Tri-Health Clinical Engineering Web site
Clinical Engineering Virtual Toolkit

By

James E. Meyer

Submitted to
the Faculty of the Information Engineering Technology Program
in Partial Fulfillment of the Requirements for
the Degree of Bachelor of Science
in Information Engineering Technology

University of Cincinnati
College of Applied Science

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_____	_____
James E. Meyer	Date
_____	_____
Professor McMahon, Faculty Advisor	Date
_____	_____
Dr. Hazim Said, Department Head	Date

Acknowledgements

The Senior Design Project has been a challenging and rewarding experience. The time and effort required was at times overwhelming. I would like to thank Professor McMahon who guided me through the process and helped me see the small steps in the long journey. Professor McMahon has been a person I could always count on through my entire education experience. I truly appreciate all his understanding and assistance throughout my time at C.A.S.

The time I have dedicated to this project left me with little spare time. These last nine months were challenging in that I was removed from my normal life. My wife Jacque has been more supportive and understanding then a husband could wish. She has been my inspiration and driving force since the first day I decided to continue higher education. I could not have dreamed of making it this far without her support and love. I will always appreciate whatever success and prosperity that my time at C.A.S. may bring. It is a blessing that I may share this with Jacque.

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Abstract

The TriHealth Clinical Engineering Department is the support center for medical technologies and is responsible for biomedical devices and imaging systems used at TriHealth. They provide training to medical personnel in equipment operation and safety and the selection and use of technology to deliver safe and effective health care. TriHealth employees are not always aware of the role and contribution of Clinical Engineering in providing service excellence to our patients. Clinical Engineering technicians do not have a convenient and easily updated location for important resources needed to perform their role. *The TriHealth Clinical Engineering Web site and Virtual Toolkit* will provide information and resources to the TriHealth and Clinical Engineering employees. The project was built using Visual Studio 2005 with ASP.NET and VB.NET. A database was created using Microsoft SQL Server 2005. The application will allow access to Service Reports, Service Manuals and other technical documentation by the technicians anywhere there is Internet access.

1. Project Description

1.1 Problem Statement

The Clinical Engineering Department supports and advances patient care by applying technology and assets of management to the healthcare field. Relationships and interaction with many different professionals throughout the facilities occur daily. This requires information and resources be made available to these professionals which will assist in providing a safe environment for patients, staff and visitors and allow the professionals to be aware of all the services offered by Clinical Engineering.

1. TriHealth has an Intranet Web site (Sourcenet) that employees use to find information concerning many aspects that they may need to perform their duties. There are many hospital departments that have a presence on Sourcenet that contain valuable information for interaction with these departments. Clinical Engineering was not a part of Sourcenet. There have been requests to add Clinical Engineering to offer information to be located on Sourcenet. A Web site needed to be designed and implemented that would be added to Sourcenet.

2. The current Clinical Engineering database does not make provisions to store scanned documents. This is the form in which we receive all vendor service reports. Service manuals are a valuable tool technician's use on a daily basis. Most manufacturers today issue their manuals in electronic form, usually on CD media. Similar to service reports, these manuals are stored in non-centralized locations throughout the department. The same manual may be required by two technicians simultaneously. An effective option to

store and access vendor reports and service manuals was needed to help maintain records in a professional manner, and to reduce downtime and improve safety. Other resources that technicians may needs to perform their duties are an equipment responsibility list, a network settings list and vendor contact information. This information needs to be available after hours during an emergency. Technicians find that this information is rarely collected in one central area or updated to reflect current status. The problem has always been that it was difficult to take advantage of these resources because of the lack of organization and availability of these tools. A centralized virtual toolkit needed to be assembled, where there are easy, multiple accesses to each tool and where all resources can be conveniently updated.

1.2 Solution Description

1. A Web site has been developed and implemented that allows for Clinical Engineering presence on the TriHealth Intranet site, Sourcenet. Visual Studio 2005 has been used to build the Web site. The programming needed utilized VB.NET and ASP.NET. The information contained within the site includes the following:

- About Us
- Contact Us
- Policies
- Preventive Maintenance Schedule
- Equipment Serviced
- Feedback Form
- Clinical Engineering Virtual Toolkit (CE Staff only)

The Web site required a server to be built using an existing computer as the framework. A RAID 5 drive has been added for increased capacity, performance and reliability. Microsoft Server 2003 with Internet Information Services 6.0 enabled and SQL Server 2005 has been installed. During development and testing the server was located at my home. A broadband router and service has been installed with a wireless router. Network settings were programmed for the appropriate ports to be opened.

2. An application has been created using VB.net that will allow the user to be presented with a group of options. These are the virtual tools available to the technicians that are stored on the server.

The application has been programmed so that with each selection the tools desired are presented through the interface.

A SQL database has been developed to manage the storage of vendor service reports, device service manuals and equipment PM schedule.

There will be four main tool selections for the technicians to use.

- Vendor Service Reports: SQL queries were written via the application that requires the user to enter specific information concerning the service reports. The SQL database returns the requested report in PDF form.
- Service Manuals: This selection allows the technician to retrieve manuals in electronic form stored on the server. The application provides fields to be entered and SQL queries are built to return the requested service manuals in PDF form.
- Shared Resources: Technicians have access to information that is critical to their job responsibilities. This is an area available to all Virtual Toolkit users.

- Private Resources: This is a private resource area available to the session user and not viewable by any other user.

1.3 User Profile

The primary users of the TriHealth Clinical Engineering Web site are the Organizations employees. They comprise many different levels of skill and knowledge. The navigation was kept clean and simple. Basic computer skills are required of the users who access the Clinical Engineering information.

The users of the Clinical Engineering Virtual Toolkit are the Clinical Engineering technicians. They are highly trained and qualified to interact with the application and the private information located on the server.

2. Design Protocols

The purpose of this project was to assemble resources for TriHealth employees and Clinical Engineering employees in one convenient easily updated location. The Web site lists options available to the employees in the navigation bar on the top of all pages. The default homepage focuses on basic information concerning Clinical Engineering and updates, current events and links. This required components of all four areas of Information Technology.

- Database Design: A SQL Server 2005 database has been built to store and query the PM schedule, vendor service reports, vendor service manuals and user information for the Virtual Toolkit.
- Networking: A Windows Server 2003 machine has been built utilizing I.I.S. 6.0. A RAID 5 logical drive has been installed. A wireless network has been installed

that allows the Web site to be connected to the internet by having a domain name of www.trihealth-ce.com using the no-ip.com client to allow for a dynamic IP address.

- Programming: The Web site has been created by using HTML. Interaction with the server is accomplished by programming pages with VB.NET and ASP.NET with Visual Studio 2005.
- Multimedia: The Web site appearance is supported by a simple but pleasing layout using Photoshop 7.0 to enhance and create images used.

2.1 Available Options to Users

- About Us section. Describes Clinical Engineering's responsibilities and information about the Clinical Engineering department employees.
- Contact Us section. Contact information during normal hours, after hours and email.
- Policies section. The department policies are available to view.
- Preventive Maintenance Schedule section. Schedule of all serviced cost centers is available to view.
- Equipment Serviced section. Information concerning equipment serviced.
- Clinical Engineering Virtual Toolkit. An area for Clinical Engineering employees only, where they can access resources that are listed in part 2 of the Solution Description.

2.3 Virtual Toolkit Function

Each technician is assigned a login and password. A Web page is displayed where the user enters name and password. After the input is verified by the database a page is presented welcoming the technician to the Virtual Toolkit. There are four selections for the technician to choose their action:

1. The Vendor Service Reports selection presents the technician with a choice to upload a report to the database or to search for a report. Information is needed to be entered into respective text boxes. Any combination of the following returns a page which includes a link to download the requested report: Control number, device, manufacturer, or work order number.
2. The Vendor Service Manual selection presents the technician with a choice to upload a manual to the database or to search for a manual. Information is needed to be entered into respective text boxes. Any combination of the following returns a page which includes a link to download the requested manual: Control number, device, manufacturer or model.
3. The Shared Resources selection displays files that are available for download from the server. The user may also upload files to be stored on the server.
4. The Private Resources selection displays files that are available for download from the server. The user may also upload files to be stored on the server. This information is only viewed and accessed by the user that is logged in for the current session.

3. Deliverables

The Clinical Engineering department Web site is an area where the Organizations employees can gather comprehensive information about the department and its responsibilities. This project delivers specific topics which have been requested. They are listed below:

1. The TriHealth Clinical Engineering Web site that will be used as a resource for the Organizations employees.
    - About Us page.
    - Contact Us page.
    - Policies page.
    - Preventive maintenance schedule page.
    - Equipment Serviced page.
    - Clinical Engineering Virtual Toolkit.

2. The Clinical Engineering Virtual Toolkit.
    - The Networking area encompasses a server using an existing computer as the framework. A RAID 5 drive was added for increased capacity, performance and reliability. Microsoft Server 2003 with Internet Information Services 6.0.is used.
    - A broadband wireless network has been installed to allow opening ports needed to operate a Web Server.

- A domain name has been registered as www.trihealth-ce.com. The no-ip.com client was installed for dynamic IP address allowance.
- SQL Server 2005 database has been created to allow for storage of PM schedule, user information, vendor service reports and vendor service manuals.
- An application has been written using VB.NET and ASP.NET with Visual Studio 2005 to allow the users to interface with the information stored on the server.
- Resource data storage area has been created on the server which allows users to read and write files and information needed.

4. Proof of Design

The goal of this project was to build a solution to the problem discussed in the Project Description section:

- Provide for Clinical Engineering presence on the TriHealth intranet, supplying information about Clinical Engineering.
- Provide virtual tools for the Clinical Engineering technicians.

An effective content Web site gives the user a simple, easy to navigate avenue to find needed information that will improve the relationship between the clinicians and Clinical Engineering. An understanding of Clinical Engineering, their role and purpose allows the users to have a better understanding of the resources provided.

The default page for www.trihealth-ce.com is the Home Page (See Figure 1). The style of all the pages in the Web site follows the Home Page. It has a header image at the top of the page, followed by a navigation area, which has links to all the other pages on the

Web site. The content area will follow and then the footer is displayed. The content area of the Home Page serves three purposes. The first box contains information about the Clinical Engineering department and their role in the Organization. The second box will be updated with recent information concerning what's new in Clinical Engineering. The third box will include links relevant to the content.

Figure 1. Home Page.

4.1 About Us Page

The About Us Page (See Figure 2) offers the user to select Bethesda North Hospital or Good Samaritan Hospital employee's page. These pages include staff pictures and information about each Clinical Engineering employee.

Figure 2. About Us Page.

4.2 Contact Us Page

The Contact Us Page (See Figure 3) offers the user information concerning how to contact Clinical Engineering employees during normal hours and after hours and lists employee Email.

Home About Us Contact Us Policies PM Schedule Equipment We Service Feedback CE Employees Only

Please use the information below to contact Clinical Engineering:

BETHESDA NORTH HOSPITAL

James E. Meyer, Account Manager 745-1295
james_meyer@trihealth.com

Clinical Engineering Technicians are on site Monday- Friday, 7:00AM – 3:30PM.

Biomedical Technicians may be reached at **745-1295.**

Imaging Technicians may be reached at **745-1593.**

After hours and weekends: (Please leave a call back number)

Biomedical Technicians on–call pager **350-0068**

Imaging Technicians on–call pager **350-1196.**

Technician Email:

Mike Zimpelman CBET, Lead BMET
mike@zimpelman@trihealth.com

Darrell Neuhausel CBET, Senior BMET
darrell_neuhausel@trihealth.com

Jim Voll CBET, Senior BMET
jim_voll@trihealth.com

Jamie Trett, BMET I
jamie_trett@trihealth.com

Richard Gaskin, Senior Field Service Specialist
richard_gaskin@trihealth.com

Richard Longstreth, Filed Service Specialist
Richard_longstreth@trihealth.com

John Teeple, BMET II
John_teeple@trihealth.com

GOOD SAMARITAN HOSPITAL

Troy Scott, Account Manager 872-1501
troy_scott@trihealth.com

Dianne Werling, Administrative Assistant 872-1501
dianne_werling@trihealth.com

Figure 3. Contact Us Page.

4.3 Policies Page

The Policies Page (See Figure 4) offers the user the opportunity to view the Clinical Engineering department's policies.

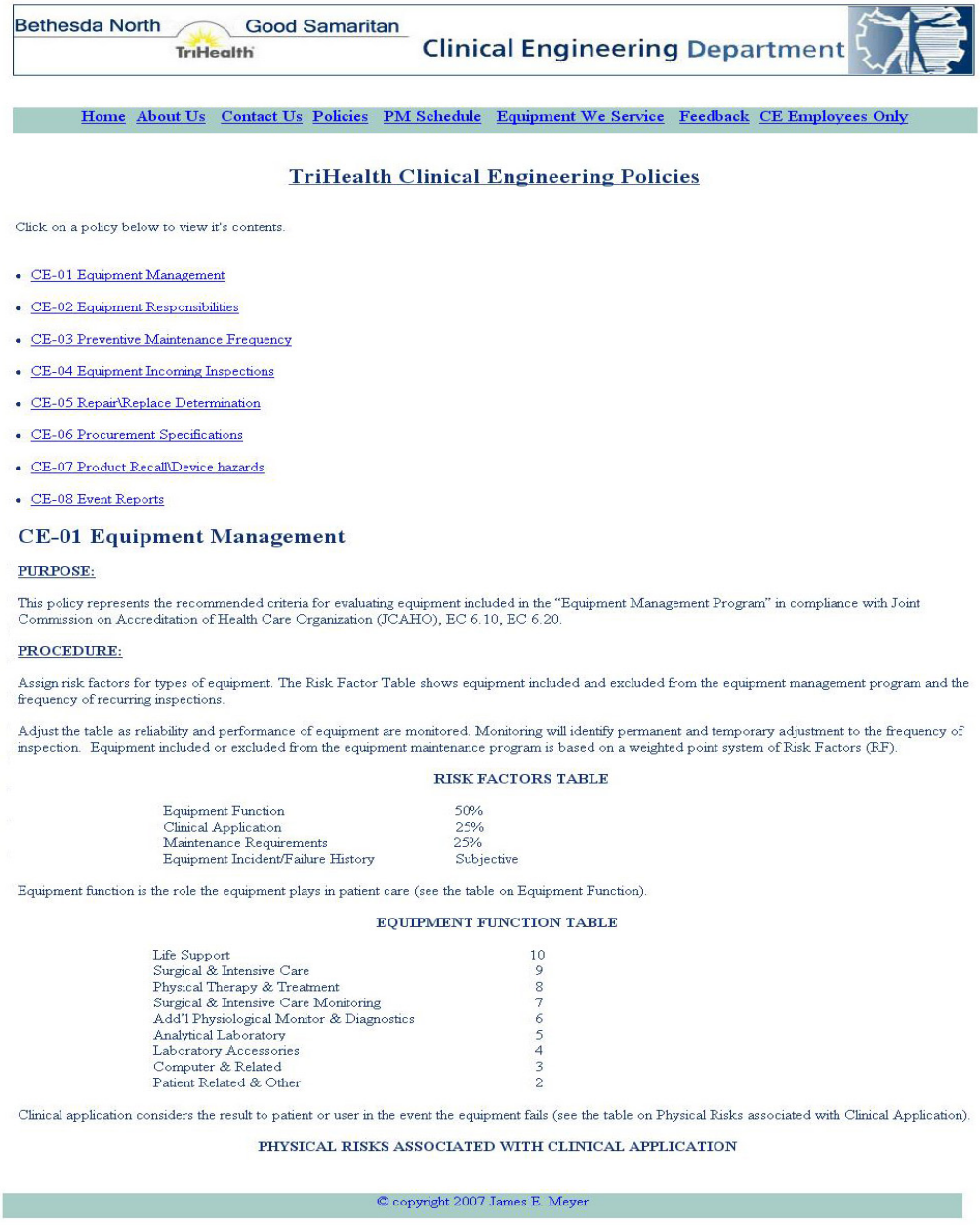


Figure 4. Policies Page.

4.4 PM Schedule Page

The PM Schedule Page (See Figure 5) will allow users to enter the cost center number for their department into a text box. When the search button is clicked a new page will return that will list equipment types and the months when the PM's are due to be completed.

Figure 5. PM Schedule Page

4.5 Equipment We Service Page

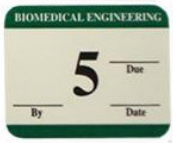
The Equipment We Service Page (See Figure 6) explains how to determine if the device is part of the Clinical Engineering Equipment Management Plan, and if the device does not have the needed identification then Clinical Engineering should be contacted.

Bethesda North Good Samaritan TriHealth Clinical Engineering Department

Home About Us Contact Us Policies PM Schedule Equipment We Service Feedback CE Employees Only

Equipment Serviced by Clinical Engineering

The TriHealth Clinical Engineering department services a wide range of medical equipment. The total inventory is over 12,000 items and growing as our facilities expand. All of the devices that Clinical Engineering maintains will have the following identification label and inspection tag if a Preventive Maintenance is required.



If your department is using a medical device without the orange identification label, Contact Clinical Engineering.

Figure 6. Equipment We Service Page.

4.6 Feedback Page

The Feedback Page (See Figure 7) provides an opportunity for the user to provide feedback about Clinical Engineering to the department leadership. There was not an option to receive unsolicited comments before the creation of the Web site. The goal is to eliminate small issues growing into a major problem by addressing them before this happens. It is also hoped that positive comments will be received and passed onto the employees to maintain a positive atmosphere.

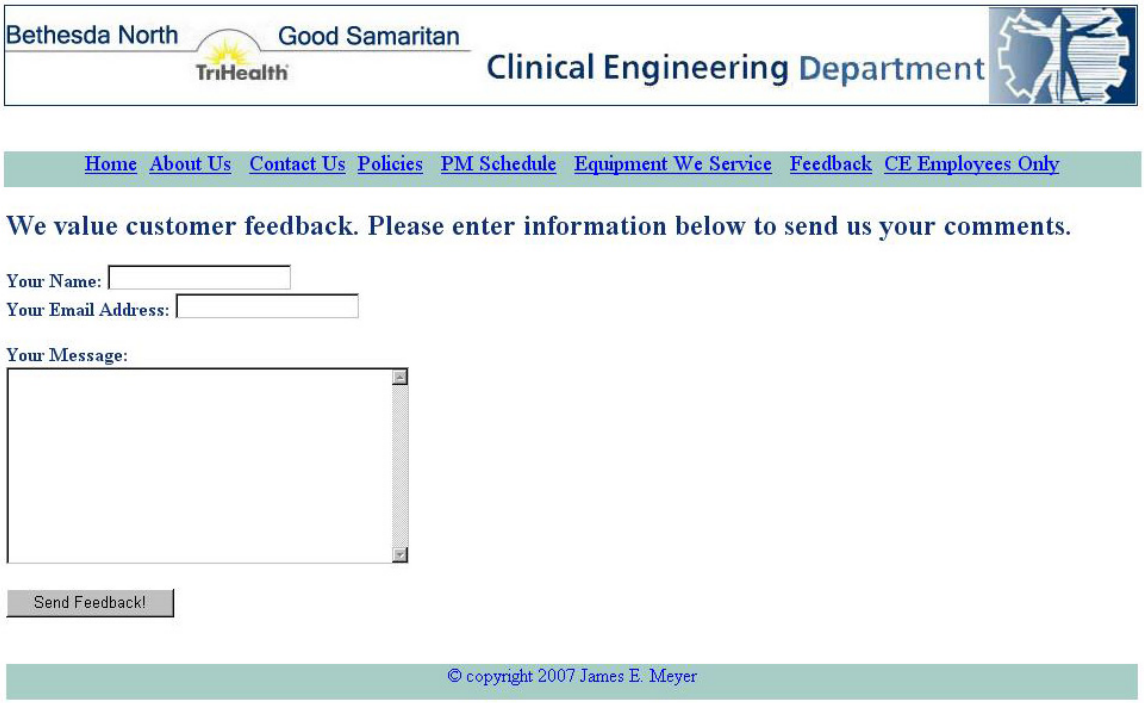


Figure 7. Feedback Page.

4.7 Virtual Toolkit

The goal of the Virtual Toolkit was to provide a content management area for the TriHealth Clinical Engineering technicians. This application will allow the department to have a managed and easily updated Web site that can be accessed anywhere there is Internet access. An effective option to store and access vendor service reports, vendor service manuals and other resources was needed to help maintain records in a professional manner, and to reduce downtime and improve safety.

The users of the Virtual Toolkit are all employees of the Clinical Engineering department. Each employee has been issued a user name and password. When the CE Employees Only link is selected from the navigation bar, the Login Page is loaded. (See Figure 8)

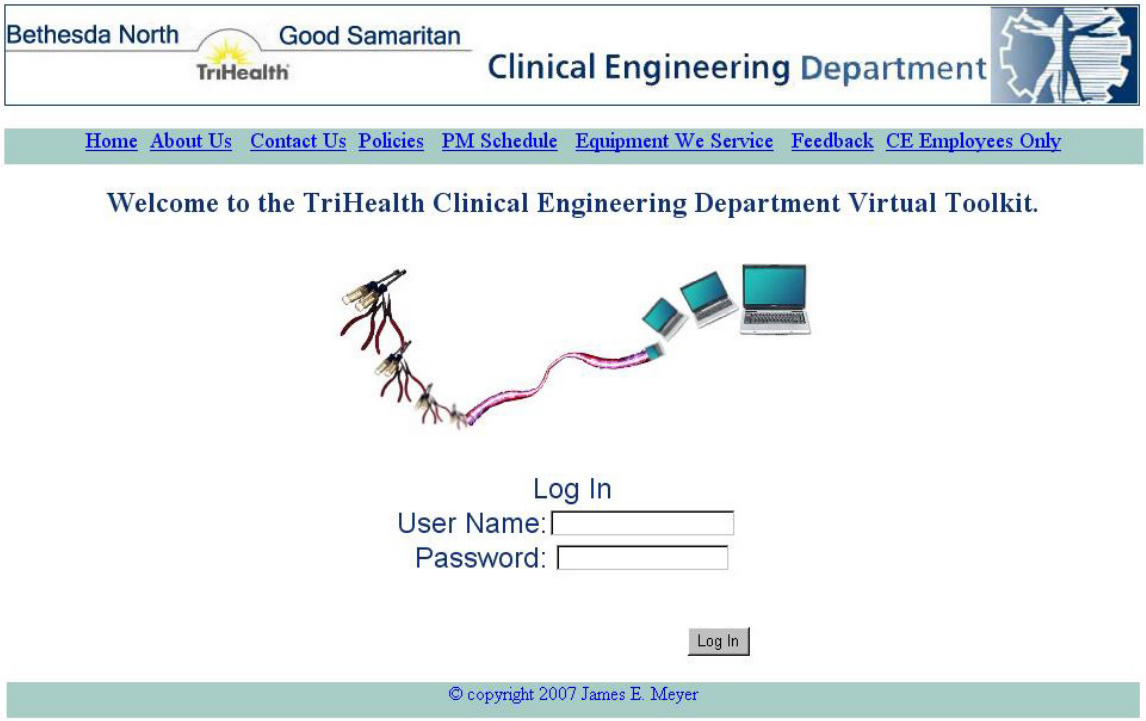


Figure 8. **Virtual Toolkit Login Page**.

After successful login, the user will be presented with four choices: Vendor Service Reports, Service Manuals, Shared Resources and Private Resources. The Reports and Manuals page will allow the user to select either upload or download function.

4.7.1 Store Vendor Service Report Page

The Store Vendor Service Report Page (See Figure 9) allows the user to upload a service report to the server. Information must be entered into the text boxes and this information along with the file location is stored as an entry in the SQL Server 2005 database.

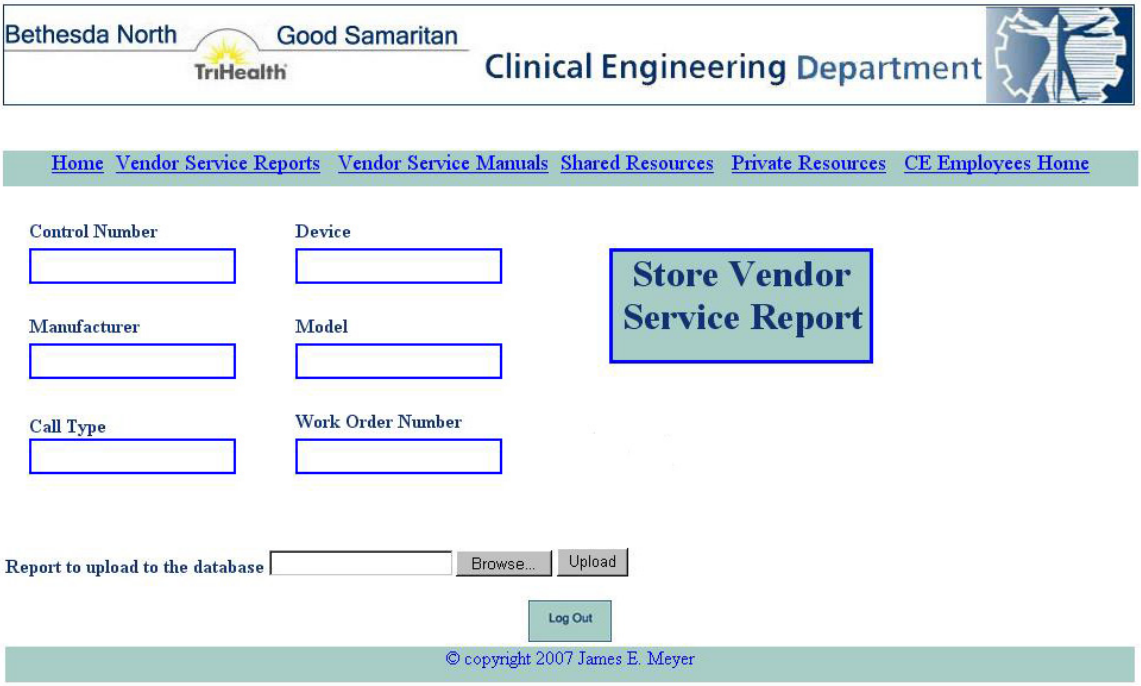


Figure 9. Store Vendor Service Report Page.

4.7.2 Download Vendor Service Report Page

The Download Vendor Service Report Page (See Figure 10) allows the user to download a service report from the server. Information must be entered into the text boxes. When the user clicks the Display Search button, the text box information is used to build a SQL query and if there is a match, a new page is loaded. This page will show the results of the query with a link to the requested report (See Figure 11). If the user clicks the Return All button, the return page will include all records in the database.

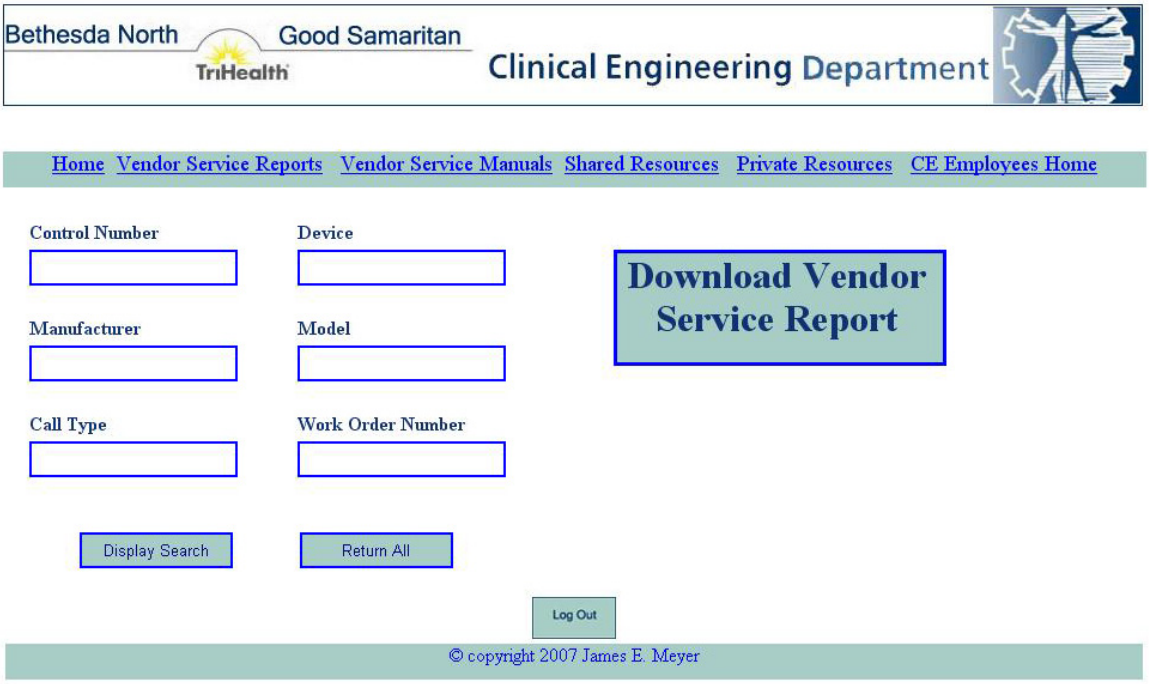


Figure 10. Download Vendor Service Reports Page.

Home Vendor Service Reports Vendor Service Manuals Shared Resources Private Resources CE Employees Home

Control_Number	Device	Model	Manufacturer	Work Order Number	Call Type	FileName
01-307211	CT	Sensation 16	Siemens	01103425	R	307211_CT_Sensation 16
01-307213	CT	Sensation 16	Siemens	01103426	R	307213_CT_Sensation 16
01-307255	CT	Sensation 16	Siemens	01103455	R	400101710013.pdf
01-123456	LinAc	Medus	Siemens	01101234	R	01-123456_MEDUS.pdf
01-305910	Gamma Camera	E-cam	Siemens	01238032	P	01-305910.01238032.400300320771.34662.04-11-2007.pdf
01-305910	Gamma Camera	E-cam	Siemens	01238032	P	01-305910.01238032.400300322512.04-11-2007.pdf
01-305910	Gamma Camera	E-cam	Siemens	01238032	P	01-305910.01238032.400300320771.34662.04-11-2007.pdf
01-303067	Linear Accelerator	Mevatron	Siemens	01238742	r	400101868915.32846.04-12-2007.pdf
01-303067	Linear Accelerator	Mevatron	Siemens	01238742	r	400101868915.32846.04-13-2007.pdf
01-300091	CT	Volume Zoom	Siemens	01238740	r	400101872888_075920_MAIL_549278_MEDUS.pdf

1 2

Figure 11. Report Search Return Page.

4.7.3 Store Vendor Service Manual Page

The Store Vendor Service Manual Page (See Figure 12) allows the user to upload a service manual to the server. Information must be entered into the text boxes and this information along with the file location is stored as an entry in the SQL Server 2005 database.

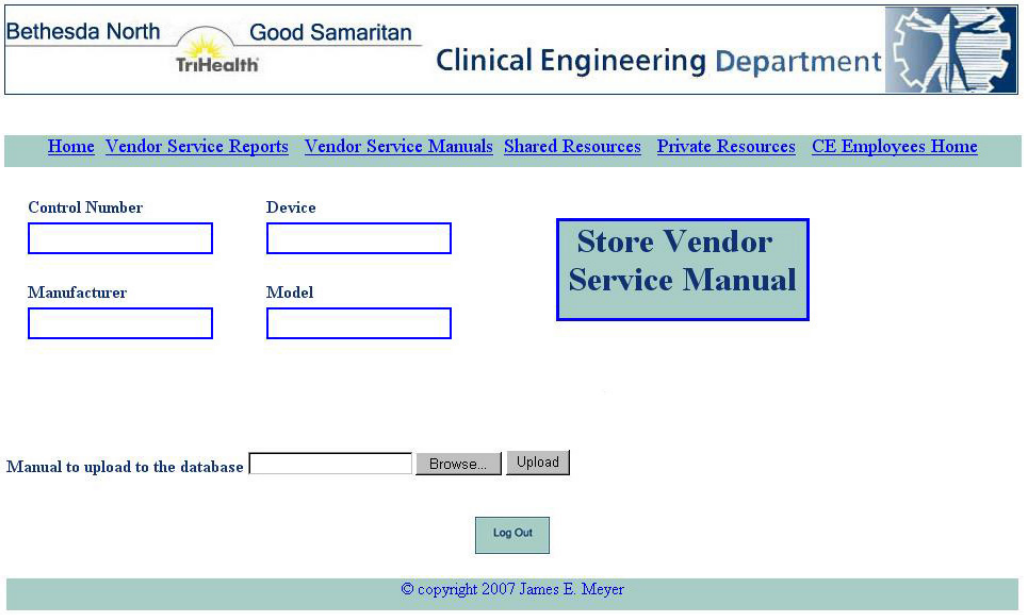


Figure 12. Store Vendor Service Manual Page.

4.7.4 Download Vendor Service Manual Page

The Download Vendor Service Manual Page (See Figure 13) allows the user to download a service manual from the server. Information must be entered into the text boxes. When the user clicks the Display Search button, the text box information is used to build a SQL query and if there is a match, a new page is loaded. This page will show the results of the query with a link to the requested report (See Figure 14). If the user clicks the Return All button, the return page will include all records in the database.

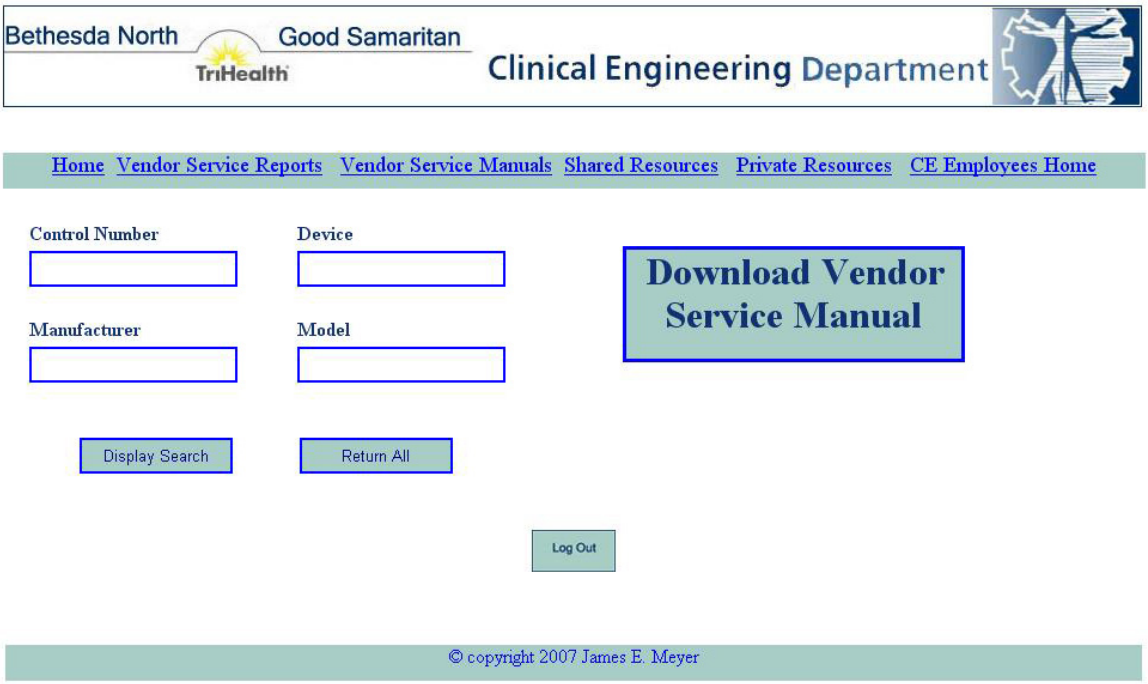


Figure 13. Download Vendor Service Manual Page.

Home Vendor Service Reports Vendor Service Manuals Shared Resources Private Resources CE Employees Home

Device	Control_Number	Model	Manufacturer	FilePath	FileName
2	1	3	4	../Manuals/test3.txt	test3.txt
1	2	1	1	../Manuals/test3.txt	test3.txt
1	01-334455	1	1		test
ct	11100	10	siemens	../Manuals/Labor Rates 02.04 w changes.doc	Labor Rates 02.04 w changes.doc
w	01-999999	w	w	../Files/test2.txt	
1	01-666666	1	1	../Manuals/Philips	test2.txt
23	01-999999	23	23	../Files	a401253.pdf
12	12	12	12	../Files/test2.txt	test2.txt
test	01-196555	test	test	../Files/a401253.pdf	a401253.pdf
44	44	44	44	../Manuals/test3.txt	test3.txt
00	00	00	00	../Manuals/test3.txt	test3.txt
Patient Monitor	01-303000	Intellivue	Philips	../Manuals/wellness.pdf	wellness.pdf
77	77	77	77	../Manuals/SR0360693661.PDF	SR0360693661.PDF
123	123	123	123	../Manuals/Test_Service_Manual.pdf	Test_Service_Manual.pdf
1	1	11	11	../Manuals/2test.txt	2test.txt

Figure 14. Manual Search Return Page.

4.7.5 Shared Resources Page

The Shared Resources Page (See Figure 15) allows the user to view additional resources on the server that they may need to perform their duties. The application will also allow the user to upload files to the server. These resources are available to any user that is logged into the application.

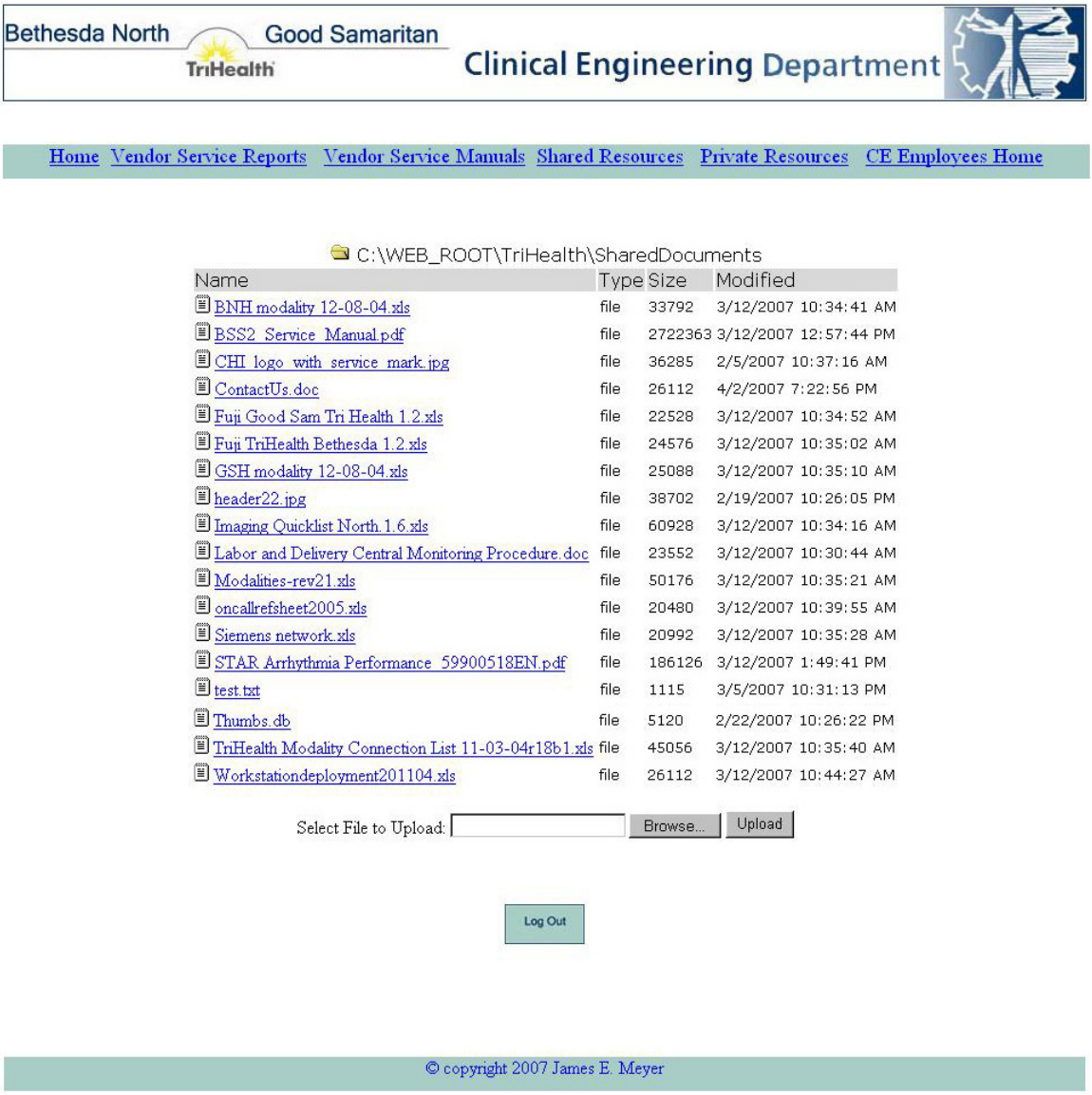


Figure 15. Shared Resources Page.

4.7.6 Private Resources Page

The Private Resources Page (See Figure 16) provides the user individual private storage space on the server. The user may store any information they may feel appropriate. The user has the option to upload and download files. Each user only has accessed to the space assigned to their user name. They may not view any other private resources.

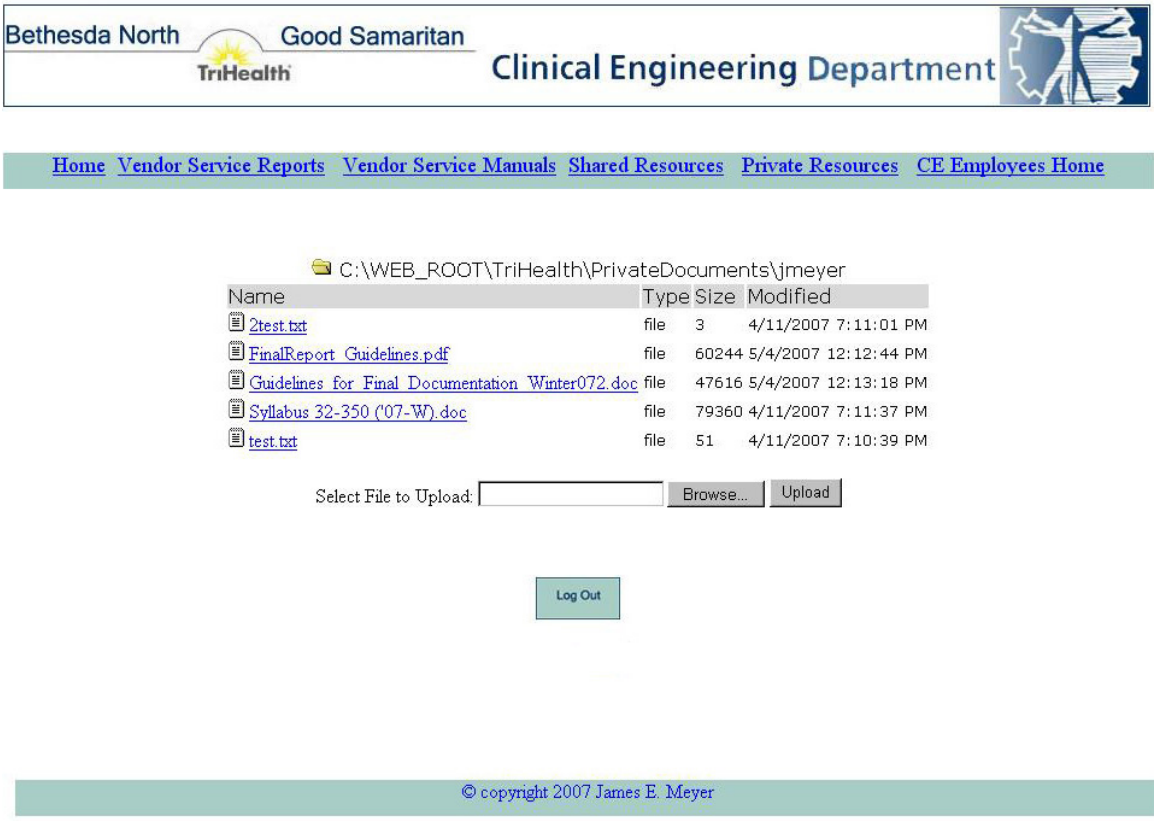


Figure 16. Private Resources Page.

5. Design and Development

5.1 Timeline

There has been a sequence of steps taken in order to complete the project on time. There were some tasks that overlapped and were dependent upon each other. Figure 17 below reflects the followed timeline.

ID	Task Name
1	Research
2	Develop Draft Proposal
3	Write Final Proposal/Presentation
4	Present Proposal
5	Build Server
6	Set Up Server and Netw ork
7	Server and Netw ork Complete
8	Learn Visual Studio 2005
9	Build Database Tables
10	Build Web site
11	Design Freeze
12	Complete Prototype Web site
13	Prototype Web site Complete
14	Present Design Freeze
15	Insert Information into Database
16	Complete Programming Web site
17	Test Web site
18	Edit Web site
19	Write Final Report
20	Web site Complete
21	Present Final Report

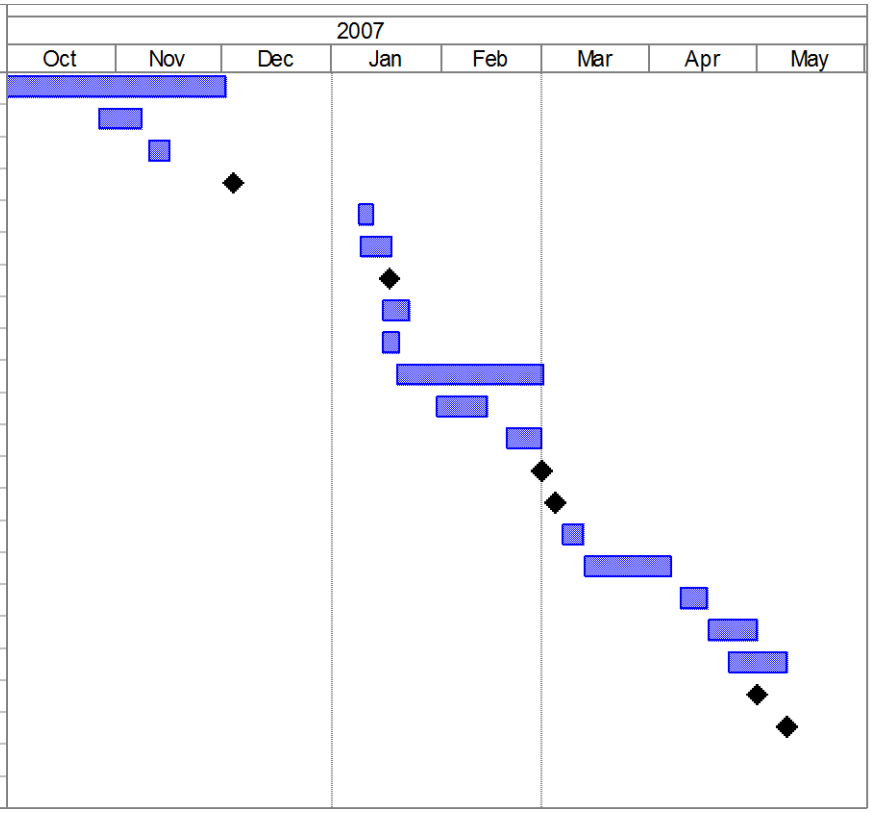


Figure 17. Timeline.

5.2 Budget

The final budget for this project is described below in Figure 18. The total retail cost of the project was $7268.00. The majority of the hardware, software and licensing agreements were provided by my employer. ISP charge, domain registration, IP reconciliation and Visual Studio 2005 were costs I incurred.

Item	Description	Retail Cost	Employer Cost	My Cost
Server	Provided by Employer	$3500.00	$2500.00	$0.00
RAID 5 Drive	Provided by Employer	500.00	400.00	0.00
Access Point	Provided by Employer	200.00	150.00	0.00
Domain Registration	My Cost	25.00	0.00	25.00
No-Ip.com Registration	My Cost	25.00	0.00	25.00
Broadband Service	My Cost	120.00	0.00	120.00
Windows Server 2003	Provided by Employer	999.00	400.00	0.00
Adobe Photoshop 7.0	Provided by Employer	599.00	300.00	0.00
SQL Server 2005	With VS 2005	700.00	0.00	0.00
Microsoft Outlook 2003	Provided by Employer	100.00	25.00	0.00
Visual Studio 2005	My Cost	500.00	0.00	24.95
TOTAL		**$7268.00**	**$3775.00**	**$194.95**

Figure 18. **Budget.**

5.3 Hardware

Listed below are the hardware specifications used for this project.

Operating System
Windows Server 2003 Enterprise Edition Service Pack 1 (build 3790)

System Model
FUJITSU SIEMENS CELSIUS R610 System Serial Number: YBDQ002086 Enclosure Type: Desktop

Processor [a]
3.07 gigahertz Intel Xeon (2 installed) 8 kilobyte primary memory cache 512 kilobyte secondary memory cache

Main Circuit Board [b]
Board: Tyan Computer Corporation S26361-D1357 Serial Number: YBDQ002086 Bus Clock: 533 megahertz BIOS: Phoenix Technologies Ltd. 1.02.1357 03/02/2003

Drives
499.97 Gigabytes Usable Hard Drive Capacity 488.63 Gigabytes Hard Drive Free Space JLMS XJ-HD166S [CD-ROM drive] PLEXTOR CD-R PX-W4824A [CD-ROM drive] 3.5" format removable media [Floppy drive] Promise 3 Disk RAID5 SCSI Disk Device (499.98 GB) -- drive 0 WD 2000JB External USB Device [Hard drive] (200.05 GB) -- drive 1

Memory Modules [c,d]
2048 Megabytes Installed Memory Slot 'J5G1' has 512 MB Slot 'J5GY1' has 512 MB Slot 'J5G2' has 512 MB Slot 'J5GY2' has 512 MB

Local Drive Volumes		
c: (NTFS on drive 0)	499.97 GB	488.63 GB free

Controllers
Standard floppy disk controller Intel(R) 82801DB Ultra ATA Storage Controller-24CB Primary IDE Channel [Controller] Secondary IDE Channel [Controller]

Display
Standard VGA Graphics Adapter [Display adapter] Plug and Play Monitor

Bus Adapters
Adaptec AIC-7902-based Ultra320 SCSI (2x) Windows Promise FastTrak TX4310 (tm) Controller Windows Promise RAID Console SCSI Processor Device Intel(r) 82801DB/DBM USB 2.0 Enhanced Host Controller - 24CD Intel(r) 82801DB/DBM USB Universal Host Controller - 24C2 Intel(r) 82801DB/DBM USB Universal Host Controller - 24C4 Intel(r) 82801DB/DBM USB Universal Host Controller - 24C7

Multimedia
Multimedia Audio Controller

Communications

1394 Net Adapter
Intel(R) PRO/1000 MT Network Connection
primary Auto IP Address: 192.168.1.100 / 24
Gateway: 192.168.1.1
Dhcp Server: 192.168.1.1
Physical Address: 00:E0:81:51:25:96

Networking Dns Server: 192.168.1.1

Virus Protection

Symantec AntiVirus Corporate Edition Version 9.0.0.338
Scan Engine Version 71.2.0.12
Virus Definitions Version 5/3/2007 Rev 17
Last Disk Scan on Monday, January 08, 2007 9:29:09 PM
Realtime File Scanning On

Other Devices

Texas Instruments OHCI Compliant IEEE 1394 Host Controller
HID-compliant device
USB Human Interface Device (2x)
Standard 101/102-Key or Microsoft Natural PS/2 Keyboard
HID-compliant mouse
PS/2 Compatible Mouse
USB Composite Device
USB Mass Storage Device
USB Root Hub (4x)

Figure 19. Hardware Specifications.

5.4 Software

Listed below are the software and versions used for this project.

Software Versions	
Adobe Acrobat Version 8.0.0.0	Microsoft SQL Server Version 9.00.3042.00
Adobe Reader Synchronizer Version 8, 0, 0, 0	Microsoft® .NET Framework Version 2.0.50727.42
Adobe Reader Version 8.0.0.2006102300	Microsoft® Visual Studio® 2005 Version 8.0.50727.42
Microsoft (r) Windows Script Host Version 5.6.0.8827	Microsoft® Visual Studio® 2005 Version 8.00.50727.42
Microsoft Corporation - CE Remote Tools Version 5.01.1651	PepiMK Software - Spybot - Search & Destroy Version 1, 3, 0, 12
Microsoft Corporation - Internet Explorer Version 6.00.3790.1830	Safer Networking Limited - SpyBot-S&D Version 1, 3, 0, 12
Microsoft Corporation - Internet Information Services Version 6.0.3790.1830	Symantec AntiVirus Version 9.0.0.338
Microsoft Corporation - Office Source Engine Version 11.0.5525	Symantec Corporation - Common Client Version 2.2.0.577
Microsoft Corporation - PKM Version 9.107.5512.0	Symantec SAVRoam Version 1.5.0.0
Microsoft Corporation - Watson Subscriber for SENS Network Notifications Version 11.0.6555	Symantec Security Drivers Version 5.3
Microsoft Corporation - Windows Installer - Unicode Version 3.1.4000.1830	WinZip Version 11.0 (7313)
Microsoft Data Access Components Version 3.526.1830.0	Wizards to adjust .NET Framework security, assign trust to assemblies, and fix broken .NET applications. Version 1.0.5000.0
Microsoft SQL Server Analysis Services Version 9.00.1399.06	
Microsoft SQL Server Version 8.00.194	

Figure 20. Software and Versions.

5.6 Testing

Testing was performed throughout the duration of the project. As different pages of the Web site were built, they were debugged and checked for technical and presentation consistency with the rest of the application. When the new pages were put online, they were tested by multiple users. The Director of Clinical Engineering was notified of the changes. Problems or issues were sought out and corrected. All feedback was considered and acted upon. Errors were corrected and relevant changes were made to assure that the technicians and users would find the Web site and Toolkit useful.

6. Conclusions and Recommendations

The goal of the TriHealth Clinical Engineering Web site and Clinical Engineering Virtual Toolkit was to fulfill the need to have access to information and provide an easily accessed and upgradeable content management system. The Web site will provide the employees of TriHealth information and tools to continue to provide service excellence to all our patients. Clinical Engineering technicians will save time and improve quality by being able to quickly store and access any needed resources from anywhere there is Internet access.

Although this project was quite a challenge, I am pleased with the outcome and I will always value the knowledge and confidence I have gained by putting forth my best effort. This project proved to me that anything can be achieved if you have a positive and confidant opinion of yourself and your task.

Appendix A.
Code Snippets

A1. Code Snippet for Private Documents (Private.aspx).

```
<%@ Import Namespace="System.IO"%>
<html xmlns="http://www.w3.org/1999/xhtml" >

<head id="Head1" runat="server">

  <title>Virtual Toolkit Private Resources</title>

    <link href="../StyleSheet.css" rel="stylesheet" type="text/css" />

<script language="VB" runat="server">

Dim currentDir As String
Dim directorySeparatorChar As Char = Path.DirectorySeparatorChar


Sub Page_Load(sender As Object, e As EventArgs)

        Dim test As String = Session("VALUE1")
        Dim notroot As String = "C:\WEB_ROOT\TriHealth\PrivateDocuments\"
        Dim root As String = notroot & test
        Dim thisPage As String = Request.Path

  currentDir = Request.Params("dir")

If currentDir Is Nothing Then
    currentDir = root
  End If

If Not currentDir.StartsWith(root) Then
    currentDir = root
  End If

  Dim sb As New StringBuilder(4096)

  If Not currentDir.Equals(Root)
Then
    ' not at the root

 Dim currentDirParent As String
 Dim lastIndex As Integer = _
```

```
    currentDir.LastIndexOf(directorySeparatorChar)

 If lastIndex <> -1 Then
    currentDirParent = currentDir.Substring(0, lastIndex)


Else
    currentDirParent = currentDir

End If

   sb.Append("<a href=").Append(thisPage)
   sb.Append("?dir=").Append(Server.UrlEncode(currentDirParent))
   sb.Append("><img width=30 border=0 src=/images/Up.gif></a><br>")

 End If

  DoUpload()

  sb.Append("<br><img border=0 src=/images/OpenFolder.gif> ")
  sb.Append("<font face=verdana>")
  sb.Append(currentDir)
  sb.Append("</font>")
  sb.Append("<br>")
  sb.Append("<table>")
  sb.Append("<tr bgcolor=#D8D8D8>")
  sb.Append("<td width=200><font face=verdana size=3>Name</font></td>")
  sb.Append("<td><font face=verdana size=3>Type</font></td>")
  sb.Append("<td><font face=verdana size=3>Size</font></td>")
  sb.Append("<td><font face=verdana size=3>Modified</font></td>")
  sb.Append("</tr>")


  Dim dirs() As String
  Try
    dirs = Directory.GetDirectories(currentDir)

    Dim d As String

 For Each d In dirs
    Dim dirName As String = Path.GetFileName(d)

    sb.Append("<tr>")
    sb.Append("<td><img src=/images/Folder.gif> ")
    sb.Append("<a href=").Append(thisPage)
    sb.Append("?dir=").Append(Server.UrlEncode(currentDir))
```

```
    sb.Append(directorySeparatorChar)
    sb.Append(Server.UrlEncode(dirName))
    sb.Append(">").Append(dirName).Append("</a>")
    sb.Append("</td>")
    sb.Append("<td><font face=verdana size=2>folder</font></td>")
    sb.Append("<td> </td>")
    sb.Append("<td><font face=verdana size=2>")
    sb.Append(Directory.GetLastWriteTime(currentDir & _
    directorySeparatorChar.ToString() & dirName).ToString())
    sb.Append("</font></td>")
    sb.Append("</tr>")

  Next
 Catch ex As Exception
 End Try

 Try
  Dim dirInfo As New DirectoryInfo(currentDir)
  Dim files() As FileInfo
  files = dirInfo.GetFiles()

  Dim f As FileInfo

For Each f In files
    Dim filename As String = f.Name

    sb.Append("<tr>")
    sb.Append("<td><img src=/images/File.gif> ")
    sb.Append("<a href=PrivateFileDownload.aspx?file=")
    sb.Append(Server.UrlEncode(currentDir))
    sb.Append(directorySeparatorChar)
    sb.Append(Server.UrlEncode(filename))
    sb.Append(">").Append(filename).Append("</a>")
    sb.Append("</td>")
    sb.Append("<td><font face=verdana size=2>file</font></td>")
    sb.Append("<td><font face=verdana size=2>")
    sb.Append(f.Length.ToString())
    sb.Append("</font></td>")
    sb.Append("<td><font face=verdana size=2>")
    sb.Append(File.GetLastWriteTime(currentDir & _
      directorySeparatorChar.ToString() & f.Name).ToString())
    sb.Append("</font></td>")
    sb.Append("</tr>")

Next
 Catch ex As Exception
```

```
  End Try

  sb.Append("</table>")
  dirContent.Text = sb.ToString()
End Sub


Sub DoUpload()

  If Not (uploadedFile.PostedFile Is Nothing)
 Then
    Try
      Dim postedFile = uploadedFile.PostedFile
      Dim filename As String = Path.GetFileName(postedFile.FileName)
      Dim contentType As String = postedFile.ContentType
      Dim contentLength As Integer = postedFile.ContentLength
      postedFile.SaveAs(currentDir & _
        directorySeparatorChar.ToString() & filename)
    Catch ex As Exception
      message.Text = "Failed uploading file"
    End Try
  End If
End Sub

</script>
</head>
 <body>

  <div>
    <div class="headerImage"></div><br /><br />

        <form id="Form1" runat="server" enctype="multipart/form-data" >
          <div class="navigationArea">
<a href="/default.aspx">Home</a>  <a href="servicereports.aspx">Vendor
Service Reports</a>  
<a href="servicemanuals.aspx">Vendor Service Manuals</a>  
<a href="index.aspx">Shared Resources</a>  
<a href="index.aspx">Private Resources</a>  
<a href="main.aspx">CE Employees Home</a>

<asp:SiteMapDataSource ID="SiteMapDataSource2" runat="server" /></div><br /><br
/>

 <asp:Label id="dirContent" runat="server"/>
  <asp:Label id="message" runat="server"/>
```

```
<p>
<%-- File Upload --%>
Select File to Upload:
<input id="uploadedFile" type="file" runat="server" />
<input type="button" id="upload"
  value="Upload"
  onserverclick="Page_Load"
  runat="server" /></p>
  <br /> <br />
  <asp:HyperLink id="hlLogout" runat="server"
NavigateUrl="/logout.aspx" Height="32px" Width="80px"
ImageUrl="~/VirtualToolkit/Logout.jpg">Logout</asp:HyperLink>

<p> <asp:SiteMapDataSource ID="SiteMapDataSource1" runat="server" /></p>

</form>      <br /> <br />

<div class="footerArea">&copy; copyright 2007 James E. Meyer</div>

  </div>

 </body>

</html>
```

A2. Code Snippet for Upload Service Reports (UpService Reports.aspx.vb).

```
Imports System.Data.SqlClient
Imports System.IO
Partial Class VirtualToolkit_ServiceReports
Inherits System.Web.UI.Page

 Protected Sub btnUpload_Click(ByVal sender As Object, ByVal e As
System.EventArgs) Handles btnUpload.Click

 Dim strFileName As String
 Dim strFilePath As String
 Dim strFolder As String

       strFolder = "C:\WEB_ROOT\TriHealth\Reports\"

       'Get the name of the file that is posted.
       strFileName = oFile.PostedFile.FileName
       strFileName = Path.GetFileName(strFileName)

       'Create the directory if it does not exist.
```

```
 If (Not Directory.Exists(strFolder))
Then

Directory.CreateDirectory(strFolder)

 End If

      'Save the uploaded file to the server.
      strFilePath = strFolder & strFileName

      If File.Exists(strFilePath) Then
      lblUploadResult.Text = strFileName & " already exists on the server!"

Else
oFile.PostedFile.SaveAs(strFilePath)
 lblUploadResult.Text = strFileName & " has been successfully uploaded."

End If

      'Display the result of the upload.
      frmConfirmation.Visible = True

      Dim myConnection As SqlConnection
      Dim myCommand As SqlCommand
      Dim ra As Integer
      Dim Test As String
      Test = "../Reports/"

      myConnection = New
SqlConnection("server=CEVIRTUALTK\SQLEXPRESS;Trusted_Connection=yes;datab
ase=C:\Program Files\Microsoft SQL Server\MSSQL.1\MSSQL\Data\Service
Reports.mdf")

 myConnection.Open()
 myCommand = New SqlCommand("insert into Reports (Control_Number, Device,
Manufacturer, Model, File_Path, File_Name, Work_Order_Number, Call_Type) values
('" & _TextBox1.Text & "','" & TextBox2.Text & "','" & TextBox3.Text & "','" &
TextBox4.Text & "','" & Test + strFileName & "','" & strFileName & "','" &
TextBox6.Text & "','" & TextBox7.Text & "')", myConnection)
 ra = myCommand.ExecuteNonQuery()
 myConnection.Close()

End Sub

End Class
```

A3. Code Snippet for Down Load Service Reports (DownServiceReports.aspx.vb).

```
Imports System.Data.SqlClient
Imports System.Data
Partial Class VirtualToolkit_DownServiceReports
Inherits System.Web.UI.Page

Protected Sub btnDisplay_Click(ByVal sender As Object, ByVal e As
System.EventArgs) Handles btnDisplay.Click

 Dim strSQL As String

If TextBox6.Text <> String.Empty Then
strSQL = "SELECT * FROM Reports where Work_Order_Number = '" +
TextBox6.Text + "'"

If RunQuery(strSQL) Then
Response.Redirect("ViewReports.aspx?Work_Order_Number=" +
Server.UrlEncode(TextBox6.Text))

 Else
lblErrorMessage.Text = "No records Found for Work Order Number " + TextBox6.Text

 End If

 ElseIf TextBox1.Text <> String.Empty Then
strSQL = "SELECT * FROM Reports where Control_Number = '" + TextBox1.Text + "'"

 If RunQuery(strSQL) Then
 Response.Redirect("ViewReports.aspx?Control_Number=" +
Server.UrlEncode(TextBox1.Text))

 Else
 lblErrorMessage.Text = "No records Found for Control_Number " + TextBox1.Text

  End If

 ElseIf TextBox4.Text <> String.Empty Then
 strSQL = "SELECT * FROM Reports where Model = '" + TextBox4.Text + "'"

 If RunQuery(strSQL) Then
Response.Redirect("ViewReports.aspx?Model=" + Server.UrlEncode(TextBox4.Text))

  Else
  lblErrorMessage.Text = "No records Found for Model " + TextBox4.Text
```

```
 End If

      ElseIf TextBox2.Text <> String.Empty Then
      strSQL = "SELECT * FROM Reports where Device = '" + TextBox2.Text + "'"

If RunQuery(strSQL) Then
Response.Redirect("ViewReports.aspx?Device=" + Server.UrlEncode(TextBox2.Text))

 Else
 lblErrorMessage.Text = "No records Found for Device " + TextBox2.Text

 End If

 ElseIf TextBox3.Text <> String.Empty Then
 strSQL = "SELECT * FROM Reports where Manufacturer = '" + TextBox3.Text + "'"

 If RunQuery(strSQL) Then
 Response.Redirect("ViewReports.aspx?Manufacturer=" +
Server.UrlEncode(TextBox3.Text))

 Else
lblErrorMessage.Text = "No records Found for Manufacturer " + TextBox3.Text

 End If

 ElseIf TextBox6.Text = String.Empty And (TextBox2.Text <> String.Empty And
TextBox3.Text <> String.Empty And TextBox2.Text <> String.Empty And
TextBox1.Text <> String.Empty And TextBox7.Text <> String.Empty) Then
 strSQL = "SELECT * FROM Reports where device = '" + TextBox2.Text + "' AND
Model = '" + TextBox4.Text + "' AnD Manufacturer = '" + TextBox3.Text + "' AnD
Control_Number = '" + TextBox1.Text + "' AnD Call_Type = '" + TextBox7.Text + "'"

  If RunQuery(strSQL) Then
  Response.Redirect("ViewReports.aspx?Device=" + Server.UrlEncode(TextBox2.Text)
+ "&Manufacturer=" + Server.UrlEncode(TextBox3.Text) + "&Model=" +
Server.UrlEncode(TextBox2.Text) + "&Control_Number=" +
Server.UrlEncode(TextBox1.Text) + "&Call_Type=" +
Server.UrlEncode(TextBox7.Text))

Else
lblErrorMessage.Text = "No records Found for search criteria you specificied"

 End If

 Else
```

```
 lblErrorMessage.Text = "You must either enter Work Order Number Or
Device/Manufactuer/Model number/Control Number/Call Type"

 End If
 End Sub

 Private Function RunQuery(ByVal sql As String) As Boolean

 Dim strConnection As String =
("server=CEVIRTUALTK\SQLEXPRESS;Trusted_Connection=yes;database=C:\PROG
RAM FILES\MICROSOFT SQL SERVER\MSSQL.1\MSSQL\DATA\SERVICE
REPORTS.MDF")

 Dim bFound As Boolean
 Dim objConnection As New SqlConnection(strConnection)
 objConnection.Open()
 Dim objCommand As New SqlCommand(sql, objConnection)
 Dim objSQLReader As SqlDataReader
 objSQLReader = objCommand.ExecuteReader
 While objSQLReader.Read()
  bFound = True
  End While
 objConnection.Close()
 Return bFound
 End Function

Protected Sub Button1_Click(ByVal sender As Object, ByVal e As System.EventArgs)
Handles Button1.Click
 Page.Response.Redirect("http://www.trihealth-
ce.com/virtualtoolkit/ReturnAllReports.aspx")
End Sub
End Class
```

A4. Code Snippet for View Reports (ViewReports.aspx.vb).

```
Partial Class VirtualToolkit_ViewReports
Inherits System.Web.UI.Page
Protected Sub Page_Load(ByVal sender As Object, ByVal e As System.EventArgs)
Handles Me.Load

 If (Not IsPostBack) Then

 If Not Request.QueryString("Work_Order_Number") Is Nothing Then
 SqlDataSource1.SelectCommand = " SELECT Work_Order_Number, Device, model,
Manufacturer, Control_Number, Call_Type, File_Name, File_Path FROM [Reports]
```

```
WHERE [Work_Order_Number] = '" +
Server.UrlDecode(Request.QueryString("Work_Order_Number")) + "'"
GridView1.DataBind()

 ElseIf Not Request.QueryString("Control_Number") Is Nothing Then
SqlDataSource1.SelectCommand = " SELECT Work_Order_Number, Device, model,
Manufacturer, Control_Number, Call_Type, File_Name, File_Path FROM [Reports]
WHERE [Control_Number] = '" +
Server.UrlDecode(Request.QueryString("Control_Number")) + "'"
GridView1.DataBind()

ElseIf Not Request.QueryString("Model") Is Nothing Then
 SqlDataSource1.SelectCommand = " SELECT Work_Order_Number, Device, model,
Manufacturer, Control_Number, Call_Type, File_Name, File_Path FROM [Reports]
WHERE [Model] = '" + Server.UrlDecode(Request.QueryString("Model")) + "'"
GridView1.DataBind()

ElseIf Not Request.QueryString("Device") Is Nothing Then
SqlDataSource1.SelectCommand = " SELECT Work_Order_Number, Device, model,
Manufacturer, Control_Number, Call_Type, File_Name, File_Path FROM [Reports]
WHERE [Device] = '" + Server.UrlDecode(Request.QueryString("Device")) + "'"
GridView1.DataBind()

 ElseIf Not Request.QueryString("Manufacturer") Is Nothing Then
SqlDataSource1.SelectCommand = " SELECT Work_Order_Number, Device, model,
Manufacturer, Control_Number, Call_Type, File_Name, File_Path FROM [Reports]
WHERE [Manufacturer] = '" + Server.UrlDecode(Request.QueryString("Manufacturer"))
+ "'"
GridView1.DataBind()

 Else
SqlDataSource1.SelectCommand = " SELECT Work_Order_Number, Device, model,
Manufacturer, Control_Number, Call_Type, File_Name, file_Path FROM [Reports]
WHERE [Device] = '" + Server.UrlDecode(Request.QueryString("Device")) + "' AND
Model = '" + Server.UrlDecode(Request.QueryString("Model")) + "' And manufacturer =
'" + Server.UrlDecode(Request.QueryString("Manufacturer")) + "' And Control_Number
= '" + Server.UrlDecode(Request.QueryString("Control_Number")) + "' And Call_Type
= '" + Server.UrlDecode(Request.QueryString("Call_Type")) + "'"
GridView1.DataBind()
 End If

 End If
End Sub
End Class
```

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