain of events that eventually resulted in the evolution of the Internet.

After the launch of Sputnik, the Advanced Research Projects Agency (ARPA) was founded as President Dwight D. Eisenhower recognized the need for the United States to maintain technical superiority. ARPA's mission was to develop imaginative and innovative research ideas and become the central research and development agency for the Department of Defense (DoD).

In 1969, DoD tasked ARPA to perform research and experiments with the communications links between DoD and military contractors. A primary goal was to develop communications systems that could overcome disruptions caused by enemy attacks. This marked the beginning of the ARPAnet. The initial system connected four sites:

➤ Stanford Research Institute (SRI)

➤ University of California at Santa Barbara (UCSB)

➤ University of California at Los Angeles (UCLA)

➤ University of Utah

In the early 1970s, Stanford University was tasked to research and experiment with multiple-packet switching technology. That's a mechanism that enhanced trustworthiness of communications when some network connections were down or unreliable. Consequent research and feasibility experiments led to the development of the TCP/IP suite.

TCP/IP later became a communications standard in 1983 and was added to the University of California at Berkeley's BSD version of UNIX. BSD UNIX was a primary enabler in allowing numerous computers and computer networks to be added to the ARPAnet.

In 1985, The National Science Foundation (NSF) created the NSFnet program. NSF's interest in supercomputing applications led to the requirement for high-speed communications links to connect researchers to NSF supercomputer centers. NSF developed its own backbone with the assistance of MCI, IBM, and the University of Michigan because fail to use the ARPAnet for this purpose. From this backbone, a number of regional networks were hung.

In 1989, ARPA pulled the plug on ARPAnet, and the NSFnet replaced ARPAnet as the backbone of the collection of local and regional TCP/IP networks that had become known as the Internet.

2.3.2 Intranet

Intranet, can be considered as a form of client-server architecture, is a term used to refer to the implementation of Internet technologies within a corporate organization rather than for external connection to the global Internet. Only selected individuals are allowed to access an intranet. Unwanted users on the Internet were blocked out from entering their Web pages and servers by using password protection, firewalls, and other technologies and techniques. Many organizations are figuring out ways to use the Internet for intranet applications.

Key features of an intranet:

- Uses Internet-based standards, such as the hypertext markup language (HTML), FTP, Telnet, HTTP, the simple mail transfer protocol (SMTP) and Web browsers.

- Uses the TCP/IP protocol suite for local- and wide-area networking.

- Comprises wholly owned content not accessible to the general Internet even through the corporation has Internet connections and runs a Web server on the Internet.

- Can be managed, unlike the Internet.

- Can be implemented on virtually all platforms with complete interoperability.

- Open architecture means large and growing number of add-on applications available across many platforms.

- Supports a range of distributed computing architectures (few central servers or many distributed servers).

➢ Structured to support integration of "legacy" information source (data-bases, existing word processing documents, groupware databases).

➢ Supports a range of media types (audio, video, interactive applications).

Some common uses of intranet include providing access to online, internal phone books, procedure manuals, and training materials; enabling employees to check inventories and order suppliers; and enabling employees to check and modify their personal benefit plan. Literally any internal business process can be supported, particularly those processes that involve the conveyance of information. In large and small organizations, intranets are almost always the best way to distribute a wide variety of internal corporate information because producing and distributing paper is usually slower and more expensive. For instance, nearly every organization publishes a quarterly product-pricing sheet or a policy manual. These documents are often hundreds of pages long, are published several times a year, and are copied and delivered to thousands and thousands of people. This is not only a very expensive process, but in most situations the information change rapidly and consequently the shelf life of the document is not very long. The information is often out-of-date by the time it arrives in the hands of the users. Putting these documents on the Web enables employees throughout the world to quickly, easily, and inexpensively access them there. Moreover, any change in the document is automatically reflected in the views of the document that everyone sees.

Intranets expedite application distribution and updating. It can lower the total cost of ownership (TCO) by reducing software maintenance and update cost.

Computing staff can place software updates and patches on the intranet and then provide a script to update employee workstations automatically the next time they log on.

2.3.3 Extranet

Extranets are used to connect companies with suppliers or other business partners. An extranet can be any of the following types: a public network, a secure (private) network, or a virtual private network (VPN).

2.3.3.1 Public network

A public network extranet exists when an organization allows the public to access its intranet from any public network, such as the Internet, or when two or more companies agree to link their intranets using a public network. Security is an issue in this configuration even some firewall checking are provided. To secure transaction between cooperating companies, each of them must provide protection for outgoing information before that information passes from each intranet onto the public network.

2.3.3.2. Private network

A private network is a private, leased-line connection between two companies that physically connects their intranets to one another. A leased line is a permanent, dedicated telephone connection between two points and is always active.

The private networks provide a high security protection against the messages flowing on it. However, this configuration is very costly and time-consuming.

2.3.3.3 *Virtual Private Network (VPN)*

A Virtual Private Network (VPN) extranet is a network that uses public networks and their protocols to send data to partners, customers, suppliers, and employees by using a system called "tunnelling" or "encapsulation". A VPN provides security shells, with the most sensitive data under the tightest control. Most extranets are implemented either as LAN-to-LAN extranets or client/server extranets. VPNs are designed to save money, so it does not require a leased line during connection. Each cooperating company's intranet is connected using the Internet. Unlike private networks, VPNs establish short-term logical connections in real time that are broken once the communication session ends.

Information on extranets is secure to prevent security breaches from unauthorized users. Authorized users connect transparently to another company's network via the extranet. Many firms are using the extranets to support their business-to-business commerce with other forms such as:

An extranet may be set up through the Internet, but frequently it is separate network connecting businesses to one another. However, some extranets such as private networks use the Internet protocols and technology to drive communications among them.

2.4 THE WORLD WIDE WEB

The World Wide Web (WWW) or the Web, is a subset of the computers on the Internet that are connected to each other in a specific way that makes those computers and their contents easily accessible to each other. The Web is a system consisting of an internationally distributed collection of multimedia files supported by clients (users) and servers (information providers). Each file is addressed in a consistent manner using its universal resource locator (URL). The files from the providers are viewed by the clients using browsers such as Mosaic, Netscape Navigator, or Microsoft's Internet Explorer. Browsers are fast becoming a standard Internet tool. The WWW links the various tools used on the Internet by providing users with a simple, consistent interface to a wide variety of information. The WWW supports text documents, Telnet sessions, sounds, graphics, file transfers and more by using hypertext. A hypertext text document not only contains information, but also links to other documents that contain related information. The standard method of formatting Web pages is to use hypertext markup language (HTML). HTML is a language that includes a set of codes attached to text. These codes are translated by the Web browser and result in a formatted Web page.

The number of Web sites has grown even more rapidly than the Internet itself. The number of Web site is currently estimated to be well over eight million and the number of Web documents is likely over a billion. As more people gain access to the Web, commercial interest in using the Web to conduct business will increase and the variety of non-business uses will become even greater.

2.5 ADVANTAGES OF WEB APPLICATION DEVELOPMENT

Developing applications using Web-related technologies grasp a lot of advantages over developing traditional information systems and end-user applications. This is factual whether the applications are being developed for internal users on an intranet or external users on the Web. The benefits of developing the web-related application can be seen from the perspective of both the users and the developers.

2.5.1 The Users Perspective

Applications are developed primarily for the end-users. Therefore, it's critical that developed applications should be easy and intuitive for users. For instance, internal users can easily access to organizational information and external users can access to databases and applications that provided. Fortunately, Web applications provide many benefits to end-users that aren't as readily achievable by using traditional systems-development tools. Here are just a few of the benefits:

➢ Graphical user interfaces

➢ Abstraction of applications and query languages using forms

➢ Browser customization

➢ Quick and easy access to information, databases, and applications

2.5.1.1   *Graphical User Interfaces (GUI)*

GUIs make life easier for end-users by enabling them to point and click to navigate applications. This makes selecting from lists, scrolling pages of information, viewing graphics, and entering inputs far easier than non-graphical systems. Standard HTML documents read by a variety of Web browsers are rendered in a common way regardless of the browser and the platform they are on. Users can concentrate on their work and retrieve the information from these applications instead of worrying about the details of making the application run.

2.5.1.2   *Abstraction of Applications and Query Languages*

HTML forms and hypertext links provide mechanisms by which the details of an application can be abstracted for the user. Users no longer are required to have detailed knowledge of the application. Instead, they're presented with forms complete with text-entry boxes, selection lists, scrollable menus, radio buttons, and checkboxes. These user-input objects guide the user to enter the information needed for a database query to be constructed by the application. Users just need to concentrate on how they can use the results of the application to their benefit.

2.5.1.3   *Browser Customization*

The current generation of graphical Web browsers enables users to customize many attributes to suit their tastes and preferences. There are some of the attributes that are user-configurable, for instances general appearance, font style, text, background, link colors, image-rendering characteristics, plug-ins and helper applications definitions, language and newsgroup access.

2.5.1.4   Quick and Easy Access to Information

Information has no value unless users can readily access it. For this, Web applications have provided common interfaces to under-used corporate databases in many intranet applications. In addition, agencies seeking to provide the public with access to the volumes of information they produce are finding that relatively simple Web interfaces provide users with access to a variety of information sources previously unavailable. Not only is the information being made available, but Web database applications are being developed that enable users to perform complex searches of the information by just clicking the mouse a few times.

2.5.2 The Developers Perspective

Web technologies provide developers with a number of advantages over traditional development tools:

- Standard technologies
- Short learning curves
- Cross-platform compatibility
- Ease of integration
- Rapid GUI development

2.5.2.1   Standard Technologies

Web applications are built on standardized protocols such as TCP/IP and HTTP, and on technologies such as HTML and CGI. Using a common network protocol (TCP/IP) as well as a browser/server communications protocol (HTTP) makes life easier for developers, because they don't need to worry about the

implementation details. Web servers, browsers, and the computers on which they reside already have this built-in support. Developers can concentrate on the application instead of the communications details.

2.5.2.2 *Short Learning Curves*

HTML is relatively easy to master quickly compare to traditional programming languages. In fact, several development tools, such as Microsoft's FrontPage, provide even novice HTML developers with development tools that are as easy to use as most word processors. This means that non-programmers--even end users--can participate in developing GUI front ends to applications. This capability enables programmers to concentrate more on developing the underlying applications to be run on the server.

2.5.2.3 *Cross-Platform Compatibility*

Browsers are obtainable for almost any make or model of computer. Furthermore, by using standard HTML, developed applications interfaces will run on most graphical browsers on almost any machine. Graphical user interfaces do not need to be specifically coded for the platform on which they will run. Web applications also leverage benefits of the client/server model of computing. The application is developed for a single runtime environment because it resides on the Web server host. This means that any computer running a browser, whether it's a PC running Windows, a Macintosh, or a UNIX workstation can access the same applications.

2.5.2.4   *Ease of Integration*

Since HTML provides the capability to easily invoke server-side programs via CGI or a Web server API, developers only need to know how to work within the CGI/server API environment in order to integrate CGI/API programs with new or existing applications such as databases or graphics-generation utilities. Databases can be accessed in CGI programs using familiar database APIs. CGI/server APIs are the glue that connects HTML GUIs on a Web browser to full-fledged applications on a Web server.

2.5.2.5   *Rapid GUI Development*

The most time-consuming aspect developed applications using a windowing system actually is coding the user interfaces. Nevertheless, using HTML (as well as ActiveX controls and VBScript) as a GUI development environment reverses this situation. Often, browser-based interfaces can be developed rapidly, which enables developers to concentrate on the development of the underlying application. It results shorter development cycles. Besides, modifications and enhancements to HTML and VBScript code typically are much faster than traditional development environments.

2.6 INTORDUCTION TO .NET TECHNOLOGY

2.6.1 Defining the Basis Element of .NET

Microsoft .NET is a set of Microsoft software technologies for connecting the world of information, people, systems, and devices. It enables an unprecedented level of software integration through the use of XML Web services: small, discrete, building-block applications that connect to each other - as well as to other, larger applications - via the Internet.
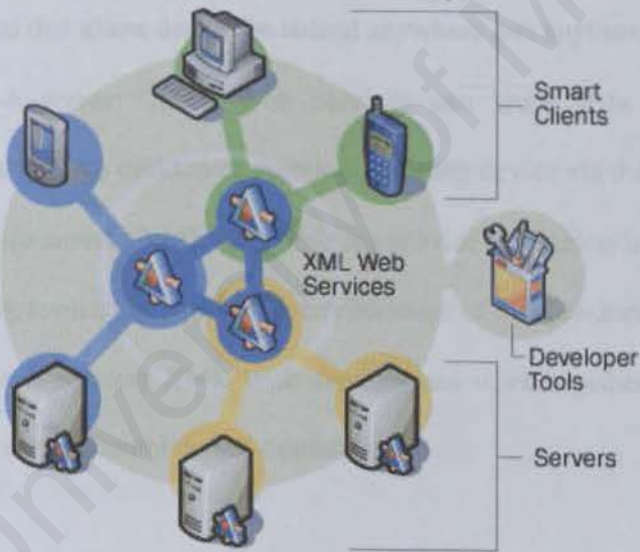
Figure 2.1 .NET Technology

.NET is infused into the products that make up the Microsoft platform, providing the ability to quickly and reliably build, host, deploy, and utilize secure and connected solutions using XML Web services. The Microsoft platform provides

a suite of developer tools, client applications, XML Web services, and servers necessary to participate in this connected world.

2.6.2 XML Web Services

XML Web services are small, reusable applications written in XML, a universal language for data exchange. They allow data to be communicated across the Internet (or internal intranet) between otherwise unconnected sources that are enabled to host or act on them, for example:

- *Client-to-client*: "Smart" clients or devices can host and apply XML Web services that allow data to be shared anywhere and anytime.

- *Client-to-server*: XML Web services can share data from a server application to a desktop or mobile computing device via the Internet.

- *Server-to-server*: XML Web services provide a common interface between existing applications within an environment of independent servers.

- *Service-to-service*: XML Web services can work together in sequence to create a more complex data operation.

2.6.3 Smart Clients

"Smart" client application software and operating systems enable PCs and other smart computing devices to act on XML Web services, allowing anywhere, anytime access to information.

2.6.4 Servers

With Microsoft® .NET, businesses will be able to turn key processes into XML Web services. From the schedule for a doctor's office to the catalog for a book seller to an exchange rate calculator for world currencies—XML Web services created and hosted by one company or individual can be used by millions of others in varied combinations to produce highly personal, intelligent computing experiences.

This distributed model of computing will put increasing demands on server infrastructures.

➢ Secure, scalable servers that deeply integrate XML will provide the backbone for hosting and deploying .NET software and services.

➢ Microsoft Windows® 2000 Server, the upcoming Windows .NET Server family, and the Microsoft .NET Enterprise Servers are the best servers to fill this role.

2.6.4.1   Benefits of .NET Servers

➢ Accelerate the integration of systems, applications, and partners using XML Web services through the servers' deep level support of XML.

➢ Facilitate aggregation of XML Web services into truly rich user experiences.

➢ Build on legacy systems rather than ripping and replacing, through simple access to mainframes with Microsoft Host Integration Server and automatic conversions of existing data formats into XML with Microsoft BizTalk Server.

2.6.4.2   Server Infrastructure

The Microsoft .NET Enterprise Servers, Windows 2000 Server family, and the upcoming Windows .NET Server family, with their built-in security, their support for XML and their ability to quickly scale-out to meet increased demands, provide the best solution to host and deploy XML Web services.

2.6.4.3   .NET Enterprise Servers

The .NET Enterprise Server family accelerates the integration of systems, applications, and partners using XML Web services through the servers' deep level support of XML. This deep support of XML allows enterprises to build on legacy systems rather than ripping and replacing them. For example, Microsoft Host Integration Server provides simple access to mainframes and Microsoft BizTalk™ Server offers automatic conversions of existing data formats into XML.

2.6.5 Developer Tools

With Microsoft® Visual Studio® .NET and the .NET Framework, developers can develop XML Web services quickly and integrate them easily with other applications. Most developers can leverage existing skills, because the .NET Framework's common language runtime allows you to develop Web services using any modern program language.

➤ Microsoft Visual Studio .NET and the Microsoft .NET Framework supply a complete solution for developers to build, deploy, and run XML Web services.

➢ These tools maximize the performance, reliability, and security of XML Web services.

Benefits of .NET Framework and Visual Studio .NET:

➢ Quickly and easily create cutting edge XML Web services and applications that scale and integrate easily.

➢ Improve the reliability, scalability, and security of your application using .NET Framework's application execution environment.

➢ Tap the broadest developer talent through the .NET Framework and Visual Studio .NET support for most modern programming languages.

➢ Enable use of existing skills to create solutions for a wide range of devices.

2.7 DEFINITIONS

■ **What is Procurement?**

Procurement means buying, purchasing, leasing or acquiring any commodities, equipment, services & construction. It also includes all functions that pertain to the obtaining of any commodities, equipment, services or construction, including description of requirements, selection and solicitation of sources, preparation and award of contract and all phases of contract administration.

■ **What is Electronic Procurement System?**

Electronic Procurement (E-Procurement) is the combination of the existing procurement system and the internet technology. E-Procurement is a user-friendly, Internet-based purchasing system that offers electronic purchase order processing and enhanced administrative functions to buyers and suppliers, resulting in operational efficiencies and potential cost savings.

The E-Procurement Service features the most modern business and commercial practices from the private sector and the most current technical capabilities offered by the Internet that will provide cost-saving opportunities to both suppliers and the state. With this online procurement system, the process of buying and purchasing can actually be all done through the Web. The process of catalogue preparation, pricing, data changing, bidding, bid selecting and other works will be all automated or semi-automated done by the web-application. The procurement agents need not make thousands of calls and checking all the forms' validity and comparing the prices with lots of data entry and etc. On the other words, data entry jobs are all done by the suppliers themselves. A procurement agent's job is to update the online system from time to time.

■ **What is Clinic Group?**

Clinic Group is a group of clinics that located in a same building or in a same area. Normally the clinic group would be known as policlinic, medical center, specialist center, or even been known as hospital.

2.8 REVIEW ON EXISTING SYSTEM

In order to have better understanding of the e-procurement system, the Internet was used as the tools to seek for example and relevant information. The information gained was being a valuable and useful guideline during the development of this project.

2.8.1 Frontier Medical - Online Medical Procurement
http://www.frontiermedical.co.uk/services.html

Frontier Medical is a medical center that provides a range of medical services including health awareness initiatives, various training programmes, consultancy, remote site medical support, health care management and online medical procurement. The online medical procurement page, which called *medekit.com* offers the following features:

❖ This Website is providing the online registration and login services to supplier who will be interested becoming registered supplier for Frontier Medical center.

❖ This Website also provides other information about the procurement system's provider.

Personal Evaluation:

❖ The design is quite well in this site. It is very simple but attractive because of the color and the design.

❖ This Website has a security login method, where the administrator and supplier have their own login menu each.

❖ This Website doesn't provide a guideline about procurement information to supplier. For example, it doesn't have a list of bidden items.

2.8.2 Eastern State Hospital - Online Purchasing Guide Directory

http://www.easternstatehospital.org/purchas.htm#VENDOR

Eastern State Hospital is a private hospital located at Williamsburg, VA. An official Website had been developed for providing all the information about the hospital. It has an Online Purchasing Guide Directory Web page, which offers the following features:

❖ This Website providing a detail guideline for on-line purchasing to supplier before the process of procurement.

❖ It also provides on-line services of "Invitation for Bids" and "Request for Proposal" to supplier.

Personal Evaluation:

❖ This Website is lacking of graphical design for the interface.

❖ This Website doesn't offer on-line registration and login services for the suppliers.

❖ The provided detail guideline is good, but too much with text presentation.

2.8.3 The Scarborough Hospital - Suppliers and Contactors Section

http://tsh.to/suppliers/procurement.html

The Scarborough Hospital also has a developed official Website which providing all the information about the hospital. There is a Supplier and Constructors Section on the Website where some information listing from the hospital, such as procurement guidelines, delivery direction and accounting inquiries. The Web page of Hospital Procurement and Purchasing Guidelines offers features below:

❖ This Web page is providing a detail guideline for the hospital procurement and purchasing transaction process to supplier.

Personal Evaluation:

❖ This Web page is quite well designed, especially the attractive of color design.

❖ This Web page doesn't offer the on-line registration and login services for suppliers.

❖ Suppliers can have a better understanding about the procedure before making procurement transaction with hospital.

2.9 CLIENT/SERVER ARCHITECTURE

As a result of the limitations of file sharing architectures, the client/server architecture emerged. This approach introduced a database server to replace the file server. Using a relational database management system (DBMS), user queries could be answered directly.

The client/server architecture reduced network traffic by providing a query response rather than total file transfer. It improves multi-user updating through a GUI front end to a shared database. In client/server architectures, Remote Procedure Calls (RPCs) or standard query language (SQL) statements are typically used to communicate between the client and server.

2.9.1 Two-tier Client/Server Architecture

With two tier client/server architectures, the user system interface is usually located in the user's desktop environment and the database management services are usually in a server that is a more powerful machine that services many clients.

Two tier architectures consist of three components distributed in two layers, client (requester of services) and server (provider of services). The three components are:

➢ User System Interface (such as session, text input, dialog, and display management services)

- ➢ Processing Management (such as process development, process enactment, process monitoring, and process resource services)
- ➢ Database Management (such as data and file services) provides stored procedures and triggers.

The two-tier client/server architecture is a good solution for distributed computing when work groups are defined as a dozen to 100 people interacting on a LAN simultaneously.

It does have a number of limitations. When the number of users exceeds 100, performance begins to deteriorate. This limitation is a result of the server maintaining a connection via "keep-alive" messages with each client, even when no work is being done.

A second limitation of the two tier architecture is that implementation of processing management services using vendor proprietary database procedures restricts flexibility and choice of DBMS for applications. Finally, current implementations of the two-tier architecture provide limited flexibility in moving (repartitioning) program functionality from one server to another without manually regenerating procedural code.

Another limitation is regarding system administration and configuration. Two tier architectures can be difficult to administer and maintain because when applications reside on the client, every upgrade must be delivered, installed, and

tested on each client. The typical lack of uniformity in the client configurations and lack of control over subsequent configuration changes increase administrative workload.

Furthermore, the two-tiered architecture is not effective running batch programs. The client is typically tied up until the batch job finishes, even if the job executes on the server; thus, the batch job and client users are negatively affected.
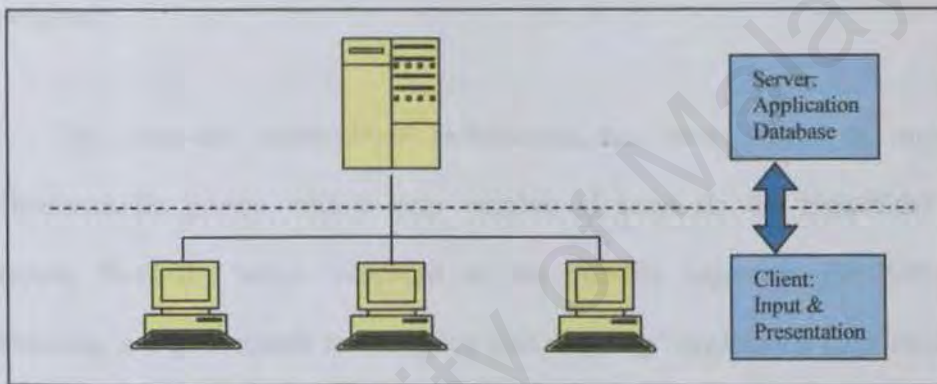
Figure 2.2 Two-Tier Client/Server

2.9.2   Three-Tier Client/Server Architecture

Three-tier architecture (also referred to as the multi-tier architecture) emerged to overcome the limitations of the two-tier architecture.

In a three-tier architecture, an intermediate connecting layer is introduced. Each of the client programs and servers then communicate with the intermediate layer. This provides a clear separation of the client programs from the data sources/sinks and allows them to be maintained more easily. Servers are typically

SQL databases but they could equally be devices as well as other types of databases. There are a variety of ways of implementing this middle tier, such as transaction processing monitors, message servers, or application servers. The middle tier can perform queuing, application execution, and database staging. For example, if the middle tier provides queuing, the client can deliver its request to the middle layer and disengage because the middle tier will access the data and return the answer to the client. In addition the middle layer adds scheduling and prioritisation for work in progress.

The three-tier client/server architecture has been shown to improve performance for groups with a large number of users (in the thousands) and improves flexibility when compared to the two-tier approach. Flexibility in partitioning can be a simple as "dragging and dropping" application code modules onto different computers in some three-tier architecture.

A limitation with three tier architectures is that the development environment is reportedly more difficult to use than the visually oriented development of two tier applications. Recently, mainframes have found a new use as servers in three tier architectures.

Advantages of 3-tier client/server architecture:

> Unlike in most two-tier implementations, the three-tier presentation client is not required to understand SQL. This added flexibility allows a firm to

access legacy data and simplifies the introduction of new database technologies.

➤ Having separate software entities allows for the parallel development of individual tiers by application specialists.

➤ Provides for more flexible resource allocation. Middle-tier functionality servers are highly portable and can be dynamically allocated and shifted as the needs of the organization change. Network traffic may be reduced.

➤ Reusable logic reduces subsequent development efforts, minimizes the maintenance workload, and decreases migration costs when switching client applications.
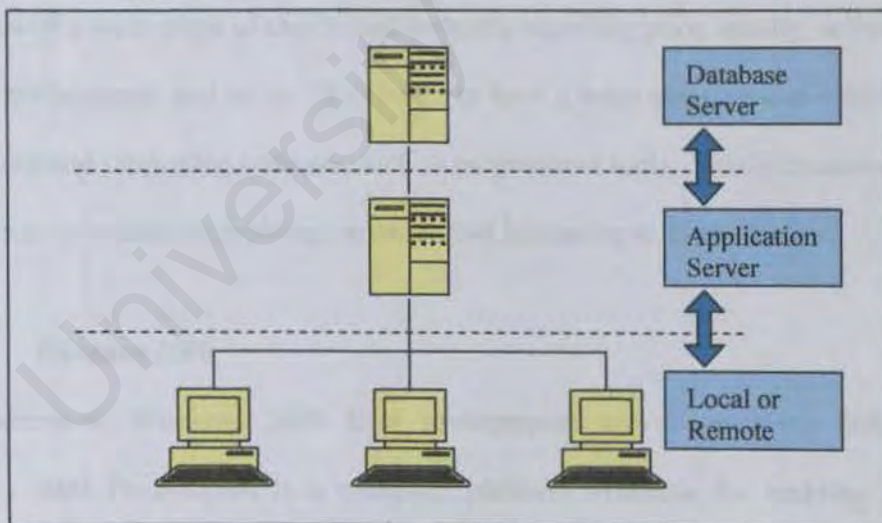
Figure 2.3 Three-Tier Client/Server

2.10 TOOLS AND TECHNOLOGIES CONSIDERATION

Nowadays, the web technology is expanded and improved rapidly, various technologies emerge to create and design a sophisticated web application. In search for the most efficient development tools, this section will briefly consider the technology of the current web-based system and at the same time highlight the appropriate new technology.

2.10.1 Development Platform

Choosing an appropriate development platform is the preliminary task before selecting suitable development tools. Typically, the development platform should always be the most cost-effective in the industry and available through numerous channels with a wide range of choice and tradeoffs regarding price, quality, delivery, support, performance, and so on. It is better to have a wide range of cost-effective applications and supporting software, such as programmer tools. This is to assure its platforms so as to support evolving hardware and increasing software demand.

2.10.1.1 *Windows 2000*

Microsoft Windows 2000 is a multipurpose server operating system. Windows 2000 Professional is a complete platform available for building and hosting web based applications with the new features introduced with the Windows 2000 Option Pack. Now, it is an easy server operating system available.

Benefits of Windows 2000 Platform:

- Point-to-point Tunneling Protocol (PPTP) of Windows 2000 provides a way to use public data networks, such as the Internet, to create a virtual private network-connecting client PCs with servers. PPTP offers protocol encapsulation to support multiple protocols via TCP / IP connections and data encryption.

- System Policy Editor and User Profiles of Windows 2000 allow system administrators to manage and maintain users' desktops in a consistency manor. System policies are used for the standardization of desktop configurations and control the user work environment and actions.

- New application programming interfaces for server application developers and better server performance deliver improved throughput and scalability for server applications such as Microsoft SQL Server.

- The Task Manager of Windows 2000 is an integrated tool for monitoring applications and reports key performance metrics of the Windows 2000 system. It provides information on each application and process that are running on the workstation, as well as memory and CPU usage.

- Improved Windows 2000 Diagnostics Tool allowed for easy examination of the system resources such as IRQ, DMA and IO addresses, all presented in an easy-to-view graphical tool.

- Network Monitor of Windows 2000 is a powerful network diagnostic tool allows examining network and from the server at the packet-level. It makes troubleshooting network problems easier.

♣ Windows 2000 allows Object Linking and Embedding (OLE). It can combine the information from several applications into one compound document using the special OLE capabilities of Window-based application.

2.10.1.2   Windows NT

Windows NT is the operating system for personal computer created for users and business requiring advanced capability. It is actually comprise of two products: Microsoft NT Workstation and Microsoft NT Server. The workstation is a little safer than Windows 98 and Windows 95.

It is designed for users especially business users, who need faster performance. The server is designed for business machines that need to provide services for LAN-attached computers. Together with an Internet server such as Microsoft's Internet Information Server (IIS), it is required for a Windows system that plans to serve Web pages. The latest version, the Windows NT Server version 5.0 is now available, called Windows 2000.

Whereas, system requirements for Windows NT 4.0 Option Pack are the system need to be installed both Windows NT Service Pack 3 and Service Pack 4 and Microsoft Internet Explorer 4.01. In order to run Internet Information Server 4.0 (IIS) and any other features on the Windows NT 4.0 Option Pack.

In term of networking, Microsoft Windows NT Server 4.0 works with Microsoft LAN Manager, Microsoft Windows for Workgroups operating system,

AppleTalk, DECPATH WORKS, IBMLAN Server, IBMSNA networks, the Internet, NFSnetworks, Novell NetWare, Remote Access Services by way of ISDN, X.25, and standard phone lines and TCL/IP networks.

2.10.1.3 LINUX

What is now known as Linux began life as a small student project at the University of Helsinki in Finland. The Linux operating system is a small, UNIX-like operating system, which is a rather remarkable operating system that works very well, is very stable, and rivals offerings from Microsoft, Apple, and Sun. Linux offers the following features:

- *Multitasking* - Linux natively runs more than one task (program) at a time in a UNIX-like fashion. It also supports preemptive multitasking, where priorities can be set for different processes.

- *Multi-user* - Many users can be networked to a single Linux server. Linux is the least expensive, and perhaps best-featured, multi-user operating system on the planet today.

- *User-friendly* - The X Window System interface and a slew of great tools make Linux easy to use.

Today, Linux claims half a million users, and that number keeps growing every day. One reason is cost -- Linux itself is free of charge, and only those who package a Linux distribution charge for it (and many don't charge at all). These

distributions, such as Red Hat Linux, vary as to their installation processes and accompanying tools.

2.10.2 Database Management System

Database technology is used in a variety of applications, which some serve only a single user on a single computer and others are for multi-users. The Database Management System is the tool that enables us to manage and interact with the database.

2.10.2.1 *Microsoft SQL Server 2000*

Microsoft SQL Server 2000 is a single process, multithreaded relational database server primarily intent for transactional processing. It is a key component in answering data management requirement, which require a large amount of information and serve many different simultaneous users. It is tightly integrated with the Microsoft Back Office family product to enable organization to improve the decision's making process and the streamline of the business process. Microsoft SQL Server 2000 provides innovations in performance, reliability and scalability as below:

- *Scalability* - SQL server is designed to accommodate more data, transactions and users with ease. The query processor in SQL Server also provides powerful support for large databases and complex queries.

- *Data Warehouse* - The data transformation services make it easy to import, export and transform heterogeneous data using OLE Database, Open Database.

- *Internet, Intranet and Commerce* - The full-text search supports the linguistic search to create special indexes of pertinent words and phrases in selected columns of selected table.

- *Ease of Use* - Microsoft SQL Server automates standard database administration operations and adds some sophisticated new tools to simplify the managing complex operations.

- *Connectivity (ODBC) or text-only files* - This means that it provides automatic distributed update capability across two or more SQL.

2.10.2.2   *Microsoft Access 2000*

Microsoft Access 2000 is a Windows-based database management system, which runs under the Windows 95/98/2000/NT operating system. Access offers an easy-to-use database for managing and sharing data. It also adds increased integration with the Web for easier sharing of data across a variety of platforms and user levels. It enables sharing of database among the co-workers over the Internet, searching and retrieving the information quickly, and taking advantage of automated, pre-packaged solutions to quickly create databases.

Also, Stat/Transfer can be used to convert data between Microsoft Access and your favorite spreadsheet, database or statistical package. Besides that, data in Microsoft Access can be migrated to the Microsoft SQL Server.

Benefits of Microsoft Access:

- An easy-to-use tool for easily finding information that provides consistency and integration with the other applications in the office suite.

- Access 2000 allows easily sharing information via the corporate Intranet and the ability to easily host a database within the browser.

- User may create solutions that combine the easy-to-use of the Access interface (client) with the scalability and reliability of SQL server.

2.10.2.3   MySQL

MySQL consists of a server daemon "mysqld" and many different client programs/libraries, which, is an implementation for the client/server. It is a true multi-user, multi-threaded SQL (Structured Query Language - the most popular database language in the world) database server.

Speed, robustness and ease of use are major consideration in MySQL. MySQL is built based on a set of routines that have been used in highly demanding production environment for many years. It already offers a rich and highly useful function set while it is still in development.

Database servers typically use some type of a monitor application to do system administration. This application can be character based, or graphical and the administrator will most likely use both since each has its strengths in different areas of system administration.

2.10.3 Web Server Technology

A web server is a program that, using the client / server model and the world wide web's Hypertext Transfer Protocol (HTTP), serves the files that form web pages to web users, whole computers contain HTTP clients that forward their requests. Every computer on the Internet that contains a web site must have a web server program or else the site files must be sent to a computer that has a web server program. Web servers often come as part of a larger package of internet-related and intranet-related programs for serving e-mail, downloading requests for FTP files, and building and publishing web pages.

2.10.3.1 *Internet Information Server 5.0 (IIS)*

Microsoft Internet Information Server 5.0 is the latest addition to Microsoft's Back Office family of products that enables the publishing and distribution of information on the internet. In other words, it is a web server integrated into Windows NT Server. Microsoft Internet Information Server is required to access applications based on Microsoft Active Server Pages.

IIS is typical of many Microsoft Windows-based products. It supports the Windows GUI and provides integration with other Windows mechanisms, such as

Active Directory, MS SQL Server and Windows Security services. IIS also leverages the benefits of COM+. On the downside, IIS requires additional Microsoft products, such as Windows 2000 or Active Directory. This dependency causes a worry of potential lock in to Microsoft products and strategy for some companies.

IIS is optimized for Windows NT Server and takes advantage of the security, which NT Server provides. The IIS is made up of three different components namely the World Wide Web (WWW) server, File Transfer Protocol (FPT) and Gopher (Gopher) server which support Virtual Server, Virtual Directories, Logging to ODBC databases, common Gateway Interface (CGI), Internet Server Application Programming Interface (ISAPI) and Secure Sockets Layer (SSL).

IIS can write file security and application events to the Windows event log, which can then be viewed using standard Windows tools, such as Event Viewer. IIS also provides logging to any ODBC database. In fact, multiple IIS servers can log to a single ODBC database.

The configuration and management of internet services that can done through the Internet Service Manager. Any services on any of the servers can be started and stopped as well as configuration and management properties such as access permissions and logon some basic and enhanced security. IIS requires a valid username and password for authentication in order to gain access to the information. The usernames must be valid usernames on the computer running IIS, or from a

Windows NT domain accessible from the IIS machine. It also offers controlling access via an IP address.

2.10.3.2 Apache Web Server

Apache Web Server is free Web server software that provides powerful and efficient performance. Apache is able to runs on many platforms such as Microsoft NT, OS/2, AIX, HP-UX, Iris, Linux, Solaris and several other operating systems.

Apache has a built-in search engine and HTML authoring tools and also supports FTP. Apache's application development tools support CGI (Common Gateway Interface), SSI (Server Side Includes), and several proprietary APIs (Application Program Interfaces). SSI is a type of HTML comment that directs the Web server to dynamically generate data for Web page when it is requested.

On the security matter, Apache supports password authentication and digital certificate authentication. It allows administrators to easily set up password-protected pages with enormous numbers of authorized users, without slowing down the server. Server access can be restricted by domain name, by IP address, or by user and group. Besides, Apache can prohibit access by directory or file, and supports SSL (Secure Sockets Layer).

Apache is also flexible enough to perform multiple Directory Index directives, where administrators can instruct the server to either send back index .html or run index .cgi when a directory URL is requested, which ever it finds in the

directory. Apache server uses Open Database Connectivity (ODBC) standard and can access Oracle, Sybase, Microsoft SQL Server, and IBM's DB2 database. Apache also supports Active Server Pages (ASPs) and Java servlets.

Today the Apache server is the most widely implemented Wed server on the Internet area. It offers a powerful and customisable approach. It has been shown to be substantially faster, more stable and more feature-full than many other Web servers. Apache is the ideal choice for the sites that received high capacity of hits per day.

2.10.4 Web Development Technology

2.10.4.1 Active Server Page .NET (ASP.NET)

ASP.NET is a programming framework built on the common language runtime that can be used on a server to build powerful Web applications. ASP.NET offers several important advantages over previous Web development models:

- *Enhanced Performance* - ASP.NET is compiled common language runtime code running on the server. Unlike its interpreted predecessors, ASP.NET can take advantage of early binding, just-in-time compilation, native optimization, and caching services right out of the box. This amounts to dramatically better performance before ever write a line of code.

- *World-Class Tool Support* - The ASP.NET framework is complemented by a rich toolbox and designer in the Visual Studio integrated development

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environment. WYSIWYG editing, drag-and-drop server controls, and automatic deployment are just a few of the features this powerful tool provides.

- *Power and Flexibility* - Because ASP.NET is based on the common language runtime, the power and flexibility of that entire platform is available to Web application developers. The .NET Framework class library, Messaging, and Data Access solutions are all seamlessly accessible from the Web. ASP.NET is also language-independent, so can choose the language that best applies to the application or partition the application across many languages. Further, common language runtime interoperability guarantees that the existing investment in COM-based development is preserved when migrating to ASP.NET.

- *Simplicity* - ASP.NET makes it easy to perform common tasks, from simple form submission and client authentication to deployment and site configuration. For example, the ASP.NET page framework allows to build user interfaces that cleanly separate application logic from presentation code and to handle events in a simple, Visual Basic - like forms processing model. Additionally, the common language runtime simplifies development, with managed code services such as automatic reference counting and garbage collection.

- *Manageability* - ASP.NET employs a text-based, hierarchical configuration system, which simplifies applying settings to the server environment and

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Web applications. Because configuration information is stored as plain text, new settings may be applied without the aid of local administration tools. This "zero local administration" philosophy extends to deploying ASP.NET Framework applications as well. An ASP.NET Framework application is deployed to a server simply by copying the necessary files to the server. No server restart is required, even to deploy or replace running compiled code.

- *Scalability and Availability* - ASP.NET has been designed with scalability in mind, with features specifically tailored to improve performance in clustered and multiprocessor environments. Further, processes are closely monitored and managed by the ASP.NET runtime, so that if one misbehaves (leaks, deadlocks), a new process can be created in its place, which helps keep the application constantly available to handle requests.

- *Customizability and Extensibility* - ASP.NET delivers a well-factored architecture that allows developers to "plug-in" their code at the appropriate level. In fact, it is possible to extend or replace any subcomponent of the ASP.NET runtime with own custom-written component. Implementing custom authentication or state services has never been easier.

- *Security* - With built in Windows authentication and per-application configuration, the applications can be assured that are secure.

2.10.4.2   *Common Gateway Interface (CGI)*

The common gateway interface (CGI) is a standard way for a Web server to pass a Web user's request to an application program and to receive data back to forward to the user. When the user requests a Web page (for example, by clicking on a highlighted word or entering a Web site address), the server sends back the requested page. However, when a user fills out a form on a Web page and sends it in, it usually needs to be processed by an application program. The Web server typically passes the form information to a small application program that processes the data and may send back a confirmation message. This method or convention for passing data back and forth between the server and the application is called the common gateway interface (CGI). It is part of the Web's Hypertext Transfer Protocol (HTTP).

Any script can be called a CGI script as long as it is installed on the server end. The majority of CGI scripts are written in Perl, with C or C++ and Java being the next most common. CGI is installed on the server end that makes it able to do things such as submit a form, create a guest book or forum, keep track of and rotate advertisements, and much more.

The server also has the capability to redirect data to any email address, persist data, dynamically serve out different content to the browser, among many other things that the browser alone simply cannot do.

2.10.4.3 *VBScript*

VBScript is Microsoft's scripting language for the Internet. VBScript has been designed to leverage the skills of millions of Visual Basic programmers to the Internet. VBScript can be used to easily create active Web pages. VBScript code is lightweight, fast, and has been optimized to be transmitted via the Internet. Since VBScript is supported by Microsoft, in the near future a great deal of VBScript/ Windows NT/ 95/ MSOfficeBackoffice integration will be seen. The main features of VBScript are as below:

- On the client side, there is the opportunity to interact with ActiveX controls to provide active and interesting content.

- On the server side, the integration with ASP and other components enable to create dynamic pages.

- There are a number of conversion functions that are supported in VBScript. The most glaring omission is the Format command.

- There is no intrinsic data types are found in VBScript. The only data type available is the Variant, which makes complete sense considering that VBScript is an OLE-implemented language. All passing of values between OLE objects is performed through Variant variables.

- The array handling in VBScript is very useful to change the base of an array variable for a specific implementation. In VBScript, all arrays must have a lower bound of zero.

2.10.4.4 *JavaScript*

JavaScript was developed by Netscape and soon modified and renames in order to tap into the Java craze that was sweeping the Internet. Netscape offered JavaScript as a much simpler way of bringing interactivity to a web page. The JavaScript features and limitations are including:

- JavaScript supports distributed processing by enabling various tasks to be performed on the client rather than on the server. A client-side scripting language such as JavaScript is ideal for performing simple operations that do not require access to information on a remote server.

- Various browser objects can easily be manipulated with JavaScript. When a user moves the mouse pointer over a hypertext link, for example, you can use JavaScript to display the URL's description on the status bar of the browser.

- By looking at the code of a JavaScript enhanced page, nonprogrammers could easily plagiarize an entire JavaScript applet and enhance web pages with a simple cut and paste.

- The most important limitation of JavaScript is it cannot write a file to the web server's hard disk.

- Another disadvantage of JavaScript is that there is not any compliant database. Data are stored in arrays as a replacement to database file.

2.10.4.5   *Hypertext Markup Language*

Hypertext Markup Language (HTML) is a language of the World Wide Web that can create Web pages with colours, test formatting, hypertext links and image. It is a simple and powerful markup language that able to generate platform-independent hypertext documents and viewable by any Web browser.

An HTML document contains both document content and tags. The document content consists of all the information actually appearing on the computer screen. The tags are the HTML codes inserted in a document that specify how a complete document or portion of it should be formatted and arranged onscreen. Since the HTML code defines the structure and formatting of a Web page, but a page may look different in two different browsers. There are a fairly large number of tags defined for HTML.

Due to the fact that HTML could not provide the real programming power for Web programmers, many alternatives such as JavaScript and VBScript are used for builds dynamic interaction and content. They are used to complement HTML.

2.11 SUMMARY

Literature review is an important approach to search and gather system requirements and relevant information. Initially, the Fact Finding Techniques topic elaborates the methods being used during conducting the researches. Then, the concepts and theory of the relevant topics were being studied and optimised the understanding. The topics are includes Intranet, intranet, extranet, electronic procurement, .NET technology and etc. Several case studies were being done to achieve some guidelines in developing the application models and requirements of the system. Finally, information of the development tools and languages were collected and compared.

CHAPTER 3 METHODOLOGY

3.1 PROJECT DEVELOPMENT METHODOLOGY

A system development methodology or also known as process model is an essential element that must include in software engineering. It shows the way in applying the set of software process activities and associated results towards produce a software product. It defines the stages of a system development project, specifies the task to be carried in and out, and the output is expected from each stage. Methodology provides guidelines for project management and control, and backed by a philosophy on its approach towards system development.

In the development of Procurement System for a clinic group, synthesis of the Unified Process development models has been identified as methodology to be used for the object-oriented approach's web-based application development.

3.2 UNDERSTANDING THE UNIFIED PROCESS

The Unified Process (UP) is a use-case-driven, architecture-centric, iterative and incremental development process framework that leverages the Object Management Group's (OMG) Unified Modeling Language (UML) and is compliant with the OMG's SPEM. The UP is broadly applicable to different types of software systems, including small-scale and large-scale projects having various degrees of

managerial and technical complexity, across different application domains and organizational cultures.

The UP is an "idea," a process framework that provides an infrastructure for executing projects but not all of the details required for executing projects; essentially, it is a software development process framework, a lifecycle model involving context, collaborations, and interactions.

3.2.1 The Unified Modeling Language (UML)

The Unified Modeling Language (UML) is an evolutionary general-purpose, broadly applicable, tool-supported, and industry-standardized modeling language or collection of modeling techniques for specifying, visualizing, constructing, and documenting the artifacts of a systemintensive process. The UML is broadly applicable to different types of systems (software and non-software), domains (business versus software), and methods and processes. The UML enables and promotes (but does not require nor mandate) a use-case-driven, architecture-centric, iterative and incremental process.

3.2.2 System Development, Systems, Models and Views

The system development lifecycle process involves a problem-solving process at a macro-level and the scientific method at a micro-level. Requirements may be characterized as problems. Systems that address requirements may be characterized as solutions. Problem solving involves understanding or

conceptualizing the problem or requirements by representing and interpreting the problem, solving the problem by manipulating the representation of the problem to derive or specify a representation of the solution, and implementing or realizing and constructing the solution or system that addresses the requirements by mapping the representation of the solution onto the solution world. Within each problem-solving step, the scientific method involves planning or predicting a hypothesis, executing or empirically testing the hypothesis, evaluating the hypothesis against the results, and deriving a conclusion that is used to update the hypothesis. These macro-level and micro-level processes are very natural and often occur subtly and sometimes unconsciously in system development.

The UML facilitates and enables the problem-solving process. It facilitates specifying, visualizing, understanding, and documenting the problem or requirements; capturing, communicating, and leveraging strategic, tactical, and operational knowledge in solving the problem; and specifying, visualizing, constructing, and documenting the solution or system that satisfies the requirements. It enables capturing, communicating, and leveraging knowledge concerning systems using models, architectural views, and diagrams.

A system is a purposefully organized collection of elements or units. The architecture of a system entails two dimensions, the structural dimension and behavioral dimension, within its context. The structural or static dimension involves what elements constitute the system and their relationships. The behavioral

or dynamic dimension involves how these elements collaborate and interact to satisfy the purpose of the system and provide its functionality or behavior.

A model is a complete abstraction of a system that captures knowledge (semantics) about a problem and solution. An architectural view is an abstraction of a model that organizes knowledge in accordance with guidelines expressing idioms of usage. A diagram is a graphical projection of sets of model elements that depicts knowledge (syntax) about problems and solutions for communication. Within the fundamental UML notation, concepts are depicted as symbols and relationships among concepts are depicted as paths (lines) connecting symbols.

3.2.3 Methodologies and Process Frameworks

A program is a collection or portfolio of projects. A project is a specific problem-solving effort that formalizes the "work hard and hope for the best" approach. A method specifies or suggests how to conduct a project. A method's descriptive aspect specifies or suggests what knowledge is captured and communicated regarding a problem and solution. A method's prescriptive aspect specifies or suggests how knowledge is leveraged to solve the problem. A process is the execution of a method on a project.

A methodology is a discipline or taxonomy, or well-organized collection, of related methods that addresses who does what activities on what work products, including when, how, why, and where such activities should be done. Workers (who), activities (how), work products (what), and the heuristics concerning them

are commonly known as process elements. Methodologies group methods as a family, methods describe processes, and processes execute methods on projects.

To provide more flexibility and scalability to address increasingly more diverse problems, where applying a single method may be insufficient and applying a whole methodology may be impractical, a subset of a whole methodology may be applied where the methodology is called a process framework and the actual subset of all of its methods that are applied on a specific project is called a process instance.

A process framework specifies or suggests who does what activities on what work products, including when, how, why, and where such activities should be done for various types of projects. A process instance specifies or suggests who does what activities on what work products, including when, how, why, and where such activities should be done for a specific project. Process frameworks describe process instances as a more flexible and scaleable family of related processes, and process instances execute a subset of a process framework on projects.

The UP is a process framework and Development Cases are process instances.

3.3 THE UNIFIED PROCESS (UP)

To effectively and successfully apply the UP, we must understand collaborations, contexts, and interactions. As an effort or project leverages the UP, collaborations focus on the elements of the project, context focuses on the process framework for the project, and interactions focus on the execution of the project. Figure 3.1 shows the various elements of the UP.
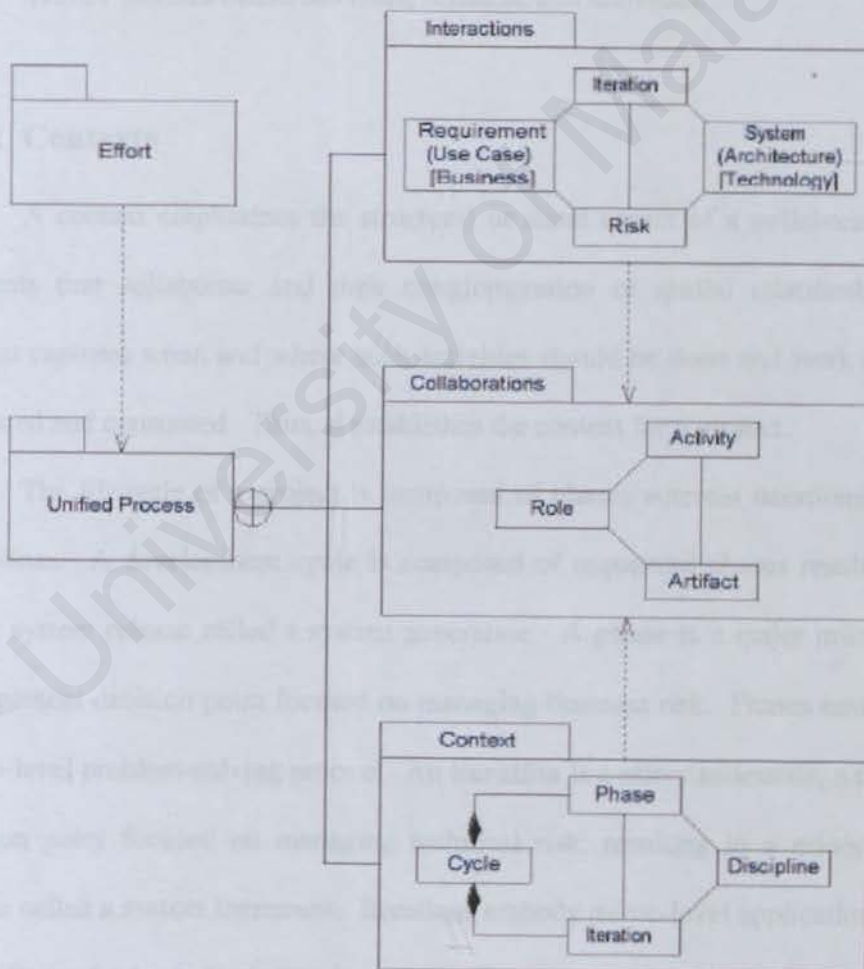

Figure 3.1 Elements of the Unified Process (UP)

3.3.1 Collaborations

A collaboration involves an interaction within a context. A collaboration captures who does what activities (how) on what work products. Thus, it establishes the elements of a project. A **role** is an individual or team who has responsibility for activities and artifacts. An **activity** is a unit of work, composed of steps, that is performed by a role. An **artifact** is an element of information that is the responsibility of a role and that is produced or consumed by activities.

The UP defines numerous roles, artifacts, and activities.

3.3.2 Contexts

A context emphasizes the structural or static aspect of a collaboration, the elements that collaborate and their conglomeration or spatial relationships. A context captures when and where such activities should be done and work products produced and consumed. Thus, it establishes the context for a project.

The lifecycle of a project is composed of phases wherein iterations involve disciplines. A development cycle is composed of sequential phases resulting in a major system release called a system generation. A **phase** is a major milestone, a management decision point focused on managing business risk. Phases embody the macro-level problem-solving process. An **iteration** is a minor milestone, a technical decision point focused on managing technical risk, resulting in a minor system release called a system increment. Iterations embody micro-level applications of the scientific method. A **discipline** is an area of concern or theme wherein workflows

describe the flow of work and wherein workflow details describe the collection of activities (with their associated roles and artifacts) often done together.

The UP defines the following four phases:

- The Inception phase, concluding with the Objective milestone, focuses on establishing the project's scope and vision.

- The Elaboration phase, concluding with the Architecture milestone, focuses on establishing the system's requirements and architecture.

- The Construction phase, concluding with the Initial Operational Capability milestone, focuses on completing construction or building of the system.

- The Transition phase, concluding with the Product Release milestone, focuses on completing transitioning or deployment of the system to the user community.

The UP defines the following three supporting disciplines:

- The Configuration & Change Management discipline focuses on managing the configuration of the system and change requests.
- The Project Management discipline focuses on managing the project.
- The Environment discipline focuses on the environment for the project, including the process and tools.

The UP defines the following six core disciplines:

- ❖ The Business Modeling discipline focuses on understanding the business being automated by the system and capturing such knowledge in a Business model.

- ❖ The Requirements discipline focuses on understanding the requirements of the system that automates the business and capturing such knowledge in a Use-case model.

- ❖ The Analysis & Design discipline focuses on analyzing the requirements and designing the system and capturing such knowledge in an Analysis/Design model.

- ❖ The Implementation discipline focuses on implementing the system based on the Implementation model.

- ❖ The Test discipline focuses on testing (evaluating) the system against the requirements based on the Test model.

- ❖ The Deployment discipline focuses on deploying the system based on the Deployment model.

The distribution of effort across phases, iterations, and disciplines focuses on addressing business and technical risks.

- During the Inception phase, most of the effort is distributed across the Business Modeling and Requirements disciplines.

- During the Elaboration phase, most of the effort is distributed across the Requirements, Analysis & Design, and Implementation disciplines.

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- During the Construction phase, most of the effort is distributed across the Analysis & Design, Implementation, and Test disciplines.

- During the Transition phase, most of the effort is distributed across the Test and Deployment disciplines.

The supporting disciplines are generally distributed throughout the four phases. The overall objective is to produce the resulting system; therefore, all of the core disciplines are engaged as soon as possible without introducing risk to the project.

3.3.3 Interactions

An interaction emphasizes the behavioral or dynamic aspect of a collaboration, the elements that collaborate and their cooperation or temporal communication. An interaction captures when and why such activities should be done and work products produced and consumed. Thus, it establishes the execution of a project as it is governed by various forces.

As minor milestones occur within major milestones, technical decision points occur within management decision points such as to align technical tactics and operations with business strategy and objectives -- essentially, establishing a bridge between business and technical forces.

An **iteration** is a step or leg along a path or route to a destination. An iteration is planned and is not ad hoc, has evaluation criteria, and results in

demonstrable progress. An iteration is iterative in that it is repetitive and involves work and rework, incremental in that it is additive and involves more than rework alone, and parallel in that work may be concurrent within the iteration.

A **use-case** is a functional requirement. For example, functionality to login or logout of a system, input data, process the data, generate reports, and so forth. As the UP is use-case driven, use cases drive or feed iterations. That is, iterations are planned and evaluated against "chunks" of functionality (or parts thereof) such as to manage agreement with users and trace project activities and artifacts back to requirements. Non-functional requirements (usability, reliability, performance, and other such characteristics) are incrementally considered as use cases evolve through the disciplines.

A system has an **architecture**. For example, the architecture of a system includes a collection of elements and how they collaborate and interact, including various subsystems for handling security, input and output, data storage, external communications, reporting, and so forth. As the UP is architecture-centric, iterations focus on architecture and evolving the system. That is, iterations demonstrate progress by evolving a puzzle of "chunks" such as to manage the complexity and integrity of the system.

A **risk** is an obstacle to success, including human, business, and technical concerns or issues. As the UP is risk-confronting, iterations confront risk and leverage feedback from previous iterations to confirm progress and discover other

unknown risks. That is, iterations confront risk that is derived from use cases and architecture such as to achieve project success, thus reconciling business and technical forces.

An iteration is a time-box with a fixed beginning and end wherein a collection of collaborations are planned, executed, and assessed in order to progressively demonstrate progress. The beginning and end are negotiated among stakeholders, management and technical members of the project community who impact and are impacted by the effort. Use cases that feed an iteration are selected based on the highest risks they confront. A use case may evolve across any number of iterations and may evolve through any number of core disciplines in an iteration. An iteration results in a single internal or external baselined and evaluated release of the system. The feedback and lessons-learned gained from an iteration feed into future iterations. The duration of an iteration is inversely proportional to the level of risk associated with the effort. Development cycles and phases may also be time-boxed; as development cycles, phases, and iterations are planned, the further the plans are in the future, the less accurate the estimates.

CHAPTER 4   SYSTEM ANALYSIS

4.1   THE UNIFIED MODELING LANGUAGE (UML)

The Unified Modeling Language (UML) is an evolutionary general-purpose, broadly applicable, tool-supported, and industry-standardized modeling language or collection of modeling techniques for specifying, visualizing, constructing, and documenting the artifacts of a system-intensive process. The UML is broadly applicable to different types of systems (software and non-software), domains (business versus software), and methods and processes. The UML enables and promotes (but does not require nor mandate) a use-case-driven, architecture-centric, iterative and incremental process.

4.1.1 Use Case

A use case describes a set of sequences of actions that a system performs, which yield an observable result of value to an actor (a user or another system) to achieve a certain goal. A use good use case is expressed from the viewpoint of the actor, in present tense and active voice. A use case should describe one aspect of usage of the system without presuming any specific design or implementation. In other words, a use case describes *what* the system needs to do without specifying *how* the system will perform.

These sequences of actions are in effect system behaviors that represent functional requirements of the system as a whole. Therefore, use cases are useful in generating functional requirements.

A use case is given a brief name seen from the viewpoint of the associated actors. The documentation of a use case typically includes:

- Brief description on what the use case does.

- Main flow of events to specify the sequence of actions performed.

- Alternate flow of events to specify what happens if some variants, or errors, are encountered.

- Pre-conditions that must be satisfied on starting the use case.

- Post-conditions that must be satisfied at the end of the use case, regardless of which flow of events is followed.

- Special requirements for other requirements, limitations and annotations.

A use case is represented graphically by an ellipse with a short name that contains an active verb and (usually) a noun phrase.

4.1.2 Actor

An actor is a coherent set of roles that interact with use cases. It represents one of two things:

- A role that user can play with regard to a system

- An entity, such as another system or a database, that resides outside the system

An actor is represented graphically by a stick man figure with a short descriptive name.

Figure 4.1 shows an example of an actor called Vendor interacting with a use case called Send Delivery Order. The arrow shows that the actor initiates the use case.

Vendor   Send Delivery Order
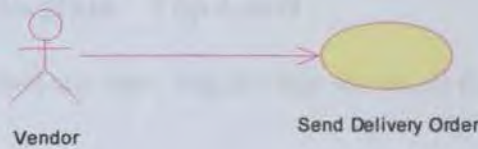
Figure 4.1 Use Case Example

4.2   ACTOR LISTING

All actors that interact with a system need to be identified first. Each actor needs to be defined unambiguously. Table 4.1 identifies the actors of Procurement System for a Clinic Group (PSCG).

Actor	Description
Vendor	Registered user of the system who can make online tendering with the clinic group
Administrative Staff	The system administrator of PSCG who updates the database system and handles online tendering

Table 4.1 Actors in the PSCG

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4.3 USE CASE DIAGRAMS

Functional requirements are best expressed in use case diagrams. This section shows use case diagrams for all the actors. A summary of all the functional requirements will be presented in the next section.

4.3.1 Use Case Diagram - Top Level

Figure 4.2 is a top-level use case diagram that shows all the actors interacting with PSCG.
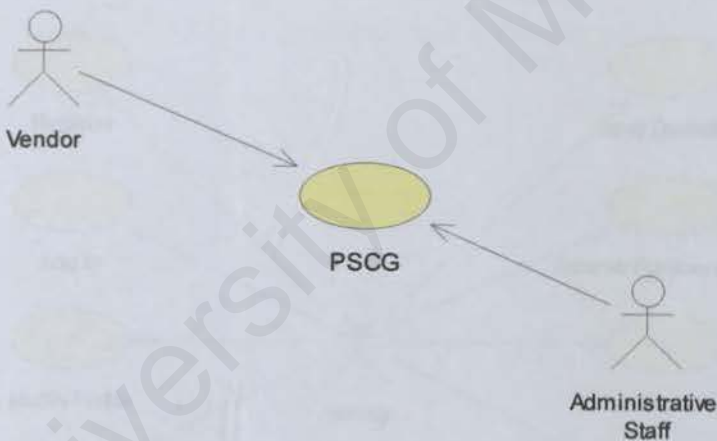
Figure 4.2 PSCG Top Level Use Case Diagram

4.3.2 Use Case Diagram - Vendor

A Vendor can carry out the following task with PSCG:

➤ Register: Register as official vendor to use the system

➤ Log In: Log into the system

➢ Modify Profile: Change information in the user profile

➢ View Request for Quotation: View information about bid items offered by the clinic group

➢ Send Quotation: Generate and send online quotation

➢ Receive Purchase Order (PO): Receive and view online PO

➢ Send Invoice: Generate and send online invoice

➢ Log Out: Log out of the system
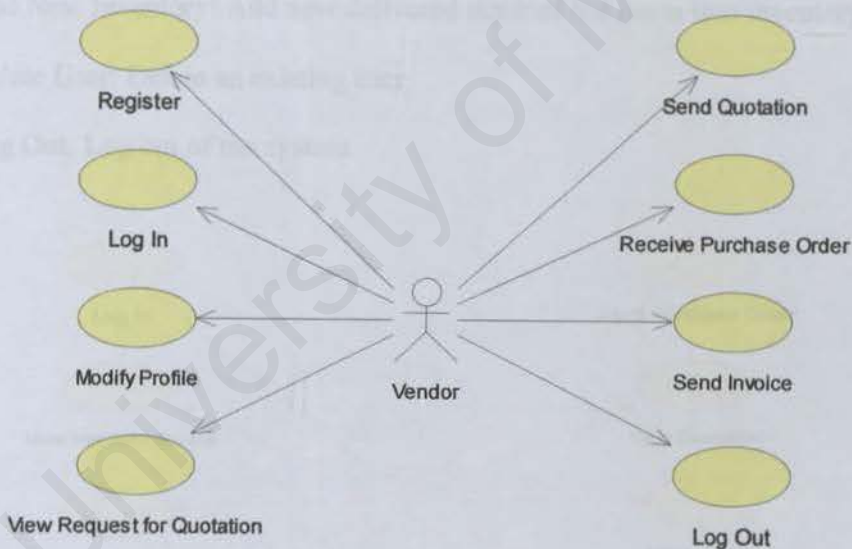
Figure 4.3 Use Case Diagram - Vendor

4.3.3 Use Case Diagram - Administrative Staff

An Administrative Staff can carry out the following task with PSCG:

- ➤ Log In: Log into the system

- ➤ View Vendors' Profile: View information about registered vendors

- ➤ Add Request For Quotation (RFQ): Upload, update and delete the latest tender information about RFQ online

- ➤ Send Purchase Order (PO): Generate and send online PO to vendor

- ➤ View Quotation: Receive and view online quotation sent by vendor

- ➤ View Invoice: Receive and view online invoice sent by vendor

- ➤ Add New Inventory: Add new delivered stock of bid items into inventory

- ➤ Delete User: Delete an existing user

- ➤ Log Out: Log out of the system
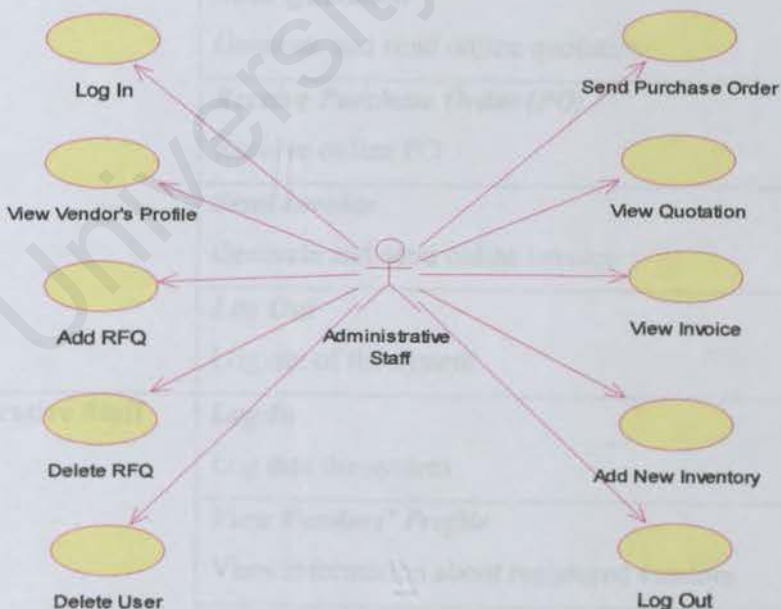
Figure 4.4 Use Case Diagram - Administrative Staff

4.4 FUNCTIONAL REQUIREMENTS

Functional requirements have been derived from the use case diagrams shown in previous section. Table 4.2 is a summary of all the requirements.

Actor	Use Case
Vendor	*Register* Register as official vendor to use the system
	Log In Log into the system
	Modify Profile Change information in the user profile
	View Request for Quotation View information about bid items offered by the clinic group
	Send Quotation Generate and send online quotation
	Receive Purchase Order (PO) Receive online PO
	Send Invoice Generate and send online invoice
	Log Out Log out of the system
Administrative Staff	*Log In* Log into the system
	View Vendors' Profile View information about registered vendors
	Add Request For Quotation (RFQ) Upload the latest tender information about RFQ online

Update RFQ	
Update (add or delete) the latest bid items on RFQ	
Send Purchase Order (PO)	
Generate and send online PO to vendor	
View Quotation	
Receive and view online quotation sent by vendor	
View Invoice	
Receive and view online invoice sent by vendor	
Add New Inventory	
Add new delivered stock of bid items into inventory	
Delete User	
Delete an existing user	
Log Out	
Log out of the system	

Table 4.2 Summary of Functional Requirements

4.5 NON-FUNCTIONAL REQUIREMENTS

Non-functional requirements are those constraints placed on the services or functions offered by the system (for instance, the required response time), or on the development process (such as the use of a specific language standard). These are important to ensure the quality of the system.

⬇ Flexibility

The system should have the capability to take advantage of the new technologies and resources. The system should be able to adapt and implement in the changing environment.

⬇ Reliability

A system is said to have reliability if it does not produce dangerous or costly failures when it is used in a reasonable manner. The system should be reliable in perform its intended functions and operations accurately. For example, whenever a button is clicked, the system should able to respond and execute particular function accordingly such as generate some messages to inform the user what is happening.

⬇ Usability

The system should be developed in such a way that it is easy to use. It should be able to enhance and support rather than restrict the processes. Besides, the interface should be self-explanatory and consistent with other application in the system environment.

🔸 User friendliness

A good flow of navigation is important to help and guide users on navigating with little effort through hyperlinks and procedure steps. Good interface is able to improve interaction between the users and the system.

🔸 Efficiency

The system should be called or accessed in an unlimited number time to produce expected outcome or output at a creditable pace or speed.

🔸 Manageability

The system should be easy to manage and handle to ensure that maintenance can be done regularly. Besides, it should enable the evolutionary of the system easy to be done and making the enhancement works simpler.

🔸 Robustness

Robustness refers to the quality that a system to handle or avoid disaster. The system should be able to continue implementing in spite of unexpected problems.

🔸 Correctness

The system should be built according to the user requirements and specifications. It must meet its objectives and mission.

Modularity

Modularity is a key factor in good programming design. Program is broken into several sections that isolated from one another that each performs distinct functions. This characteristic will make testing and maintenance much more easier.

Maintainability

The system where the software should be able to be understood, corrected, adapted and allow enhanced in the future.

Expandability

The degree to where the architectural, data, or procedural design can be extended.

Security

The system should involve the capability in performing authentication and authorisation of valid users. The system should mandate a user to input a username and password before being allowed access into the system. This is important to provide security characteristic to privacy and confidential data, in order to avoid improper admission of eavesdroppers or hackers to the system.

4.6   ANALYSIS OF TECHNOLOGICAL REQUIREMENTS

Analysis of current technologies and development tools is essential for deciding the appropriate requirements that support the implementation of Procurement System.   There were many types of technologies available in the market. Following the programming languages, development tools and technologies are chosen based on their ability to meet the stated requirements.

4.6.1 Development Platform

Microsoft® Windows 2000

Procurement System is a web-based application that relies heavily on the server technologies used. Microsoft Windows 2000 Professional is chosen as to be the foundation of other required servers. The reasons of choosing Windows 2000 Professional are because of:

- **Value.**   Windows 2000 can help users reduce costs through improved management and increase productivity through improved reliability and ease of use.

- **Reliability.** The average system uptime of Windows 2000 was over 50 times that of Windows 98 and 17 times that of Windows NT Workstation 4.0.

- **Manageability.** Windows 2000 is easier to deploy, manage, and support. Centralized management utilities, troubleshooting tools, and support for self-healing applications all make it simpler for administrators and users to deploy and manage desktop and laptop computers.

✦ **Security.** Windows 2000 provides comprehensive security features to protect sensitive business data, both locally on desktop computer and as it is being transmitted over local area network, phone lines, or the Internet.

✦ **Usability.** Windows 2000 combines the power and security of its predecessor, Windows NT Workstation, with the traditional ease of Windows 98. It also provides more wizards, a centralized location for common tasks, and menus that adapt to the way they work.

✦ **Data Access.** When user uses Windows 2000 in conjunction with Windows 2000 Professional, user can take advantage of IntelliMirror technologies. By letting user store their important information and desktop settings on a central computer, IntelliMirror lets them work on any computer attach to their network as they are at their own desk.

4.6.2 Database Management System

Microsoft SQL Server 2000

Microsoft SQL Server 2000 builds on and extends the performance, reliability, quality, and ease of use of SQL Server version 7.0. It also includes a number of new features that further establish SQL Server as the best database platform for OLTP, data warehousing, and e-commerce applications. There are several key reasons SQL Server 2000 has been chosen as the database management system as follows:

✦ SQL Server is a high-performance relational database system that is tightly integrated with the Windows NT and Windows 2000 operating systems.

- Enhance of architecture by utilizes database and transaction files at the operating system level and provides dynamic sizing for databases and transaction logs.

- Lesser amount of time required to administer SQL Server.

- SQL Server provides very advanced security features.

4.6.3 Web Server Technology

Microsoft® Internet Information Server 5 (IIS)

Microsoft Internet Information Server (IIS) has been selected as the Web server software of this project because it is a high-end enterprise-level server. It has been proved as powerful, and easier to set up and maintain than many of its UNIX-based server.

IIS offers a superb platform for building sophisticated Internet applications. Its tight integration with Windows 2000 Professional provides powerful security, administration and development functionality.

IIS provides some beneficial features as below:

- Easy installation and uninstall on the existing hardware with graphical setup.

- Flexible since Windows 2000 Professional runs on thousands of standard hardware platforms.

- Accessible since all kinds of browsers can work with it.

- Virtual server support optimized hardware and allows for hosting multiple sites.

- Integration with Windows NT built-in security provides capabilities for secure transactions with the SSL (Secure Sockets Layer) support and for authentication.

- Windows-based Web authoring and development tools are supported.

- Integration with existing industry-standard database such as Microsoft SQL Server, Microsoft Access, Oracle, Informix, Sybase and other ODBC-compliant databases.

- Indexing of HTML pages and Microsoft Office documents with Index Server facility in IIS.

4.6.4 Web Development Technology

Active Server Page .NET (ASP.NET)

Active Server Pages .NET technology is chosen to provide the functionality for building dynamic and interactive web pages. It is chosen over other forms of scripting due to:

- **Easy Programming Model.** ASP.NET makes building real world Web applications dramatically easier. ASP.NET server controls enable an HTML-like style of declarative programming that let building great pages with far less code than with classic ASP. Displaying data, validating user input, and uploading files are all amazingly easy. Best of all, ASP.NET pages work in all browsers -- including Netscape, Opera, AOL, and Internet Explorer.

♣ **Flexible Language Options.** ASP.NET lets leveraging the current programming language skills. Unlike classic ASP, which supports only interpreted VBScript and JScript, ASP.NET now supports more than 25 .NET languages (including built-in support for VB.NET, C#, and JScript.NET -- no tool required), giving unprecendented flexibility in the choice of language.

♣ **Rich Class Framework.** Application features that used to be hard to implement, or required a 3rd-party component, can now be added in just a few lines of code using the .NET Framework. The .NET Framework offers over 4500 classes that encapsulate rich functionality like XML, data access, file upload, regular expressions, image generation, performance monitoring and logging, transactions, message queuing, SMTP mail, and more.

♣ **Compiled execution.** ASP.NET is much faster than classic ASP, while preserving the "just hit save" update model of ASP. ASP.NET will automatically detect any changes, dynamically compile the files if needed, and store the compiled results to reuse for subsequent requests. Dynamic compilation ensures that your application is always up to date, and compiled execution makes it fast.

VBScript

After considering several languages that are available in the market, VBScript seems to be the most desirable scripting language. This is because VBScript is the default scripting language for ASP.NET. Moreover, it is much easier to learn. VBScript is easy to implement as well as it does not require any additional software besides Windows 2000 Professional (or Windows NT) and Internet Information Server. VBScript is chosen as scripting language because:

- VBScript code is lightweight, fast, and has been optimized to be transmitted via the Internet.

- VBScript is supported by several other Web browsers in addition to Internet Explorer-specifically, browsers from Oracle, Spyglass, and Net Manage.

- VBScript is supported by Microsoft; in the near future, a great deal of VBScript/ Windows NT/95/ MSOfficeBackoffice integration will be seen.

HTML

HTML is simple yet powerful markup language used to generate independent hypertext documents that are viewable by a Web browser. It is very popular because of its simple syntax. HTML makes Web programming work easy and simple but to certain extent. There is no prior programming knowledge needed to learn HTML. Therefore, simple HTML pages can be developed almost immediate with access to word processing applications.

4.7 SYSTEM ARCHITECTURE

The following is Figure 4.6, which shows the 3-tier client/ server architecture
to be implemented in PSCG.
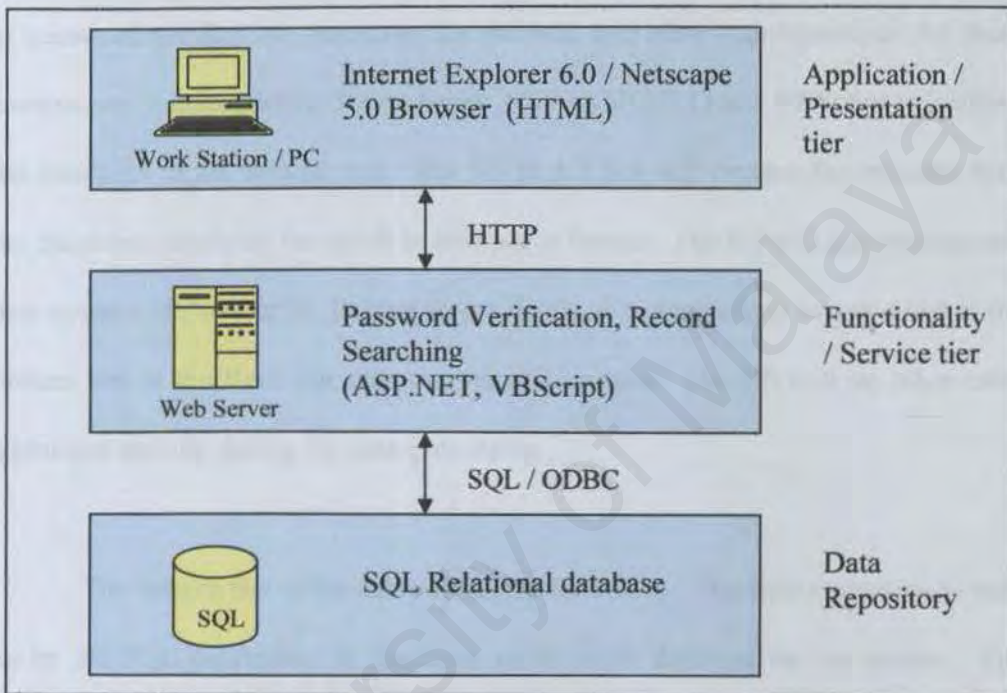
Figure 4.5 Three -Tier Client / Server Architecture

In PSCG, the application/ presentation tier consists of all the necessary
application. In this layer, the main application component that appears to the user is
the Web browser, which will provide the user interface. HTML are used to activate
the application layer. All of them provide the most flexible and dynamic interface
for the users. The application always resides within the web server, which is the
Internet Information Server (IIS) 5.0.

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The middle tier is known as the functionality of service tier. The communications between this tier and the application layer depends on the Hypertext Transfer Protocol (HTTP) for the web pages transfer. Then the functionality tier consists of the components that are created to support PSCG such as password verification, searching for records, and others configuration. All these components require Active Server pages .NET (ASP.NET) and VBScript to perform the functions in the web servers. The IIS in this tier will process the requests from the client and produces the result in web pages format. The IIS will also process any data request of the user by linking to the database server, which is contained at the bottom tier of the three-tier client/server architecture. The IIS will do other extra additional activity during the data processing.

The bottom tier is the data repository for PSCG. The data repository is built up by the SQL databases. It functions as the main database for the system. The components in the middle tier are connected with the SQL databases in the bottom tier through the combination of Structured Query Language and ODBC.

4.8 SOFTWARE SPECIFICATION

The software requirements prior to implementation of the system are show as the table below:

Software Component	Requirements
Operating System	Microsoft Windows 2000 Professional
Web Server	Microsoft Internet Information Server 5
Database Management System	Microsoft SQL Server 2000
Web Development Technology	Active Server Page .NET
Scripting Languages	VBScript, HTML
Web Browser	Microsoft Internet Explorer 6
MSDN Library	Microsoft Development Network

4.9 HARDWARE SPECIFICATION

Following are a few hardware specifications that are required to run this system:

Hardware Components	Requirements
Computer	Pentium 233 MHz processor and above
Memory	64 MB RAM or above
Hard disk space	4 GB or above
Others	Network connection

CHAPTER 5   SYSTEM DESIGN

5.1 INTRODUCTION

The goal of object-oriented design (OOD) is to design the classes identified during the analysis phase. OOD requires taking the objects identified during object-oriented analysis and designing classes to represent them. We identify and define additional objects and classes that support implementation of the requirements.

5.2 OBJECT

An object is simply a real-world thing or concept. There are three essential aspects of objects.

- ➤ An object has *identity*. This generally takes the form of a human-readable name, but an object can also be anonymous.

- ➤ An object has *state*. This includes the names of the various properties that describe the object (its **attributes**) and also the values of those attributes at some point in time.

- ➤ An object has *behavior*. This is represented by functions, referred to as **methods**, that use or change the values of the object's attributes.

5.3 CLASS

A class is a collection of objects that have the same characteristics. An object that belongs to a particular class is often referred to as an instance of that class. A class doesn't have state like an object. However, a class defines attributes that belong to each object of that class. A class defines behavior in terms of operations, as opposed to methods. An operation represents a service that an object can request to affect behavior; a method is an implementation of that service. Each operation of a given class is represented by at least one method within each of the objects belonging to that class.

In Unified Modeling Language (UML), the standard notation for a class is a rectangle with three compartments. The top compartment contains the name of the class. The middle compartment contains the attributes that belong to the class, and the bottom compartment contains the class's operations. A class can be shown with attributes and operations visible or hidden. Figure 5.1 below is an example of a User Account class. Notice that the *password* attribute of the User Account class has an associated data type (String), so as same with the other attributes.

```
              Vendor
         Vendor_ID
         Vendor_Name
         Vendor_Add
         Vendor_Postcode
         Vendor_City
         Vendor_Country
         Vendor_State
         Vendor_PhoneNo
         Vendor_Email
         Vendor_Status

         Register()
         Login()
         ViewRFQ()
         SendQuotation()
         ReceivePO()
         SendInvoice()
         EditProfile()
```
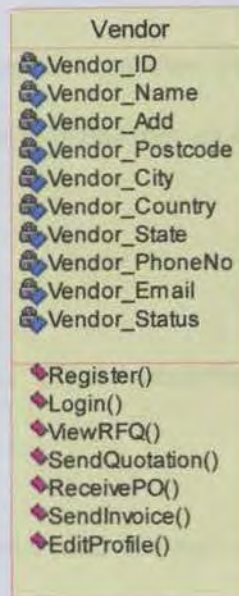
Figure 5.1 A Class Example

Classes have relationships among them.   There are three types of relationships, which are association, aggregation and generalization.

An association is a structural connection between classes. An association is assumed to be bi-directional, which means can be used to navigate from one object of the class to another object at another class.

 ➢ An association can have a name that indicates the nature of the relationship.

 ➢ An association can contain roles, which describes how a class participates in a relationship.

 ➢ An association can show multiplicity. This indicates how many objects are associated with each class can be presented within the association.

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Figure 5.2 shows an association between User Vendor Account class and Vendor class, in which one vendor owns only one user account.
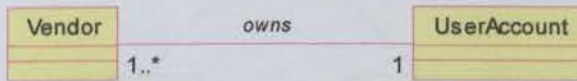
Figure 5.2 Class Association Example

An aggregation is a special kind of association – a "whole/part" relationship within which one or more smaller classes are "parts" of a larger "whole". Figure 5.3 shows that, a BidBoard class contains one or more Bid Item class (bid items).
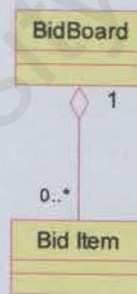
Figure 5.3 Class Aggregation Example

Generalization refers to a relationship between a general class (the superclass or parent) and one more specific version of that class (the subclass or child). Figure 5.4 is a class generalization example.

5.4 CLASS DIAGRAM

This section presents the static design view of the Procurement System for a Choic

Group (PSCG) by means of class d

Figure 5.4 Class Generalization Example

A class diagram which consisting of classes and their relationships, provides a static design view of the system, by putting all the classes and relationships together.

5.4 CLASS DIAGRAM

This section presents the static design view of the Procurement System for a Clinic
Group (PSCG) by means of class diagram.
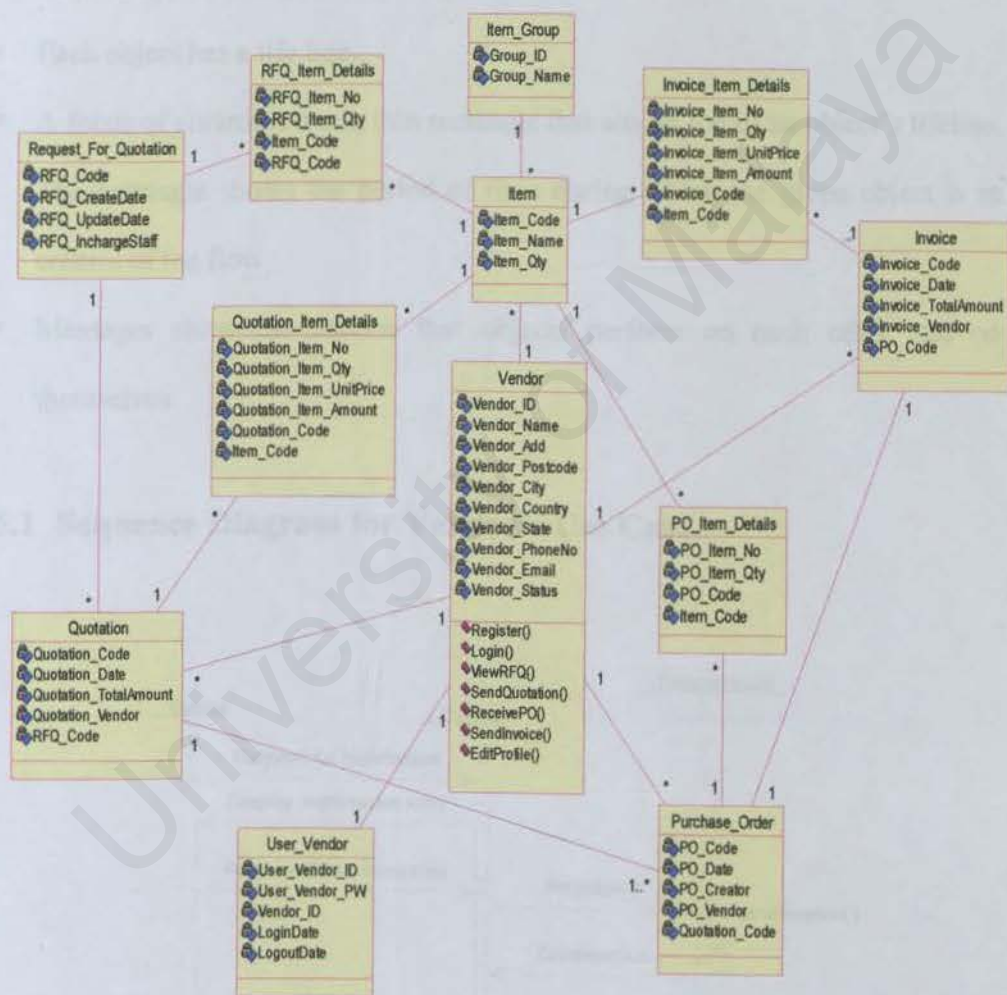
Figure 5.5 PSCG Class Diagram

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5.5 SEQUENCE DIAGRAM

The UML sequence diagram is a diagram that focuses on the time ordering of the messages that go back and forth between objects. A sequence diagram has four key elements:

- Objects appear along the top margin.

- Each object has a life line.

- A focus of control is a tall, thin rectangle that sits on top of an object's lifeline. The rectangle shows the period of time during which the given object is in control of the flow.

- Messages show the actions that objects perform on each other and on themselves.

5.5.1 Sequence Diagram for Vendor's Use Case
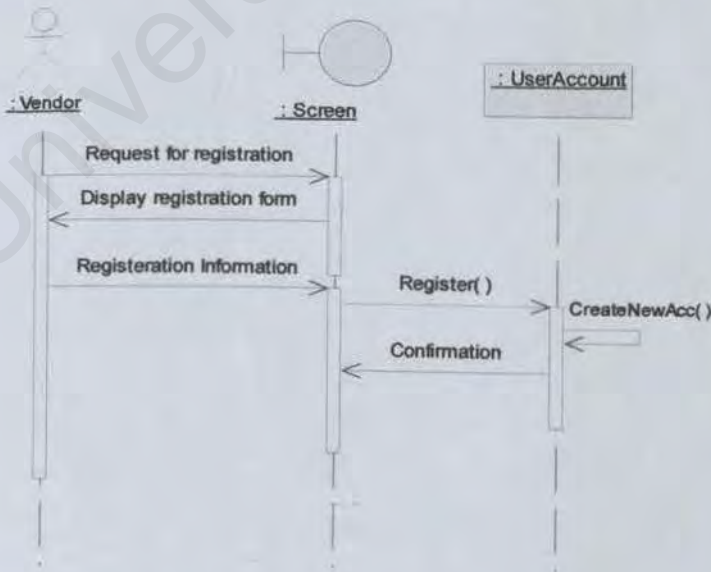
Figure 5.6 Sequence Diagram (Register)

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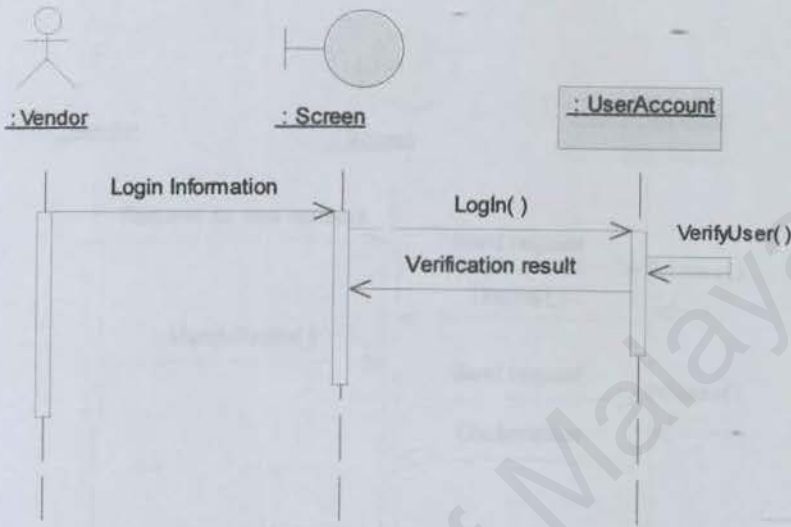
Figure 5.7 Sequence Diagram (Log In)
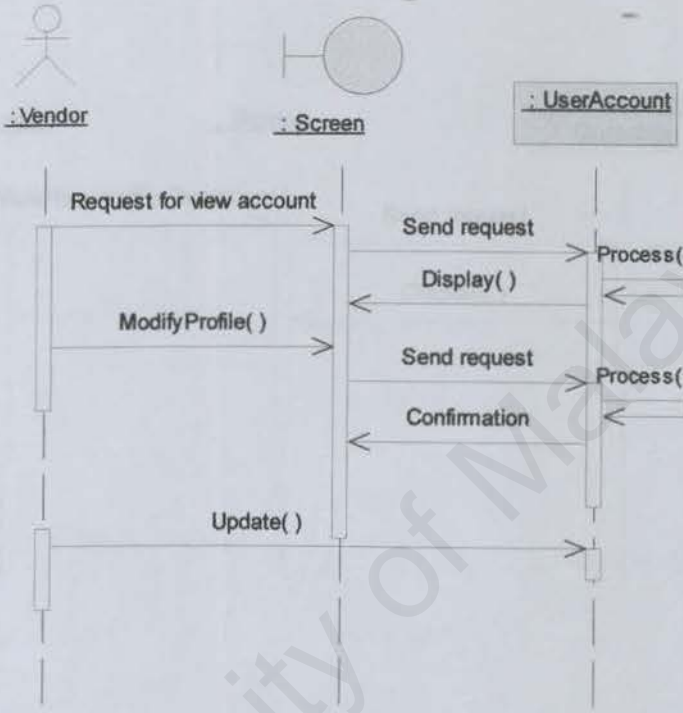
Figure 5.8 Sequence Diagram (Modify Profile)
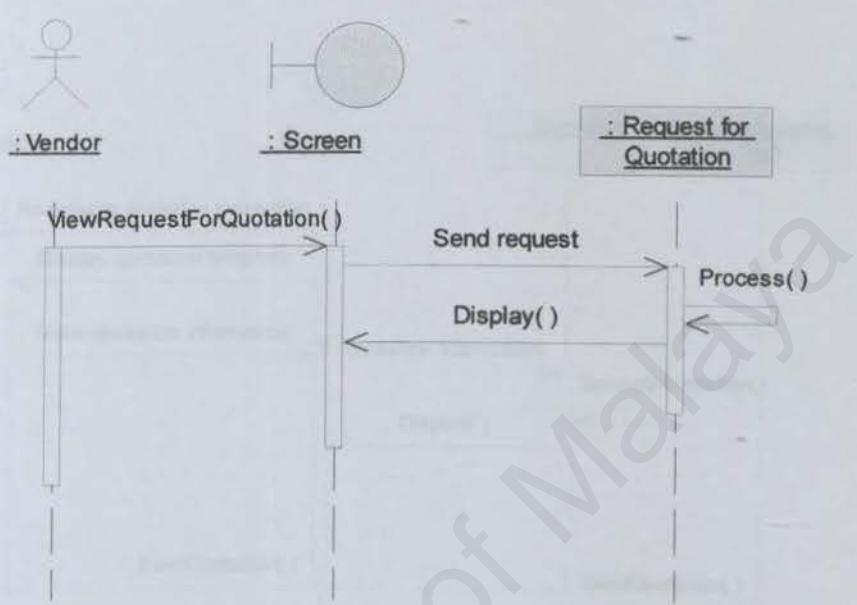
Figure 5.9 Sequence Diagram (View Request For Quotation (RFQ))
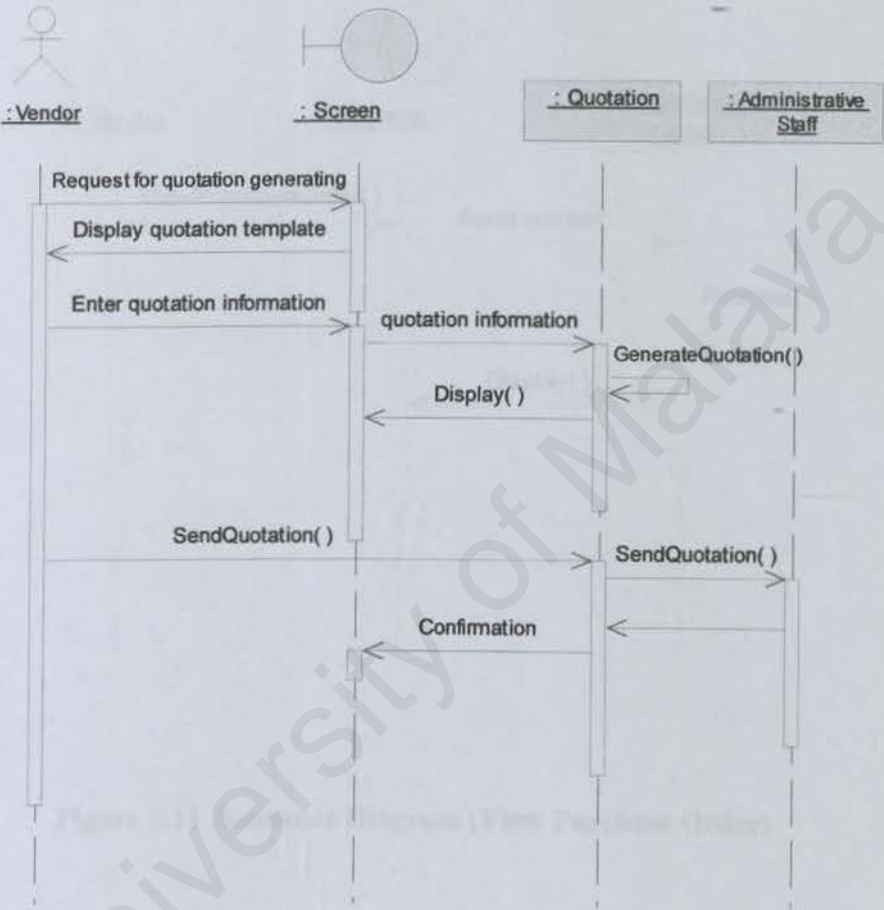
Figure 5.10 Sequence Diagram (Send Quotation)
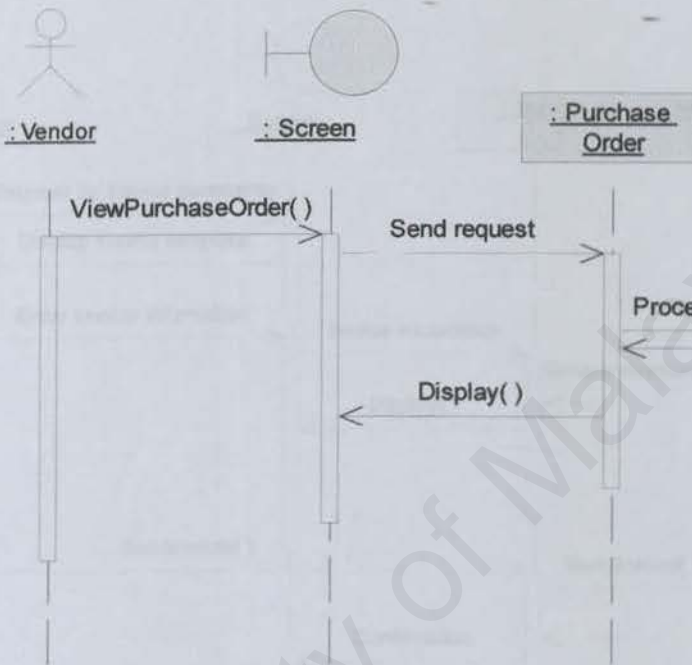
Figure 5.11 Sequence Diagram (View Purchase Order)
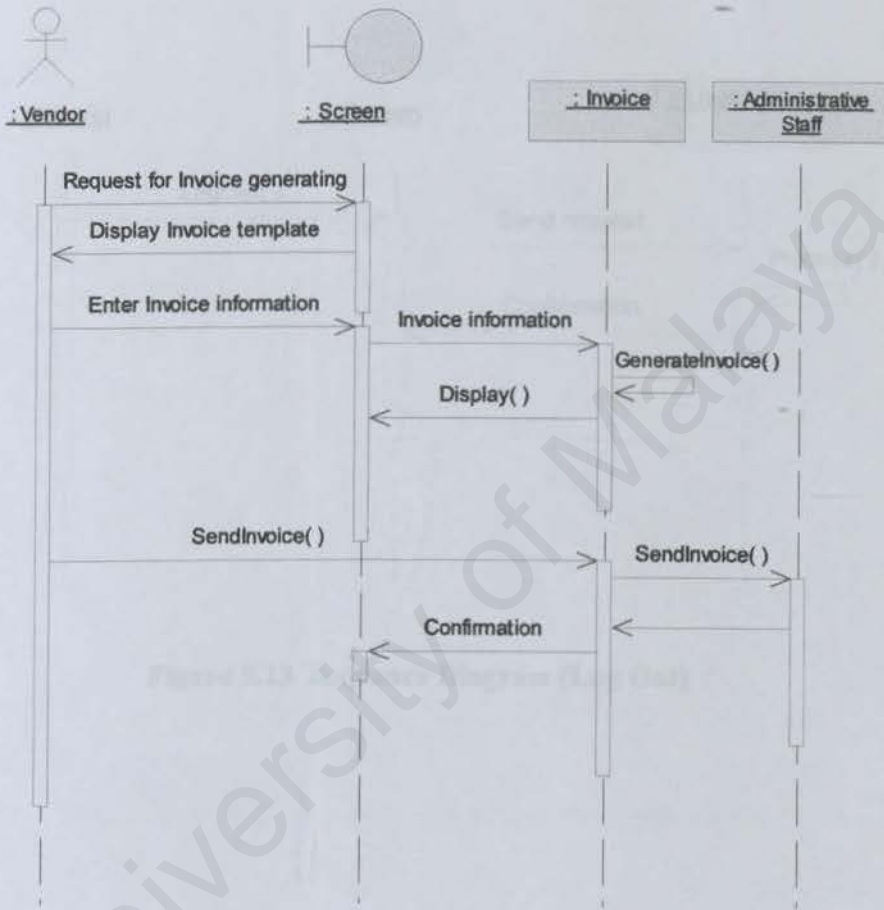
Figure 5.12 Sequence Diagram (Send Invoice)

Figure 5.13 Sequence Diagram (Log Out)

5.5.2 Sequence Diagram for Administrative Staff's Use Case
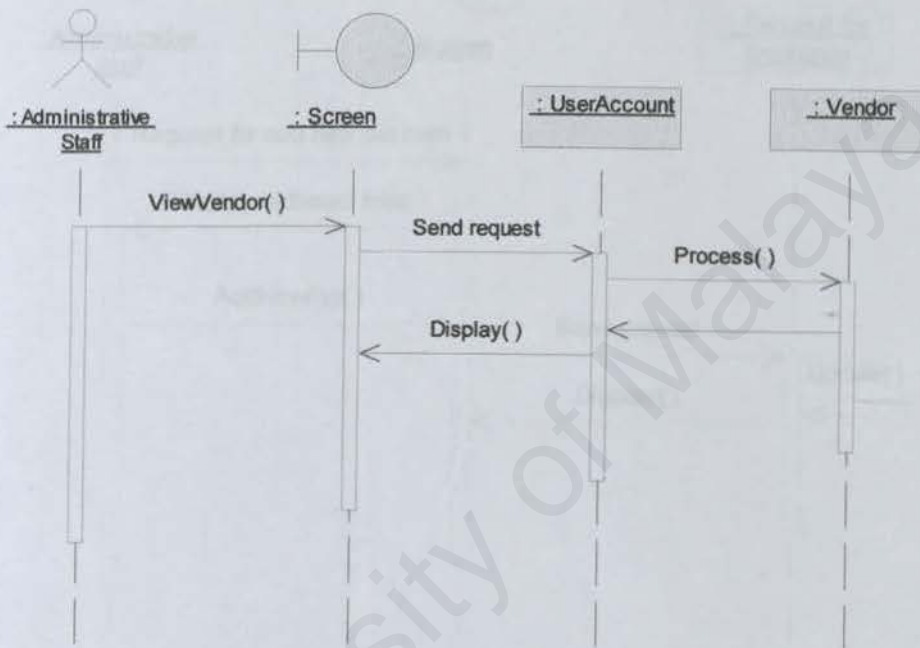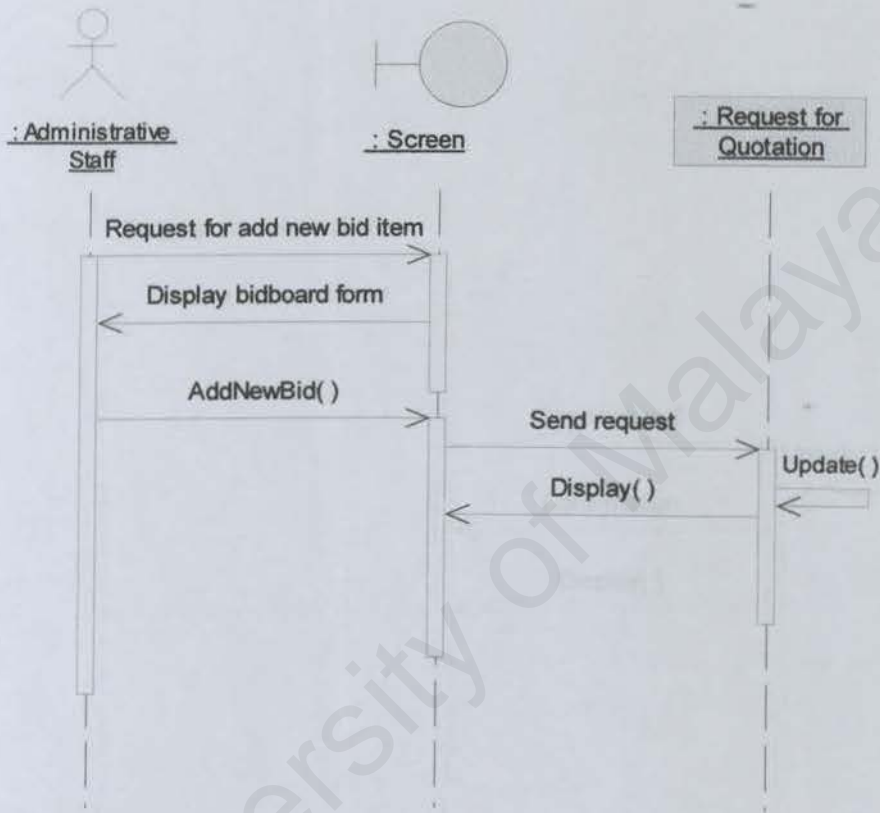

Figure 5.14 Sequence Diagram (View Vendors' Profile)

Figure 5.15 Sequence Diagram (Send Request For Quotation (RFQ))
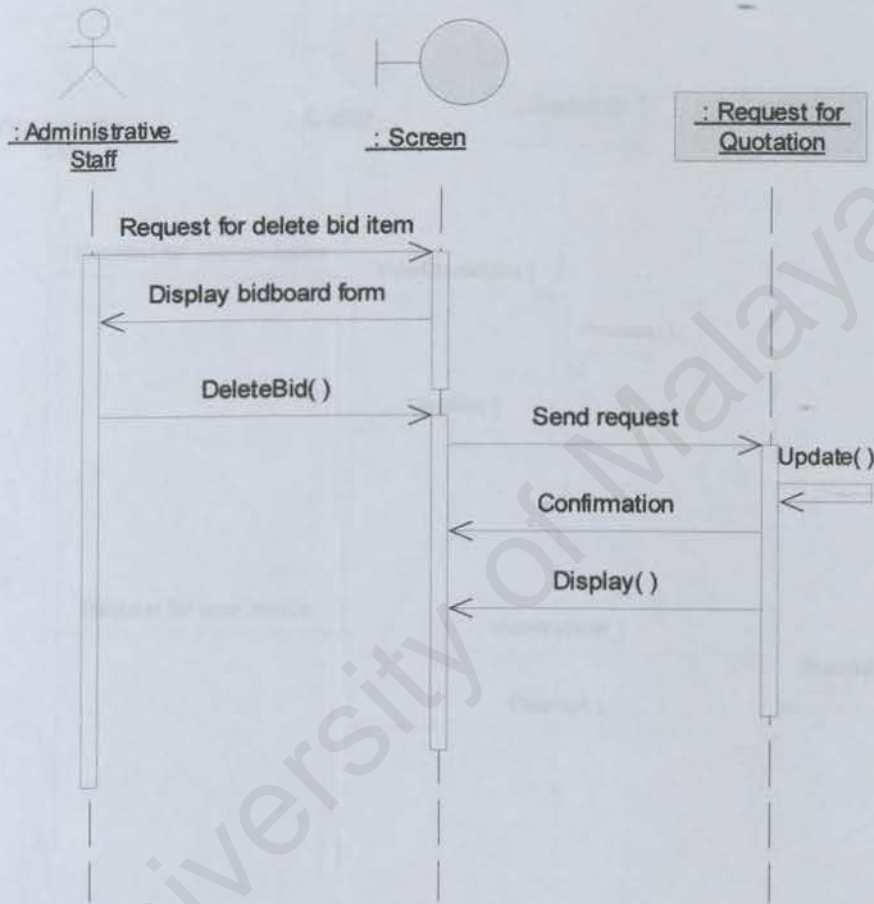
Figure 5.16 Sequence Diagram (Delete RFQ)

Figure 5.17 Sequence Diagram (View Quotation & View Invoice)
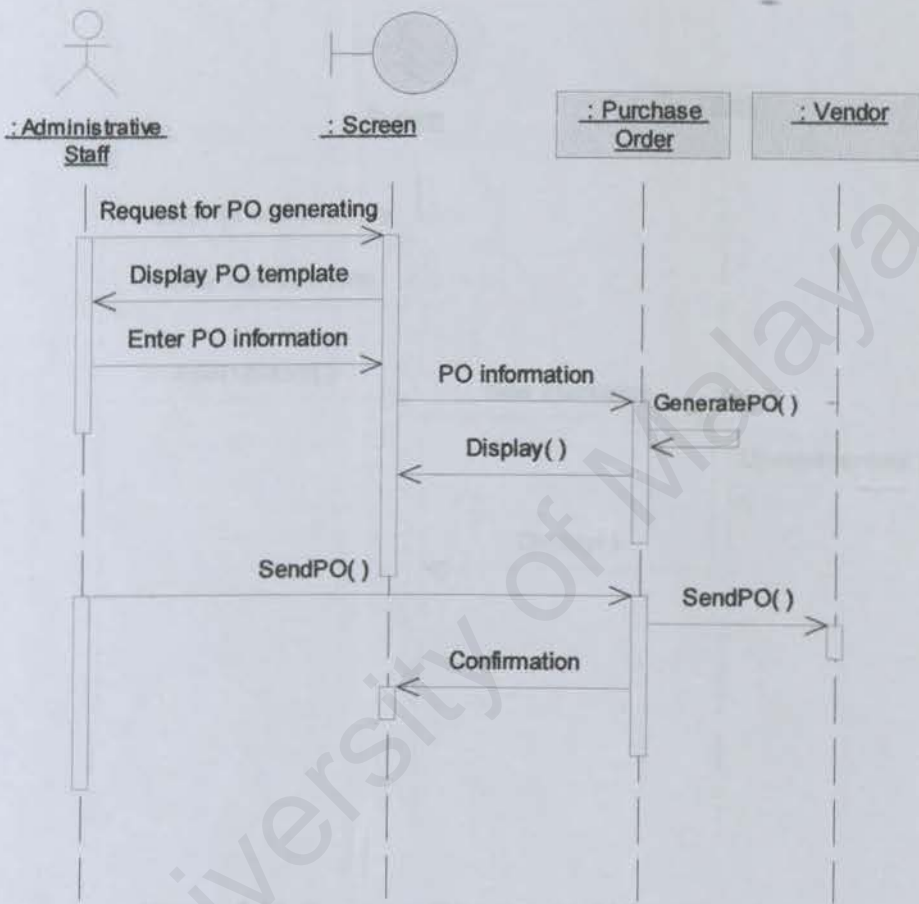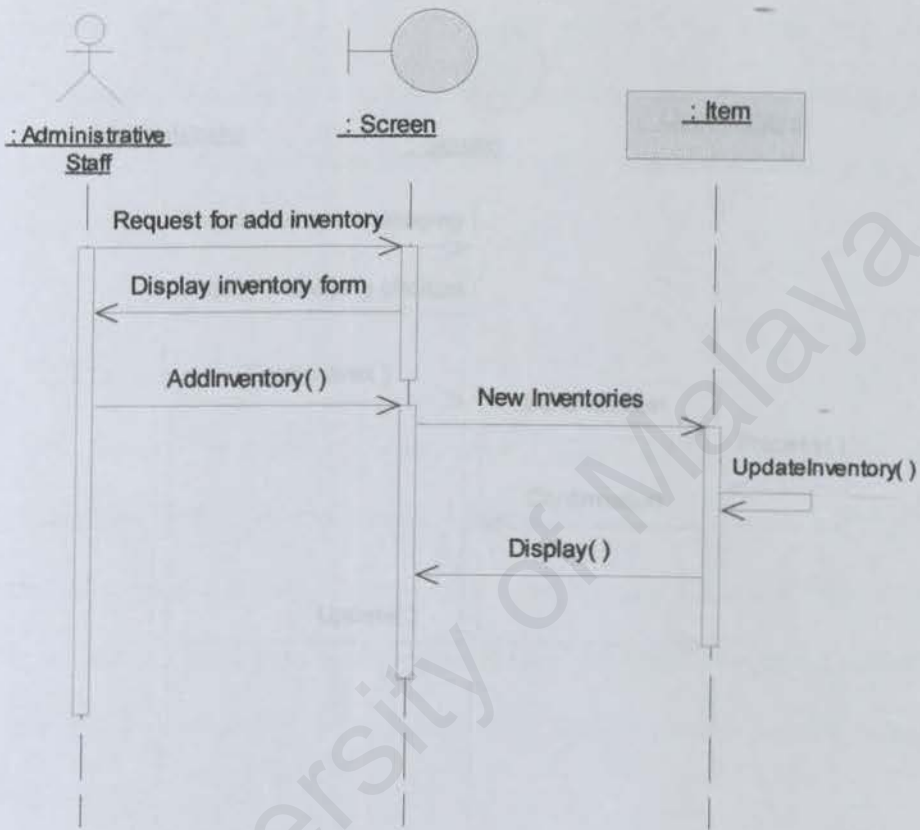
Figure 5.18 Sequence Diagram (Send PO)

Figure 5.19 Sequence Diagram (Add Inventory)

5.6 DATABASE DESIGN

Figure 5.20 lifeline labels:
: Administrator   : Screen   : UserAccount

Request for user managing

Display managing choices

DeleteUser( )

Send request

Process( )

Confirmation

Update( )

Figure 5.20 Sequence Diagram (Delete User)

5.6 DATABASE DESIGN

A design methodology is defined as a structure approach that uses procedures, techniques, tools and documentation aids to support and facilitate the process of design. The design of a database is very important because it can affect greatly on the performance of data retrieval, updating, and query as well in the run-time period of the system.

5.6.1 Table Mapping

The design of Procurement System For A Clinic Group (PSCG) is based on relation database model. In a relational database, the schema is made up of tables, consisting of rows and columns, where each column has a name and a simple data type. In an object model, the counterpart to a table is a class (or classes), which has a set of attributes (properties or data members). Object classes describe behavior with methods.

A tuple (row) of a table contains data for a single entity that correlates to an object (instance of a class) in an object-oriented system. The mappings essential to object and relational integration are between a table and a class, between columns and attributes, between a row and an object and between a stored procedure and a method.

The following tables show the description of data types, which are most commonly to be used in the PSCG database.

Table 1: Vendor

TUPLE NAME	DATA TYPE	LENGTH	DESCRIPTION
** Vendor_ID	varchar	5	Vendor's ID –
Vendor_Name	varchar	50	Vendor's name
Vendor_Add	varchar	50	Vendor's address
Vendor_Postcode	varchar	8	Vendor's postcode
Vendor_City	varchar	50	Vendor's city
Vendor_Country	varchar	50	Vendor's country
Vendor_State	varchar	50	Vendor's state
Vendor_PhoneNo	char	15	Vendor's contact number
Vendor_Email	varchar	50	Vendor's email address
Vendor_Status	char	1	Vendor's status (S-suspended, A-Active)

Table 2 : Request for Quotation (RFQ)

TUPLE NAME	DATA TYPE	LENGTH	DESCRIPTION
** RFQ_Code	varchar	6	Code number of RFQ
RFQ_CreateDate	datetime	8	Date of RFQ created
# RFQ_InchargeStaff	varchar	5	In-charged staff ID

Table 3 : RFQ_ItemDetails

TUPLE NAME	DATA TYPE	LENGTH	DESCRIPTION
** RFQ_Item_No	int	4	Item unit number in RFQ
RFQ_Item_Qty	int	4	Quantity of item unit in RFQ
# RFQ_Code	varchar	6	Code number of RFQ
# Item_Code	int	4	Item Unit Code

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Table 4 : Quotation

TUPLE NAME	DATA TYPE	LENGTH	DESCRIPTION
** Quotation_Code	varchar	6	Code number of Quotation
Quotation_Date	datetime	8	Date of Quotation created
Quotation_TotalAmount	money	8	Total amount for Quotation
# Quotation_Vendor	varchar	5	Vendor's ID
# RFQ_Code	varchar	6	Code number of RFQ

Table 5 : Quotation_ItemDetails

TUPLE NAME	DATA TYPE	LENGTH	DESCRIPTION
** Quotation_Item_No	int	4	Item unit number in Quotation
Quotation_Item_Qty	int	4	Quantity of item unit in Quotation
Quotation_Item_UnitPrice	money	8	Price of item unit in Quotation
Quotation_Item_Amount	money	8	Sub amount of item unit in Quotation (price per unit x quantity)
# Quotation_Code	varchar	6	Code number of Quotation
# Item_Code	int	4	Item Unit Code

Table 6 : Purchase Order (PO)

TUPLE NAME	DATA TYPE	LENGTH	DESCRIPTION
** PO_Code	varchar	6	Code number of PO
PO_Date	datetime	8	Date of PO created
# PO_Vendor	varchar	5	Vendor's ID
# PO_InchargeStaff	varchar	5	In-charged staff ID
# Quotation_Code	varchar	6	Code number of Quotation

Table 7 : PO_ItemDetails

TUPLE NAME	DATA TYPE	LENGTH	DESCRIPTION
** PO_Item_No	int	4	Item unit number in PO
PO_Item_Qty	int	4	Quantity of item unit in PO
# PO_Code	varchar	6	Code number of PO
# Item_Code	int	4	Item Unit Code

Table 8 : Invoice

TUPLE NAME	DATA TYPE	LENGTH	DESCRIPTION
** Invoice_Code	varchar	6	Code number of Invoice
Invoice_Date	datetime	8	Date of Invoice created
Invoice_TotalAmount	money	8	Total amount for Invoice
# Invoice_Vendor	varchar	5	Vendor's ID
# PO_Code	varchar	6	Code number of DO

Table 9 : Invoice_ItemDetails

TUPLE NAME	DATA TYPE	LENGTH	DESCRIPTION
** Invoice_Item_No	int	4	Item unit number in Invoice
Invoice_Item_Qty	int	4	Quantity of item unit in Invoice
Invoice_Item_UnitPrice	money	8	Price of item unit in Invoice
Invoice_Item_Amount	money	8	Sub amount of item unit in Invoice (price per unit x quantity)
# Invoice_Code	varchar	6	Code number of Invoice
# Item_Code	int	4	Item Unit Code

5.7 USER INTERFACE DESIGN

An interactive graphical or form-based user interfaces is an important requirement for an interactive system. The effort in designing, specifying and implementing a user interface plays a significant role in application development.

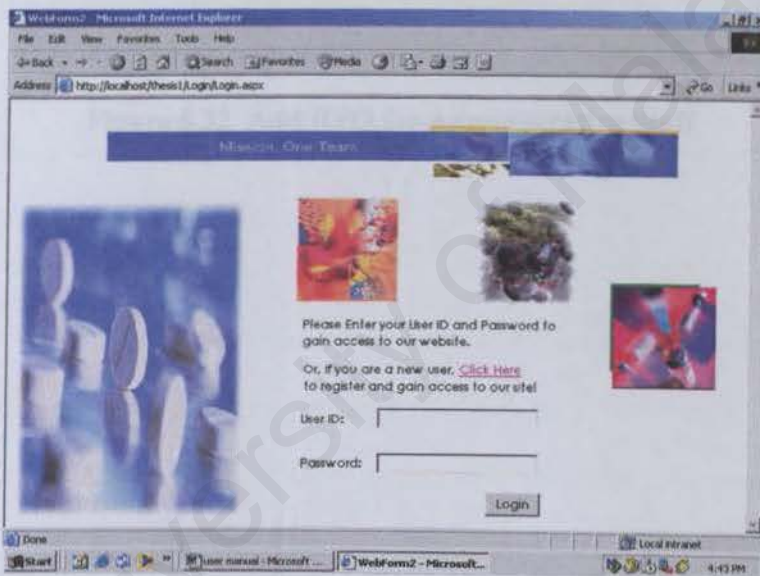Here are some examples of my system outcome of user interface design:

Figure 5.21 Login Page

Figure 5.22 Add RFQ for Administrative Staff

CHAPTER 6 SYSTEM IMPLEMENTATION

6.1 INTRODUCTION

The purpose of system implementation is to convert planned system design and requirement analysis into program codes. System implementation includes coding, testing and documenting the system as well as training the end users and system administrators. Well developed software will be the final product of system implementation. Since this process involves realization of previous planning, modification is considered necessary if better solution of design is discovered. Each phase tends to overlap one another.

Structure and relationships of the system those are easy to describe with charts and tables actually always not straightforward to write as code. In addition, many coding problems such as syntax error, runtime error and data connection error may occur during the coding process. As the system evolves in the future, coding is not an easy task especially in a way that is understandable not only to us, but also to others who revisit it for testing.

6.2   DEVELOPMENT ENVIRONMENT

Development environment has certain impact on the development of a system. Using the suitable hardware and software not only help to speed up the system development but also determine the success of the project. The hardware and software tools used to develop the entire system are as below.

6.2.1 Hardware Requirements

Below is the list of hardware used during the development of the system:

- Pentium IV 1.8 GHz Processor
- 128 PC800 RDRAM
- More than 10 GB hard disk space
- 32 bit True Color SVGA
- 32MB Geforce2 MX200 video adapter
- 56 Kb modem connection
- 1.44 MB floppy disk drive
- CD-RW 12X10X32 drive

6.2.2 Software Tools Requirements

Below is the list of software used during the development of the system:

- Microsoft Windows 2000 Professional
- Microsoft Internet Information Server 5.0
- Microsoft SQL Server 2000

- Microsoft Visual Studio .NET
- Microsoft Internet Explorer 6
- Adobe Photoshop 6.0
- Microsoft FrontPage XP
- Microsoft Word XP

6.3   SYSTEM DEVELOPMENT

6.3.1 Web Pages Coding

Microsoft Visual Studio .NET is used as the main ASP.NET coding tools. There are many useful features which could positively improve and speed up the development. Web Forms are an ASP.NET technology that can be used to create programmable Web pages. Web Forms pages can be used to create programmable Web pages that serve as the user interface for Web application. A Web Forms page presents information to the user in any browser or client device and implements application logic using server-side code. Web Forms render themselves as browser-compatible HTML and script, which allows any browser on any platform to view the pages. Using Web Forms, Web pages can be created by dragging and dropping controls onto the designer and then adding code.

In Web Forms pages, the user interface programming is divided into two distinct pieces: the visual component and the logic. The visual element is referred to as the Web Forms page. The page consists of a file containing static HTML, or ASP.NET server controls, or both simultaneously.

The Web Forms page works as a container for the static text and controls the display, by using the Visual Studio Web Forms Designer plus ASP.NET server controls. The logic for the Web Forms page consists of code that created to interact with the form. The programming logic resides in a separate file from the user interface file. This file is referred to as the "code-behind" file and has an ".aspx.vb"

or ".aspx.cs" extension. The logic written in the code-behind file can be written in Visual Basic (VB) or Visual C#. For the development of PSCG, I used VB as the logic written in the code-behind file, and all the files have ".aspx.vb" extension.

The code-behind class files for all Web Forms pages in a project are compiled into the project dynamic-link library (.dll) file. The .aspx page file is also compiled, but somewhat differently. The first time a user browses to the .aspx page, ASP.NET automatically generates a .NET class file that represents the page, and compiles it to a second .dll file. The generated class for the .aspx page inherits from the code-behind class that was compiled into the project .dll file. When a user requests the Web page URL, the .dll files run on the server and dynamically produce the HTML output for that page.

In preventing unauthorized user, components at session-level scope are used. Session- level scope means that one object instance will service all request from a single user within their ASP.NET session. In PSCG program codes, user ID and password objects are defined as session-level scopes' objects.

6.3.2 Database Connection

The database used in PSCG is created using Microsoft SQL 2000, which is named MRMS. There are 34 tables and 4 views in this database. There are few steps to connect to database and retrieve data to ASP.NET page. Firstly, Domain Server Name (DSN) is used to connect to data source. This is done by configuring ODBC Data Source under Administrator Tools dialog which is found under Data

Sources (ODBC) in control panel. Among number of types of DSN, System DSN is chosen because it is accessible to all users of the system. After click the 'add' button and select ODBC driver that used to access data store – SQL server, a System DSN is created. The last step is to select the appropriate database file.

There is a file that constitutes an ASP.NET application called Web.config. This file is containing the configuration information for that ASP.NET application. In order to retrieve data in ASP.NET page, a script is written as below for establishing the database connection:

```
<appSettings>

    <add key="constring" value="database=MRMS;user
id=sa;password=;Trusted_Connection=yes;server=ANX815\THESIS"/>

</appSettings>
```

With the script above written in the Web.config file, I just need to include a few lines of script in every ASP.NET pages as below, which automatically declare the connection to the database for every ASP.NET pages:

```
Imports System.Data.SqlClient
............
Dim conn As SqlConnection =
New SqlConnection(ConfigurationSettings.AppSettings("constring"))
............
............
```

6.3.3 Development Tools

As mention in earlier sections, Microsoft Visual Studio .NET (VS .NET) is used to create and manage web-based application in PSCG. VS .NET is a complete set of development tools for building ASP Web applications, XML Web services, desktop applications, and mobile applications. Visual Basic .NET, Visual C++ .NET, and Visual C# .NET all use the same integrated development environment (IDE), which allows them to share tools and facilitates in the creation of mixed-language solutions. In addition, these languages leverage the functionality of the .NET Framework, which provides access to key technologies that simplify the development of ASP Web applications and XML Web services.

Although ASPs are simply text files and can be created in ANSI editor, such as notepad, VS .NET offers better development environment which introduces three work views which are code-view, design-view and combination of both views.

Microsoft Visual Basic, Microsoft C++, and Microsoft JScript have all been updated to meet the latest development needs. Additionally, a new language, Microsoft C#, has been introduced. These languages leverage the functionality of the .NET Framework, which provides access to key technologies that simplify the development of ASP Web applications and XML Web services.

ASP.NET builds on the programming classes of the .NET Framework, providing a Web application model with a set of controls and infrastructure that make it simple to build ASP Web applications. ASP.NET includes a set of controls

that encapsulate common HTML user interface elements, such as text boxes and drop-down menus. These controls run on the Web server, however, and push their user interface as HTML to the browser. On the server, the controls expose an object-oriented programming model that brings the richness of object-oriented programming to the Web developer. ASP.NET also provides infrastructure services, such as session state management and process recycling, that further reduce the amount of code a developer must write and increase application reliability.

Microsoft Visual Studio .NET provides project management software solution for high-end Web development. Its significant features are:

- Support for ASP.NET which generates HTML pages on the fly.
- Support for database integration from desktop to high end (ODBC compatibility).
- Support for VBScript and Jscript in HTML files.
- Visual design tools, template and wizards help to generating SQL statement commands with a point-and-click interface.

6.4   CODING STANDARD

Standardization in coding is stringently implemented in PSCG. This is because consistency of coding enables others to understand what and why these program codes are written. Standardization in coding is very important to help in locating faults and making changes. In addition, it clarifies which sections of the program perform which specific functions. Modifications in design are easy to put into operation in the standard coding as the program is designed in structuring code according to standards. Also, standardization helps us to organize our thoughts and avoid mistakes.

For a typical ASP.NET file in PSCG, the following standardization codes are fundamental to include into the file.

```
Imports System.Data.SqlClient
```

This statement provides a connection of database to be imported into the Web Pages

```
Public Class Login
    Inherits System.Web.UI.Page
```

This statement provides a provides a collection of instances of the Import class representing documents to be imported into the Web Pages

```
#Region " Web Form Designer Generated Code "
<System.Diagnostics.DebuggerStepThrough()>
Private Sub InitializeComponent()
End Sub
```

This statement is called "Web Form Designer Generated Code", which required by the Web Form Designer

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```
Private Sub Page_Init(ByVal sender
As System.Object, ByVal e As System.EventArgs)
Handles MyBase.Init
InitializeComponent()
End Sub
#End Region
```

```
Dim conn As sqlconnection = New sqlconnection
(ConfigurationSettings.AppSettings("constring"))
```
This statement declares the connection of database with the Web Pages

```
Private Sub Page_Load(ByVal sender
As System.Object, ByVal e As System.EventArgs)
Handles MyBase.Load
  'Put user code to initialize the page here
End Sub
```
This statement declares the function for the Web Pages coding

```
..............
..............
End Class
```

6.5 DOCUMENTATION

The purpose of program documentation is to explain to a reader what the program do and how they do it. Program documentation is a set of written description that enables others to continue with present work without losing track of what had been doing. It provides an easy understanding programming guideline for others to do modification or testing in the future. Besides that, system can be easily setup at any time by referring the prepared documentation. Program documentation can be divided into internal documentation: a descriptive material written directly within the code, and external documentation: all other documentation.

6.5.1 Internal Documentation

Internal documentation actually refers to comments within the codes. This documentation is prepared especially for those who will be reading the source codes of Procurement System for a Clinic Group (PSCG). Thus, summary information is provided to identify the program and describe its data structures, algorithms and control flow.

In PSCG, some important section of ASP.NET script functions is commented. This is useful for separates between two different functions and locates the required function rapidly according to the written comment. Comments are written within the comment tag in order that these comments will not be executed as ASP.NET script. The comment tag used by VBScript is '.

For example:

'—— *Get the User ID* ——

'—— *Close the Database Connection* ——

6.5.2 External Documentation

External documentation is part of the overall system documentation. The entire system design and analysis requirement has already been written clearly on the documentation.

The obtainable of external documentation let others who may never look at the actual source code refer to it. In external documentation, there is much more useful information that is not stated in internal documentation or source codes of the system. Without external documentation, some research background and the motivation to create the system will not be acknowledged by other.

External documentation is also valuable for future reference when the system is going to implement on other work field. Modification will be easier since the primitive idea is already established for further development. More to the point, other programmers can refer external documentation to expand the idea on doing the similar system.

CHAPTER 7   SYSTEM TESTING

7.1   INTRODUCTION

Testing is a critical element in uncovering logical error and to test the system reliability. The goal is to design tests that will uncover the greatest number of errors or classes of errors with the minimum amount of time and effort.

In developing a system, testing usually involves several stages. First, each program component is tested on its own, isolated from the other components in the system. Such testing is known as unit/module testing.

The primary goal of unit testing is to confirm that the unit is correctly coded and that it carries out the functions it is supposed to carry out. This stage of testing verifies that the component functions properly with the types of input and output expected from studying the component's design. After each component has been tested, the interaction between these components must be tested again to ensure that the components can be integrated.

When the individual components are working correctly and meet the objectives, these components are combined into a working system. Integration testing is done on the groups of integrated modules to verify that the system components work together as described in the system and program design specifications.

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System testing is the final testing procedure. A system test is a series of different tests designed to fully exercise the system to uncover its limitations and measure its capabilities. The objective is to test an integrated system and verify that it meets specified requirements. System testing takes place at a higher level, the testing focuses on behavior rather than function or functional structure.

7.2   TESTING STRATEGY

The testing strategy in this Procurement System for a Clinic Group (PSCG), involved unit testing, integration testing and system testing. The objective of unit testing is to ensure all coding of the functions implement the design correctly. The purpose of doing integration testing is to see whether the module could be integrated properly. Finally, system testing verifies that overall system is functioning properly and system performance and objective are achieved.

7.2.1 Unit Testing

Unit testing is the first testing procedure. Unit testing is done after the completion of each function according to functional requirement. The unit testing process is similar as to find faults in components. There were several steps being carried out for this application:

✓   Examine all the program codes by reading through it. Consecutively, try to spot algorithm, data and syntax faults.

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✓ Compare the code with the specifications and with design to make sure all relevant cases have been considered.

✓ Publish the web pages in web browser in order to eliminate remaining syntax faults.

✓ Develop test cases to show the input is properly converted to the desired output.

✓ Boundary conditions are tested to make sure the functions run at boundaries established for limiting or restricting processing.

✓ Test all errors handling paths.

Unit testing follow exactly these steps, and one specific unit is examined with them one at a time.

7.2.2 Integration Testing

After satisfied that individual components are working correctly. These components will be combined into a working system. This will be the beginning of integration testing. The integration process is planned and coordinated properly with the intention that the faults which occur during this stage do not rely within the unit of the system. This will be easier for the task to detect the cause of the faults. The emphasis of integration testing is on testing database between modules.

The top down integration approach has been adopted for this system. The top level controlling component is tested by itself. Then, all components called by tested components are combined and tested as a larger unit. This approach is reapplied until all components are incorporated.

Aspects	Tested	Evaluated
Ease of navigation	√	Good
Linkage	√	Good
Information shared	√	Good

Table 7.1   Integration Testing and Evaluation

7.2.3 System Testing

System testing is very different from unit testing and integration testing. In unit testing, developer has complete control over the testing process, including prepared test data, and test cases. However, in system testing, the customer also test the system, making sure that it meets their understanding of the requirement, which may be different from the developers. Different from other testing objective, the purpose of system testing is to ensure that the system does what the customer wants it to do. There are several steps in testing a system, which are functional testing and performance testing.

7.2.3.1   Functional Testing

System testing begins with function testing which is based on the functional requirements. A function test checks that the integrated system performs its function

as specified in the system analysis. In PSCG, functional testing will be carried out
on two main modules which are vendor module and administrator staff module.

FUNCTIONAL TESTING			
(1)	*Vendor Section*		
	Aspects	**Tested**	**Evaluated**
a)	**User Register / Login Module**		
	Login	√	Good
	Logout	√	Good
	Register	√	Good
	Edit / Update User Profile	√	Good
b)	**Request For Quotation (RFQ) Features**		
	View Details of RFQ	√	Good
c)	**Quotation Features**		
	Submit New Quotation	√	Good
	Edit Quotation	√	Good
	View Details of Quotation	√	Good
	Delete Submitted Quotation	√	Fair
d)	**Purchase Order Features**		
	View Purchase Order	√	Good
e)	**Invoice Features**		
	Send Invoice	√	Good
	Edit Invoice	√	Good
	View Details of Invoice	√	Good
	Delete Sent Invoice	√	Fair

(2)	Administrative Staff Section		
	Aspects	Tested	Evaluated
a)	Request For Quotation (RFQ) Features		
	Add New RFQ	√	Good
	Edit / Update RFQ	√	Good
	View Details of RFQ	√	Good
	Delete RFQ	√	Good
b)	Quotation Features		
	View Received Quotation	√	Good
c)	Purchase Order Features		
	Send New Purchase Order	√	Good
	Edit Purchase Order	√	Good
	View Details of Purchase Order	√	Good
	Delete Sent Purchase Order	√	Fair
d)	Invoice Features		
	View Received Invoice	√	Good
e)	Others		
	Login	√	Good
	Logout	√	Good
	View Vendors' List & Details	√	Good

Table 7.2   Functional Testing and Evaluation

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7.2.3.2   *Performance Testing*

Performance testing compares the integrated components with the non-functional system requirement. It addresses the non-functional requirements. The non-functional that have been stated during system analysis and design phase will be tested one by one with all function. Thus, for PSCG, the performance test will be focus on the aspect of user friendly, integrity, efficiency and flexibility.

Non-Functional Aspects	Tested	Evaluated
Attractiveness	√	Fair
Page layout / design	√	Fair
Readability of Text	√	Fair
Hyperlink Performance	√	Good
Prevention of Unauthorized	√	Good
Response Time	√	Good
Retrieval of Data	√	Good

Table 7.3   Non-Functional Testing and Evaluation

CHAPTER 8

SYSTEM EVALUATION & CONCLUSION

8.1 INTRODUCTION

System evaluation is implemented by more that simply comparing the information obtained with the information which is expected. It is also related to the user environment, attitudes, information principles and several other matters which must be given consideration before the actually efficacy can be concluded.

At all phases of the system approaches, evaluation is a process that occurs continuously, drawing on a variety of sources and information.

The role of this evaluation phase was to determine:

➢ The extent to which the expected outcomes have been realized

➢ The prescriptive value of the process where extraneous factors were taken consideration.

8.2 SYSTEM STRENGTHS

The following are the Procurement System for a Clinic Group (PSCG) strengths:

❖ *Provide a simple and user-friendly interface*

PSCG is outfitted with simple interface. With its simple interface, user with basic experience with web browser will certainly find PSCG easy to use, simple to learn and easy to understand. PSCG user-friendly interface is layered with buttons and hyperlink navigation for user to execute command with no difficulty. Form and table is used to insert data and display record. PSCG offers uncomplicated interface that user can easily achieve the results what they want.

❖ *Page restriction access security incorporated*

PSCG is mainly divided into two user privilege areas, which are vendor and administrative staff. Thus, it is crucial for the system to have stringent page restriction access security. When a user is logging in, the system will verify that a user has the proper credentials to access a web page before it is displayed on his screen. With this security feature, user will not be able to access to other web page with different user privilege level. In addition, user is unable to browser any web page (except login page) in PSCG before logging on to the system.

❖ *Provide an easy way of procurement management*

PSCG provides the easier way for vendor to do their online procurement transactions electronically with the clinic group. This will help to increase the efficiency of procurement process, instead of manually key-in data system by the staff.

❖ *Resource reusability*

Although PSCG comprises of two user level, system resources are always reusability and shared for one and others. By using combination of primary keys and some security features, vendor and administrative staff always share the same database system to organize and manage the PSCG function.

❖ *System transparency*

The system provides circumstance where the front-end users of the system need not have to know the detail system structure, location of the database and anything related to the system. Therefore, front-end user can use the system without much difficulty.

❖ *Keep Records*

This system will give the users the availability to keep all records that done by the vendor and administrative staff. The information of the records can be added, edited and deleted by both vendor and administrative staff.

8.3 SYSTEM LIMITATIONS

PSCG has demonstrated system limitation as following:

- PSCG currently not supports dynamic notice board features. This is meaning that administrative staff unable to publish an automate web page using insertion of forms. This feature is not convenient to perform as a minor module as planning earlier. For a complete development of dynamic notice board, it needs well organized database which is separate from PSCG database. Furthermore, it will eventually perform as HTML / ASP.NET page generator which is not suitable for the initial idea of development PSCG. Therefore, this feature is not included in current PSCG.

- For security reason, the vendor who has the authority to create a quotation or invoice can only create a new quotation / invoice, list out previous quotations/invoices, view the details of quotations/invoices, and then submit it. The vendor cannot edit the items of records after had submitted the forms to administrative staff. If this has to be altered, then the vendor will have to email and inform the administrative staff.

- Sometimes, there will be some error in saving record into the database. Some of the errors that encountered can be listed out like the data that enter was not match with the field type in database, but there are many possible errors that

can happen and there are still some errors that cannot be listed out in the message.

- Due to time constraint, the reports that needed for some forms used had not yet been generated. Some reports like list of each submitted quotations and invoices, received purchase order and etc.

8.4 PROBLEMS ENCOUNTERED AND SOLUTIONS

Develop a system is not an easy task especially the obligation to fulfill the requirements for customer. It takes time to gain experiences and learn from mistakes. However, there is no time for us to make any mistakes or further comprehensive adjustments. Various problems have been encountered during the process of system development. Some major problems are difficult to be solved, sometime even causing the development process go beyond the schedule. Fortunately, these major problems have been solved eventually. The following are some of the major problems encountered and solution suggestions:

➤ *Inexperience In Development Environment*

This is the first time for me to create a system using Visual Studio .NET and using ASP.NET technology. This is because this software has not been used before. Many special functions and features of the software still to be discovered and tested during the development stage, this again slow down the

development process. However, this problem is solved by doing more studied on how to use the software. Besides, surfing net for tutorials also has been carried out to improve the expertise of using the software.

➤ *Lack experience In Programming Language*

I have not been using ASP.NET technology before, so there are some times that I do not know how to write certain coding. In addition, there is very less exposure to this language during the ordinary study in faculty. Thus, it is very difficult for someone to deal with the language very well within short period of time. As a result of this problem, it confines programmer creativity to further extend the functionality of the system. In PSCG, most of the modules are constructed using very basic ASP.NET script, consequently some sophisticated features of ASP.NET script are unable to implement in this system. To solve the problem, utilize of development software will decrease the chance to write the script from sketch. As well, reference books become very crucial to improve the familiarity of the script.

➤ *Limited Knowledge About The Procurement Process In Clinic Group*

Because I have limited knowledge about how the procurement process flow and what information related to the procurement, I face some problem when develop the system. But, I solved it after my interview with a previous trainee of a hospital and some research doing on Internet. This helps a lot in my development phase.

8.5 FUTURE ENHANCEMENTS

Due to the limitations of this system, there are a few suggestions that may be useful to future enhancement of the PSCG. The suggestions are as below:

✓ A PSCG without dynamic notice board is not a completed system. Thus, it is recommended that in the future enhancement, this facilities will be considered to add into the system in order to make the system more sophisticated. With dynamic notice board, administrative staff can publish the clinic group latest information to the web by just filling some form. Vendors may also view the previous published information according to its date and other factors. With this feature, HTML / ASP.NET web page can be easily generated without prerequisite of expert web knowledge.

✓ Error message can be listed out more details so that the users can notice what the system is going on when there is an error happens and no need to seek help from the administrative staff if the error is not important.

✓ Report that needed should be generated for certain used. Many reports that can be produces to check the transaction account whether is correct or not using the information that already store in the database.

✓ The interface of PSCG is not attractive and organized enough. Thus, it is recommended to improve the existing interface by adding flash presentation to the opening page, create attractive buttons using animated gif and etc.

8.6 CONCLUSIONS

PSCG opens a new approach to implement the sharing database with Medical Records Management System (MRMS) into the new way of communication between clinic staffs and vendors of the clinic group. PSCG major aim is to allow vendor manages and generates his/her transaction records and sends it to administrative staff of clinic group.

With PSCG, the spread of the latest information, events or news of clinic group become easier. In addition, this system enables vendors and administrative staffs update any latest transaction records to each other users. This eventually increases interactions between staffs and vendors of the clinic group.

At the moment, PSCG supports many features such as user privilege security system, request for quotation / quotation / purchase order / invoice forms' generator, form posting, vendors and staffs database management system and transaction records' content management system. All of these features are well performance in user friendly, integrity, efficiency and flexibility. In addition, it shows that basic features in typical procurement system are also available in PSCG.

As a conclusion, this project gave me the opportunity to construct a full web-based application from sketch. I have gained precious experience and knowledge as the project progresses. The project has to put me into practice all the concepts of programming which has been learnt in the span of three years in University Malaya.

Directory: \thesis1\

Filename	: **AdminPage.aspx**
Objective	: A page that the administrative staff can be accessed
Access level	: administrative staff

Filename	: **Expired.aspx**
Objective	: Remind about the expired of user ID
Access level	: administrative staff, vendor

Filename	: **Home.aspx**
Objective	: The default page of PSCG
Access level	: administrative staff, vendor

Filename	: **Invoiceform.aspx**
Objective	: Add item for invoice
Access level	: vendor, administrative staff

Filename	: **noAccess.aspx**
Objective	: Warning page for vendor
Access level	: vendor

Filename	: **VendorPage.aspx**
Objective	: A page that the vendor can be accessed
Access level	: vendor, administrative staff

Directory: \thesis1\Administrator\

Filename : **VendorDetailView.aspx**

Objective : View vendor's details

Access level : administrative staff

Filename : **VendorDisplay.aspx**

Objective : View the list of vendors

Access level : administrative staff

Directory: \thesis1\Invoice\

Filename : **InvoiceDetails.aspx**

Objective : View invoices' details

Access level : administrative staff, vendor

Filename : **InvoiceDisplay.aspx**

Objective : View the list of invoices

Access level : vendor

Directory: \thesis1\Login\

Filename : **FirstTime.aspx**

Objective : Form of submitting UserID and password

Access level : vendor

Filename   : **Login.aspx**

Objective   : The main login page of PSCG

Access level   : administrative staff, vendor

Filename   : **Register.aspx**

Objective   : Registration form

Access level   : vendor

Filename   : **UserEdit.aspx**

Objective   : Editable form of user profile

Access level   : vendor

Filename   : **UserProfile.aspx**

Objective   : Display the user profile

Access level   : vendor

Directory: \thesis1\PurchaseOrder\

Filename   : **POdetails.aspx**

Objective   : View purchase orders' details

Access level   : administrative staff, vendor

Filename   : **POdisplay.aspx**

Objective   : View the list of purchase order

Access level   : administrative staff

Filename   : **POform.aspx**

Objective   : Purchase Order form

Access level   : administrative staff

Filename : **VendorUser.aspx**

Objective : View the list of received purchase order

Access level : vendor

Directory: \thesis1\Quotation\

Filename : **QuotationDetails.aspx**

Objective : View quotations' details

Access level : vendor, administrative staff

Filename : **QuotationDisplay.aspx**

Objective : View the list of quotation

Access level : vendor

Filename : **QuotationForm.aspx**

Objective : Quotation form

Access level : vendor

Filename : **StaffUse.aspx**

Objective : View the list of received quotation

Access level : administrative staff

Directory: \thesis1\RFQ\

Filename : **RFQdetails.aspx**

Objective : View Request for Quotation's details

Access level : administrative staff, vendor

Filename : **RFQdisplay.aspx**

Objective : View the list of RFQ

Access level : administrative staff

Filename : **RFQform.aspx**

Objective : RFQ form

Access level : administrative staff

APPENDIX B

USER MANUAL

INTORDUCTION

This user manual is about the Procurement System (PSCG), because this system is a sub module to the whole clinic group management system, so, I will just show out the page that related to the procurement process. There are two parts in the procurement system. If user login as a vendor, he / she has the authority to generate a quotation and invoice. Vendor can create a quotation for the clinic group by entering the page below after viewing the uploaded request for quotation. Another part is when user login as an administrative staff and has the authority to change the information that related to procurement process.

- **Login Page**

  Every user of this PSCG system (neither vendor nor administrative staff) requires entering their user ID and password to gain access into the website. Warning message will be pop-up if a user tries to access the website without submitting any user account information.
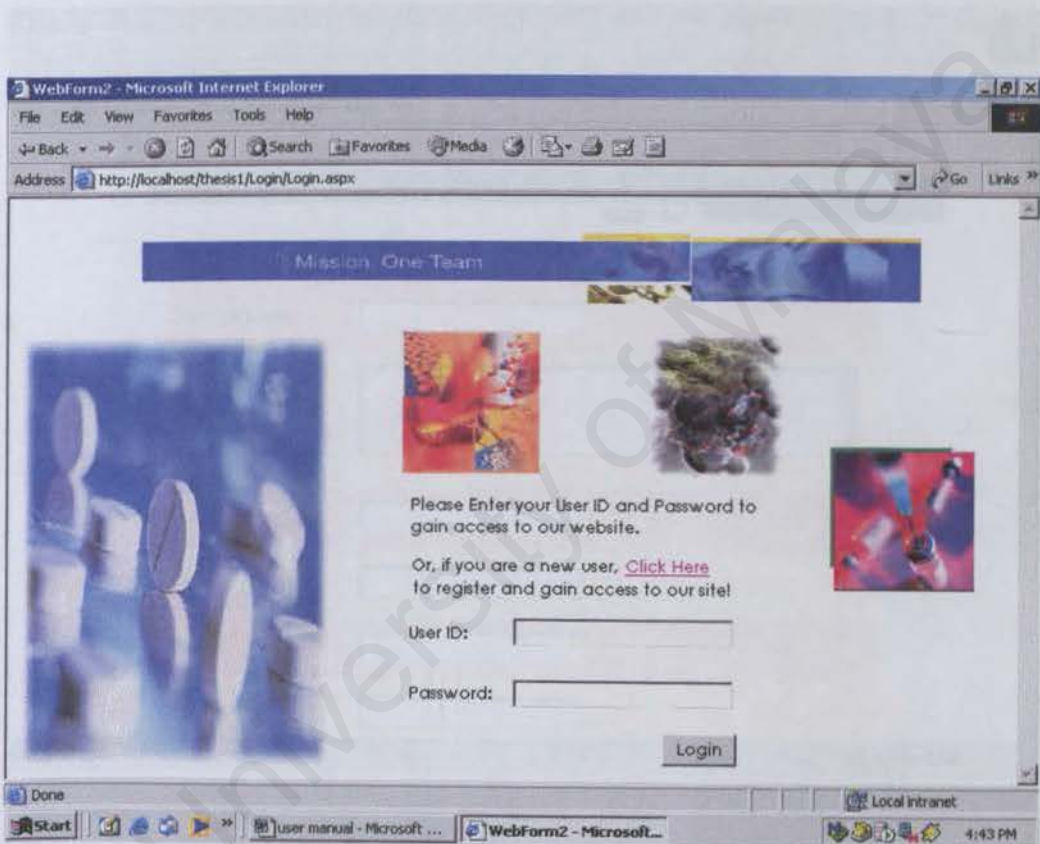
- **Register Page**

  The 'Click Here' hyperlink on the Login Page will redirect user to the
  registration form. New user need to submit the profile information by filling
  up a form, to be registered as an official vendor of the clinic group.

- **Home Page**

  This is the main page of the PSCG website. There is some uploaded

  information for the user to be viewed, especially the latest of RFQ (Request

  For Quotation). There are four hyperlinks of navigation, which will redirect

  the user to different pages:

  Home   -> Home Page

  Vendor   -> Vendor Page

  Administrator   -> Administrative Staff Page

  Sign Out   -> Login Page

- **Vendor Page**

  This page displays the list of functions for the vendor to execute their procurement transaction. There are three functions that been provided for vendor: Send Quotation, View Purchase Order and Edit Profile. Vendor may click on those hyperlinks to continue their procurement transaction.
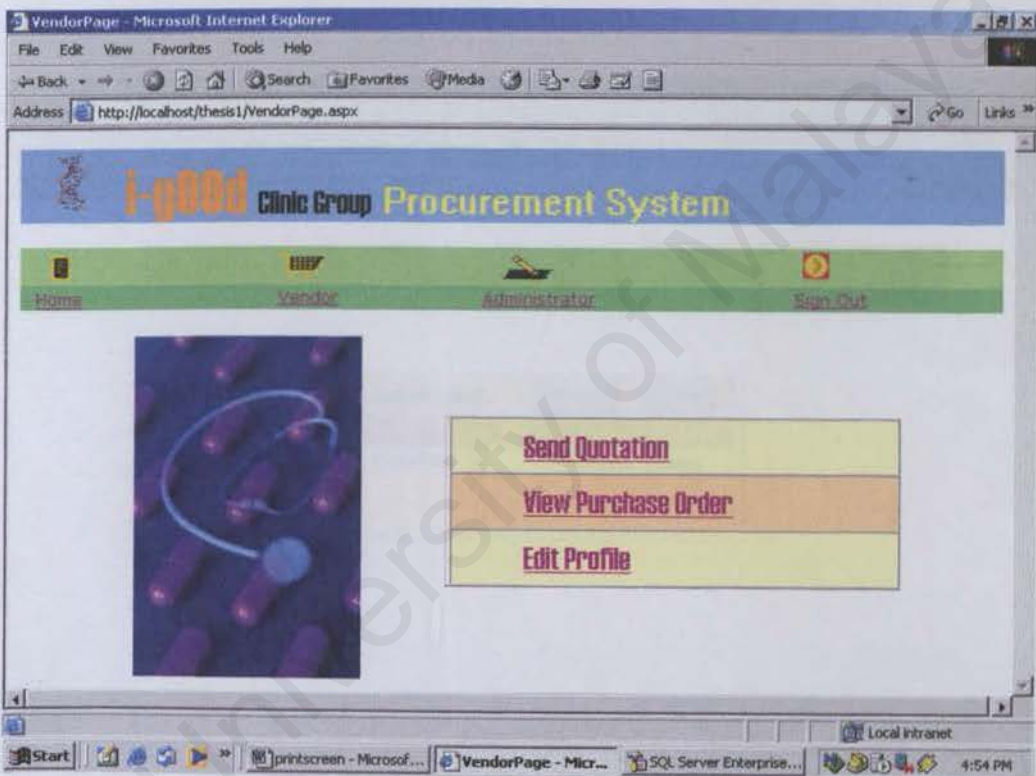
- **Send Quotation Pages**

  The first page displays the list of quotations that the vendor had submitted to clinic group previously. Vendor may view the details of quotation by clicking on 'Details" hyperlink, or redirect back to Vendor Page by clicking the 'Cancel' button. Vendor can submit a new quotation after viewing the RFQ at Home Page, by clicking 'Add New' button.
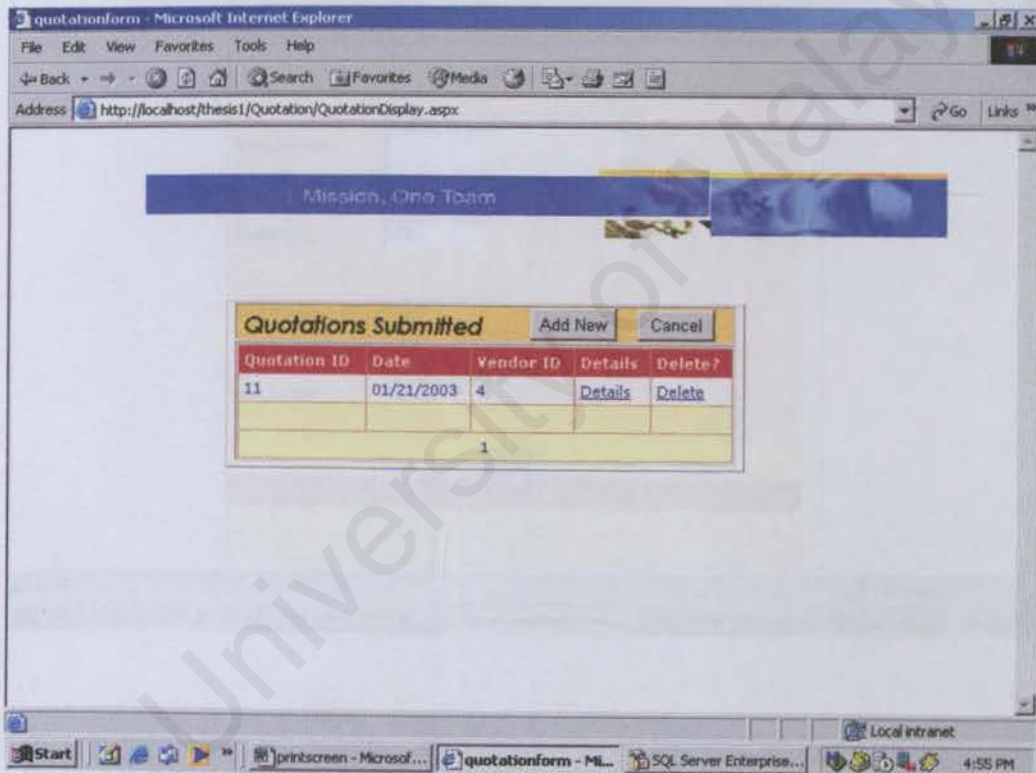
The 'Add New' button redirect user to this Add New Item form. Vendor can enter the information that needed for quotation, include the item name, quantity and price. The item has to be added one by one, by clicking 'Add' button each time finished entering one item information.

The table at below the form will display the entered information of items for the quotation. Vendor will submit the complete quotation, by clicking the 'Submit' button.

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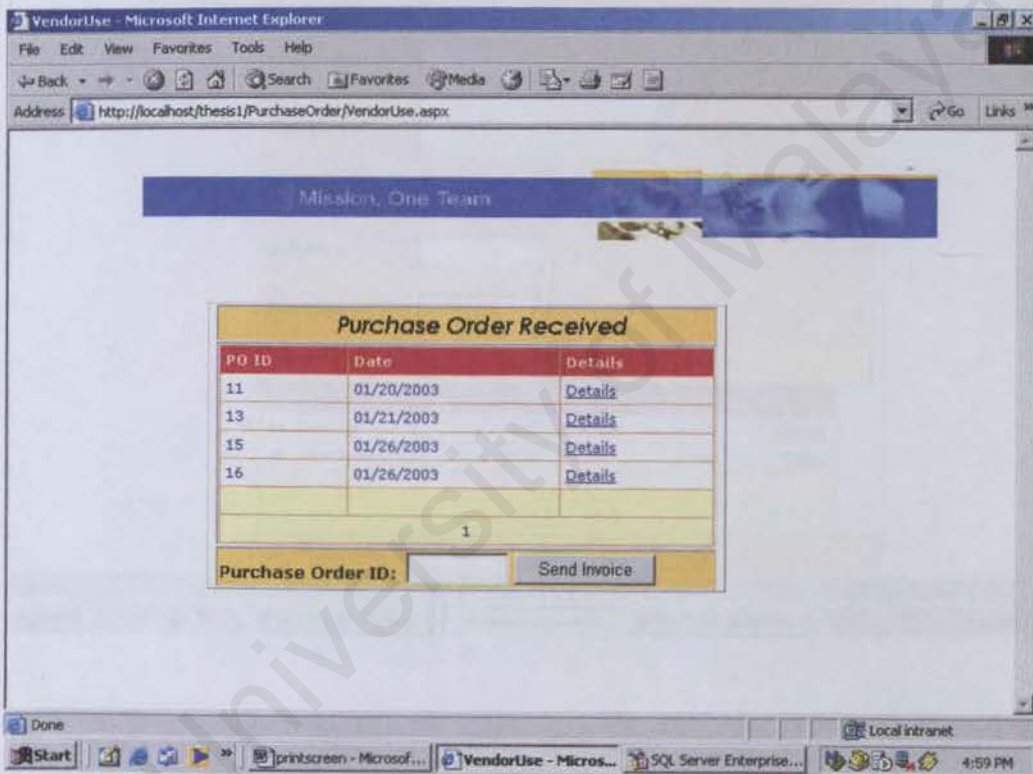
After submitting the quotation, vendor will be redirected back to the first
page of Send Quotation Pages, which display the updated information about
submitted quotation. Vendor may click on the 'Details' hyperlink in the
table to view the details of each quotation.
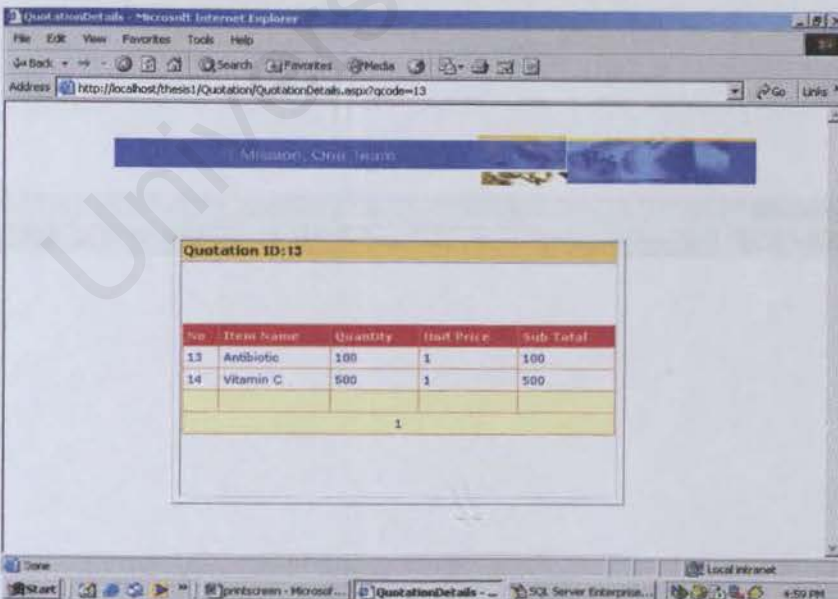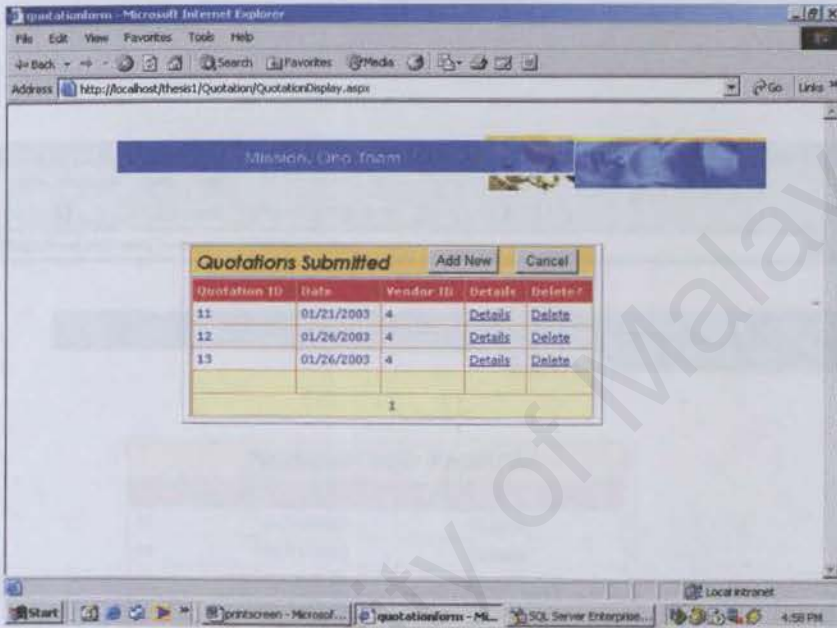
This page displays the details of each selected quotation.

- **View Purchase Order Pages**

  This is the first page that displays the list of received Purchase Order (PO) which sent by the administrative staff of clinic group. Vendor may send the invoice based on the received PO, by entering the PO ID and clicking 'Send Invoice' button.

The 'Send Invoice' button will redirect vendor to the form below, which

displayed the information of that specific PO. Vendor need to enter the total

price of the invoice before submitting the invoice.

After submitting the invoice, vendor will be redirected back to the first page of Invoice Pages, which display the updated information about submitted invoice. Vendor may click the 'Details' hyperlink in the table to view the details of each invoice.
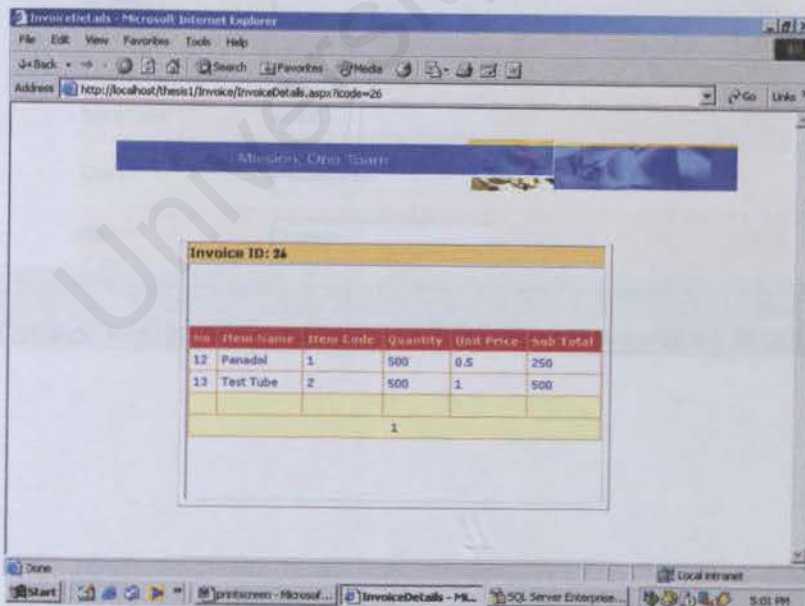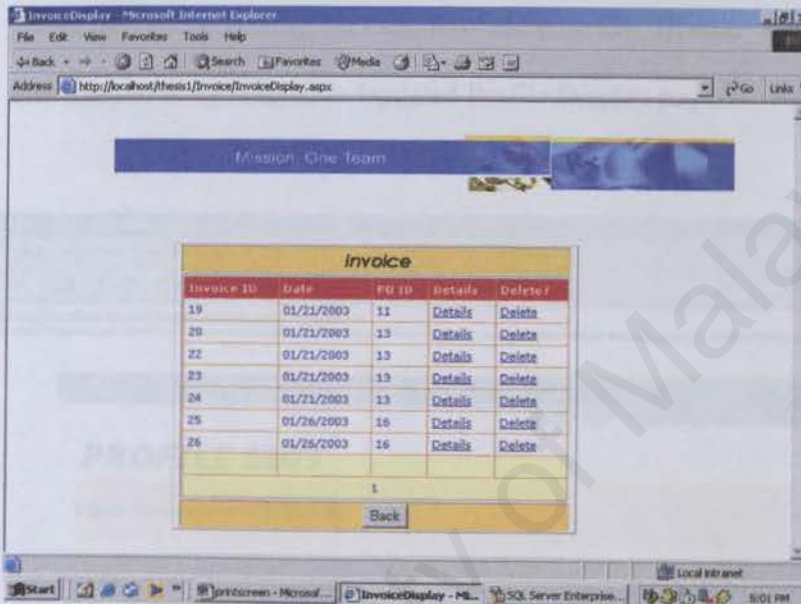
This page displays the details of each selected invoice.

- **Edit Profile Pages**

  User may edit his / her profile form time to time, by clicking the 'Edit Profile' hyperlink on the Vendor Page. There are editable textboxes that allowed the user to edit his / her profile directly on the form. When the user finish the profile editing, he / she may click on the 'Update' button at below this form to be redirected to Updated Profile Display page.

This page displays the updated profile which had been edited by the user.

- **No Access Page**

This is the warning page pop-up for vendor if he / she try to enter the

Administrative Staff Page.
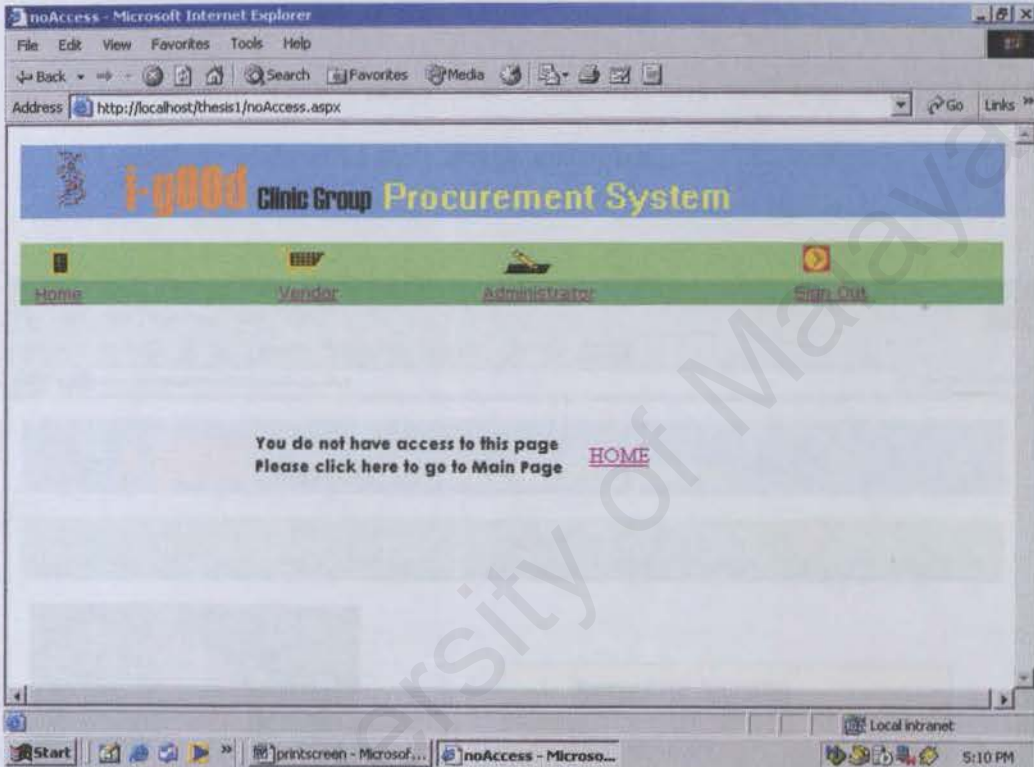
- **Administrative Staff Page**

  This page displays the list of functions for the administrative staff to execute their procurement transaction and manage the clinic group procurement system. There are five functions that been provided for administrative staff: Add Request for Quotation, View Quotation, Send Purchase Order, View Invoice and View Vendor List. Administrative staff may click on those hyperlinks to continue their system managing.
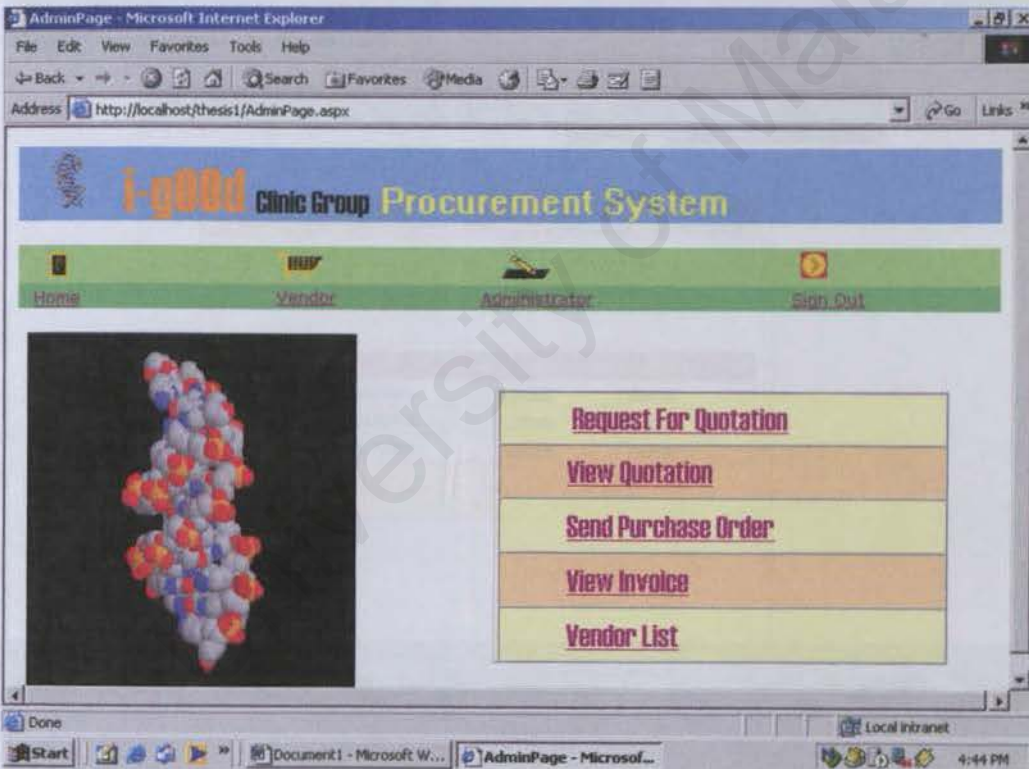
- **Request For Quotation (RFQ) Pages**

  The first page displays the list of RFQ that the administrative staff had
  uploaded on website previously. Staff may view the details of RFQ by
  clicking on 'Details" hyperlink, or redirected back to Administrative Staff
  Page by clicking on the 'Cancel' button. Staff can add a new RFQ by
  clicking the 'Add New' button.
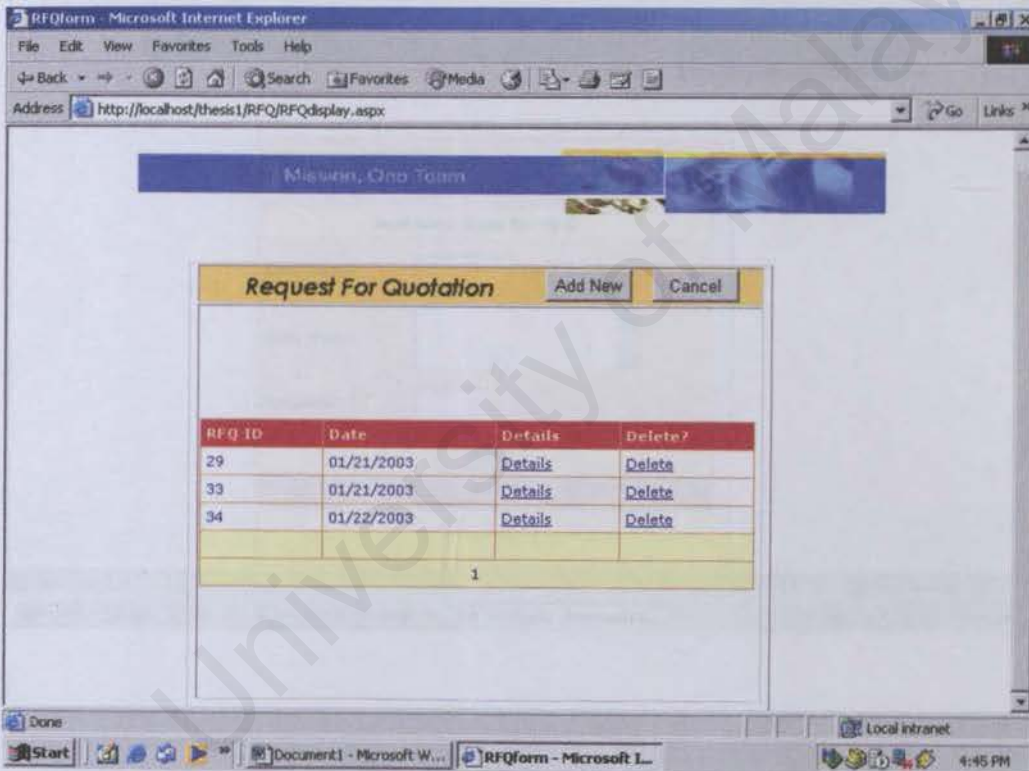
The 'Add New' button redirect user to this Add New Item for RFQ form. Staff can enter the information that needed for RFQ, include the item code, item name and quantity. The item has to be added one by one, by clicking 'Add' button each time finished entering one item information.

The table at below the form will display the entered information of items for the RFQ. Staff will upload the complete RFQ, by clicking the 'Submit' button.

After submitting the RFQ, staff will be redirected back to the first page of
RFQ Pages, which display the updated information about submitted RFQ.
Staff may click the 'Details' hyperlink in the table to view the details of each
RFQ.
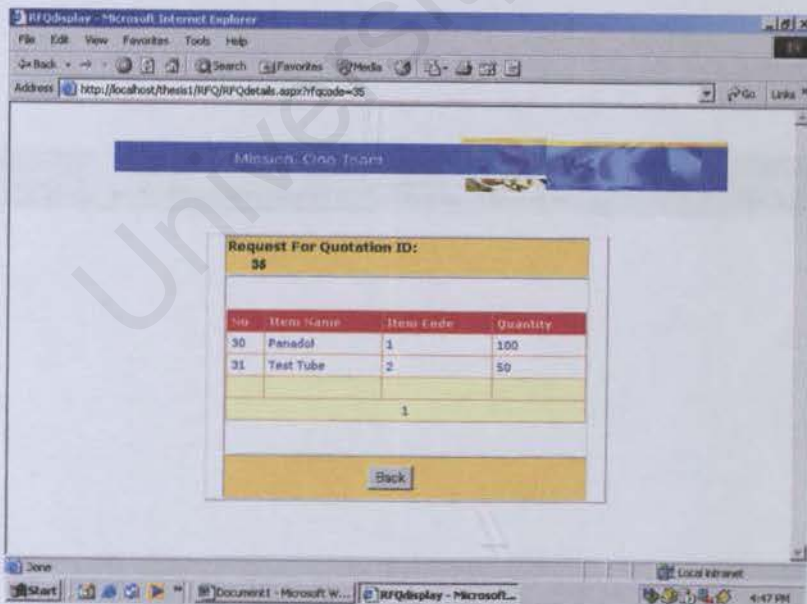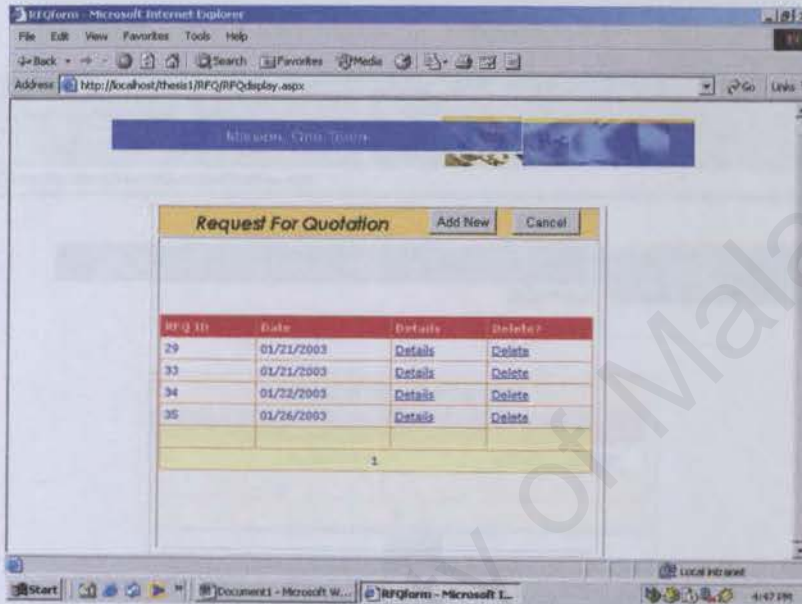
This page displays the details of each selected RFQ.

- **View Quotation**

This is the first page that displays the list of received Quotation which sent

by the vendor. Staff may view the details of quotation, by clicking 'Details'

hyperlink.
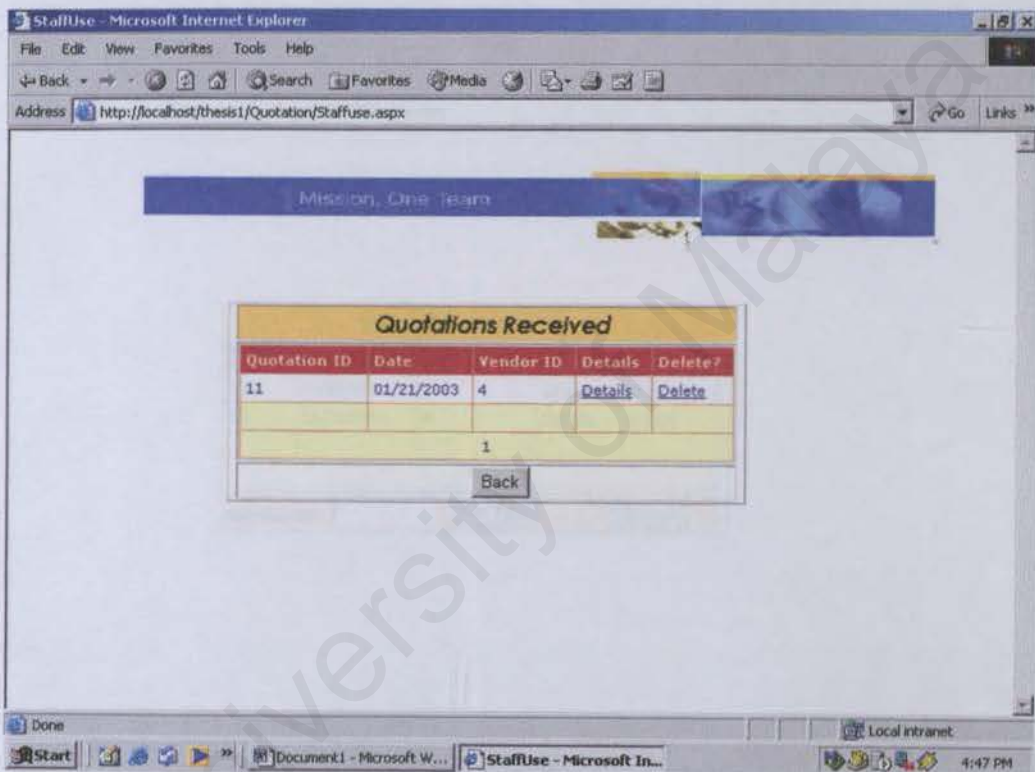
- **Send Purchase Order Pages**

    This is the first page that displays the list of Purchase Order (PO) which sent

    by the administrative staff previously. Staff may send the PO, by entering

    the specific Vendor ID and clicking on the 'Add New' button.

This is the redirected page that displayed the details of PO stated with PO Code and Vendor ID, when user clicks on the 'Details' hyperlink on the first page of Send PO Pages.

The 'Add New' button redirect user to this Add New Item for PO form. Staff can enter the information that needed for PO, include the item code, item name and quantity. The item has to be added one by one, by clicking 'Add' button each time finished entering one item information.

After submitting the PO, staff will be redirected back to the first page of PO Pages, which display the updated information about sent PO. Staff may click the 'Details' hyperlink in the table to view the details of each PO. User will be redirected back to Administrator Page by clicking 'Cancel' button.
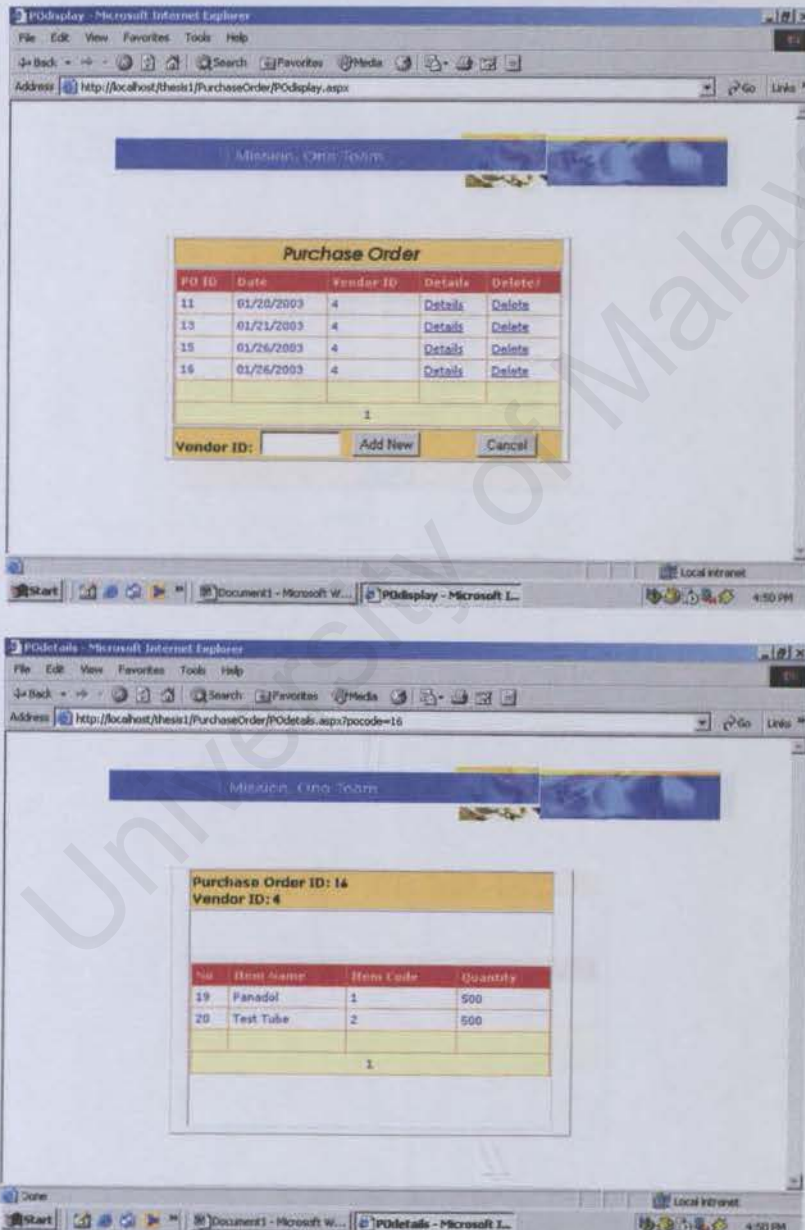
This page displays the details of each PO with stated PO Code and Vendor ID.

- **View Invoice Page**

  This is the first page that displays the list of received invoice which sent by the vendor. Staff may view the details of invoice, by clicking 'Details' hyperlink.
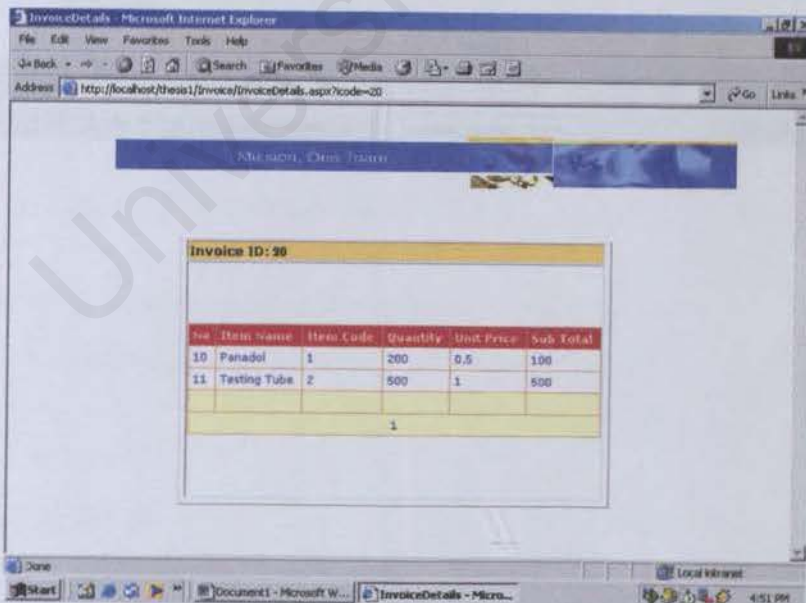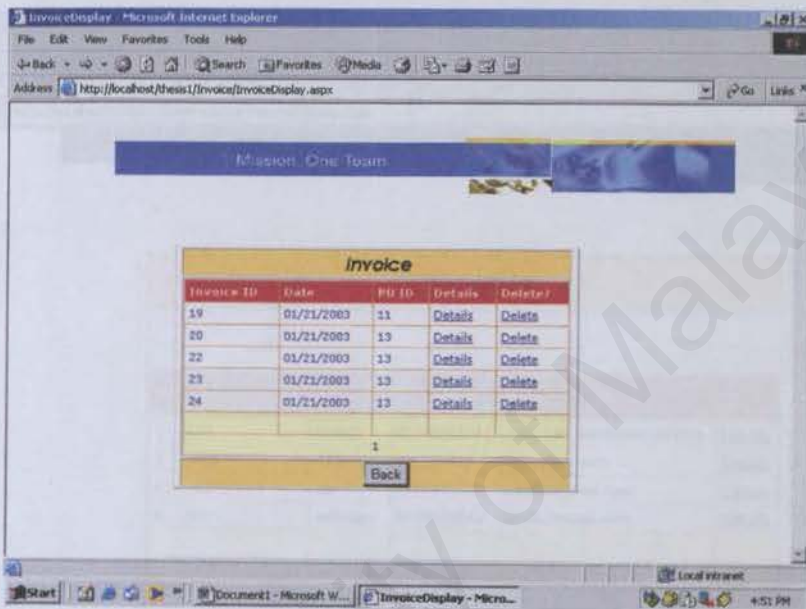
This page displays the details of each selected invoice.

- **Vendor List Page**

  This page displays the list of registered vendors to the PSCG website. Staff

  may click on the 'Details' hyperlink to view the details of vendors' profile.
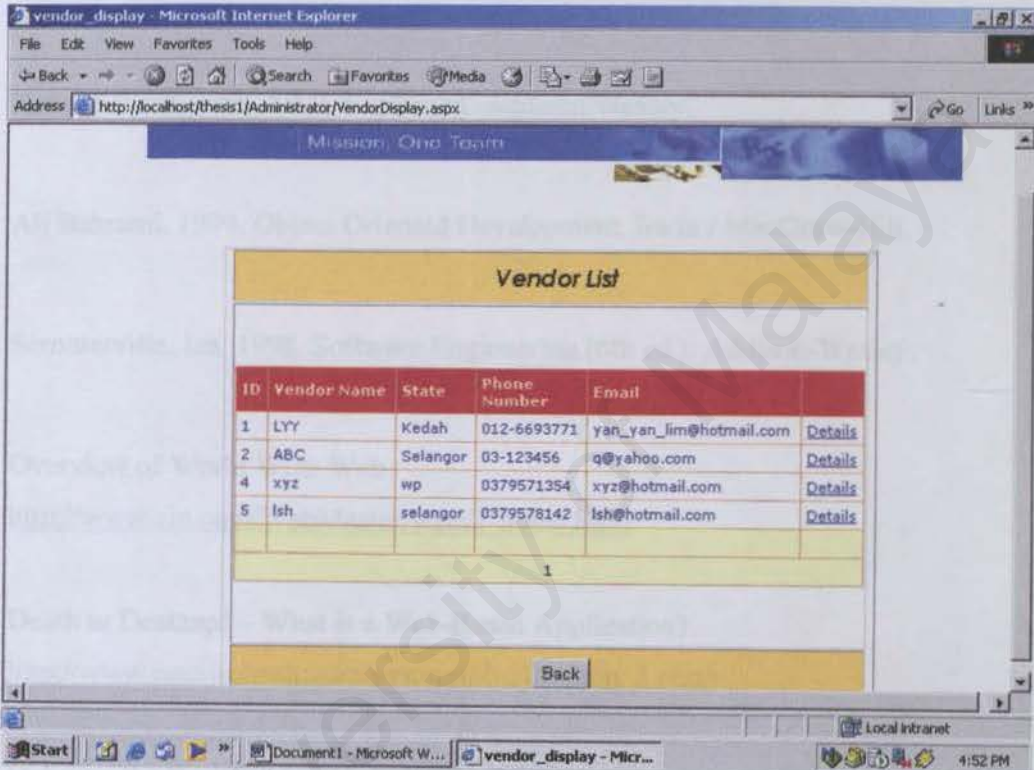
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http://www.internetweek.com/newslead01/lead042001.htm

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http://www.linux.org/info/index.html

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http://www.microsoft.com/windows2000/professional/default.asp

Apache

http://www8.zdnet.com/pcmag/features/webserver/iwsr1.htm

Access 2000

http://www.microsoft.com/office/access/default.htm

SQL

http://www.microsoft.com/sql/default.asp

Microsoft Internet Information Server

http://www8.zdnet.com/pcmag/features/webserver/iwsr5.htm

VBScript

http://msdn.microsoft.com/scripting/default.htm?/scripting/vbscript

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http://home.earthlink.net/~salhir

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http://www.frontiermedical.co.uk/services.html

Eastern State Hospital - Online Purchasing Guide Directory

http://www.easternstatehospital.org/purchas.htm#VENDOR

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