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Development of a Custom Call Management System for the Service Department of Premiere Copier Inc.

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Professional Project

Development of a Custom Call Management System for the Service Department of Premiere Copier Inc.

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Regis University

School for Professional Studies

Master of Science in Computer Information Technology

August 2006

Table of Contents.

Document Revisions

Work Progress	Date	Notes
First Draft of the Outline	5-19-2006	Basic Document Structure
Outline Revised Draft	5-24-2006	Some Additions, more concrete sections and chapters
Draft of Chapter 1	6-4-2006	Rough draft
Chapter 1 REVISED	6-11-2006	Corrections to content and structure
Chapter 2 Rough Draft	6-21-2006	
Bibliography Rough Draft	6-21-2006	Research Sources
Chapters 1 and 2 REVISED	6-25-2006	Spelling errors, some changes to content, Appendix section added
Chapter 2 and Bibliography REVISED	6-29-2006	New content
Chapter 3 Rough Draft	7-16-2006	
Chapter 3 REVISED	7-23-2006	New content, spelling corrections
Chapter 4 Draft	7-29-2006	All Chapters revised, Front matter added
Chapter 4 REVISED	8-7-2006	New Content
Chapter 5 Draft	8-8-2006	Chapter 5 added
Final Draft	8-15-2006	
Last Revision	8-20-2006	This version

1. Chapter I – Introduction
1.1. Business description

Premiere Copier Inc. is a small company specializing in sales and service of new and refurbished copy machines, multifunctional devices and printers. The company is an authorized dealer of CopyStar (a division of Kyocera Mita) and Muratec brands. Despite the small size, Premiere Copier has one of the largest sales volumes nationally.

The company consists of three major departments:

- Administrative – runs the business aspects of the operations, client billing, collections, purchasing the supplies and payroll.

- Sales – this department consists of sales managers and the salespeople, which do telemarketing, write proposals, meet with potential clients, do mail outs and prepare other marketing materials.

- Service – this department consists of the service manager, the dispatcher, service technicians, IT specialists, the inventory manager and a delivery driver.

The above structure allows the company to get an average of three machines sold every day, which is above national average of just three machines a week. With a guaranteed service response time of less than four hours and a very low callback ratio Premiere Copier ranks one of the highest in overall customer satisfaction.

Keeping up with the idea of providing the best services to customers for a reasonable price and with least amount of hassles Premiere Copier is always looking for ways to improve. One of such improvements is project the TechHelper which is going to be discussed in the following sections.

1.2. Current business process

The following flowchart represents the basic structure of the current business process and the usage of the computer system to facilitate some major functions of it:
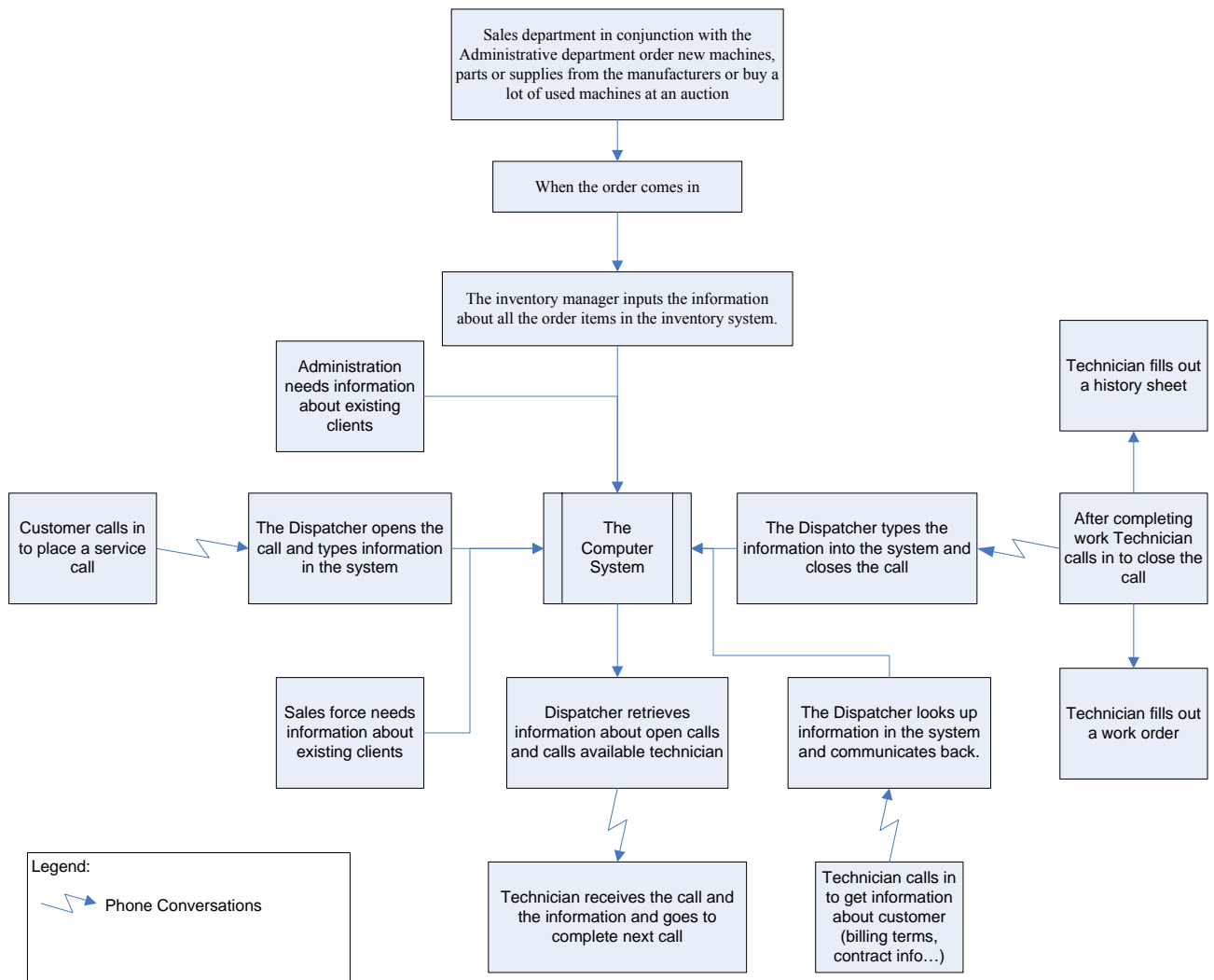
Drawing 1. Current Business Process

1.2.1. Current system architecture

Hardware:	Seven computer desktop workstations Six Technicians' laptops
Network architecture	Peer-to-Peer (no dedicated server)

Operating System	MS Windows XP
Network Hardware	The network is based on a Linksys Broadband Wireless Router and a SMC Fast Ethernet 16port switch. All the devices are 10/100 Mbps.
Database Server	NONE - The Database resides on the service/dispatch desktop workstation.
Web/Email	The Premiere Copier web site is hosted by a third party company, which also provides POP3 and web email services.
Internet Service Provider (ISP)	The Internet access is provided by CBeyond via a dedicated T1 line.
Backup Solution	The system has no dedicated backup solution. Currently backup are performed by copying the database file to a recordable CD.
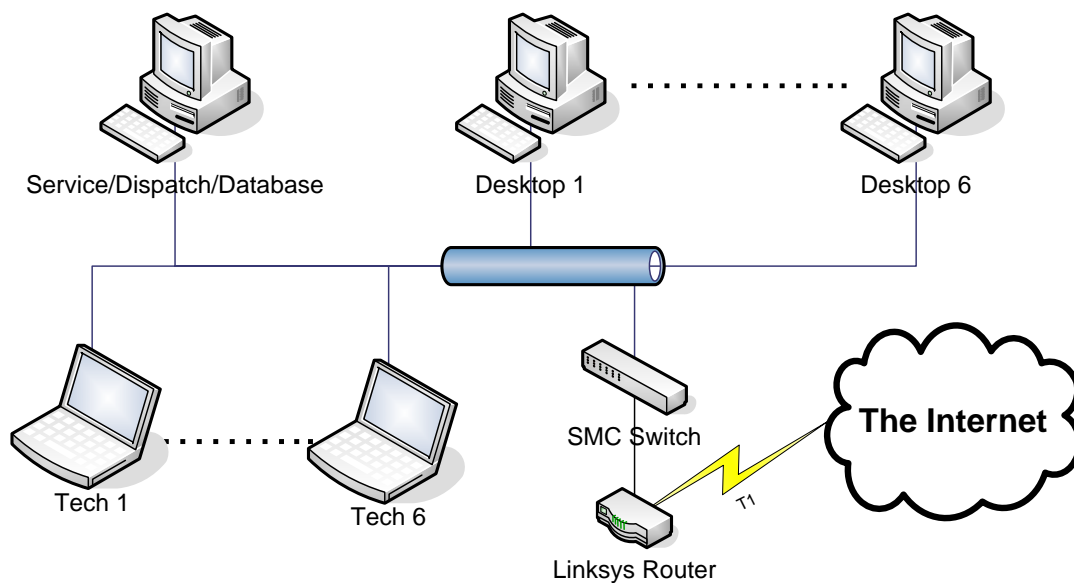
Drawing 2. System Architecture

1.2.2. Current software

As mentioned above, all the computers are running MS Windows XP with a basic set of productivity tools installed.

Premiere Copier presently uses a MS Access 2.0 based database called TrackIt to manage the service calls, machine inventory, technicians' stock, parts and supply inventories and all the customer information. The database is custom built for use in copier service industry, but has a few shortcomings which are going to be discussed in the next section.

1.2.3. Problems with the system currently used

System Architecture	The absence of a dedicated server makes for a very sluggish and unreliable system
Network Hardware	With the growing number of users 100Mbps backbone will create a bottleneck and a 16 port unmanaged switch will run into capacity problems as well
Database	MS Access 2.0 presents a number of limitations: Single .mdb file storing the data and the front end GUI (Graphical User Interface) Low reliability Poor performance – the whole .mdb file is opened on each workstation Page and Table Level Locking (big chunks of data getting locked thus slowing down the system performance) No security – no built in data protection
Backup	No dedicated backup solution
Web/Email	Third party hosting and email solution limits the amount of email users to twenty and does not allow running active content. Storage is also limited to 50MB. Additional storage or emails come at a steep monthly price.

1.3. Project TechHelper

The project TechHelper is going to be completed in several revisions. The scope of this document is only the first revision. Following revisions will have expanded functionality which is going to be documented separately.

1.3.1. Goals of the project

Premiere Copier needs a system that will facilitate the functionality required by the current business process as well as being more robust, reliable and scalable. The new system has to

mitigate all the problem areas mentioned in the section 1.2.3. The complete list of the requirements is presented in the Section 3.1.1.

This project is the first real life experience for the one man developing team as well. Working through the whole development life cycle of the application, fulfilling the roles of project manager, developer and designer at the same time presents an excellent educational opportunity as well.

1.3.2.   New system architecture

The new system architecture is going to incorporate the existing workstations and the technicians' laptops. A dedicated server is going to host the database, domain, web and the email services. Ethernet switch will have to be upgraded to facilitate new functionality. The following table summarizes the changes to the system architecture:

Hardware:	Seven computer desktop workstations Six Technicians' laptops One dedicated server
Network architecture	Domain based with a dedicated server
Operating System	MS Windows XP for workstations Windows 2003 Server for Small Business or Linux based OS
Network Hardware	Linksys Broadband Wireless Router 24 port unmanaged switch with at least 2 Gigabit ports Wireless internet cards for all the technicians
Database Server	Server running the database solution
Web/Email	Web site and email services are going to be hosted on the local server

Internet Service Provider (ISP)	The Internet access is provided by CBeyond via a dedicated T1 line.
Backup Solution	RAID array on the server plus daily tape backups

Different options for all the parts of the system mentioned above are going to be discussed in detail in Chapter 2 of this document. Following drawing illustrates the architecture of the new system:
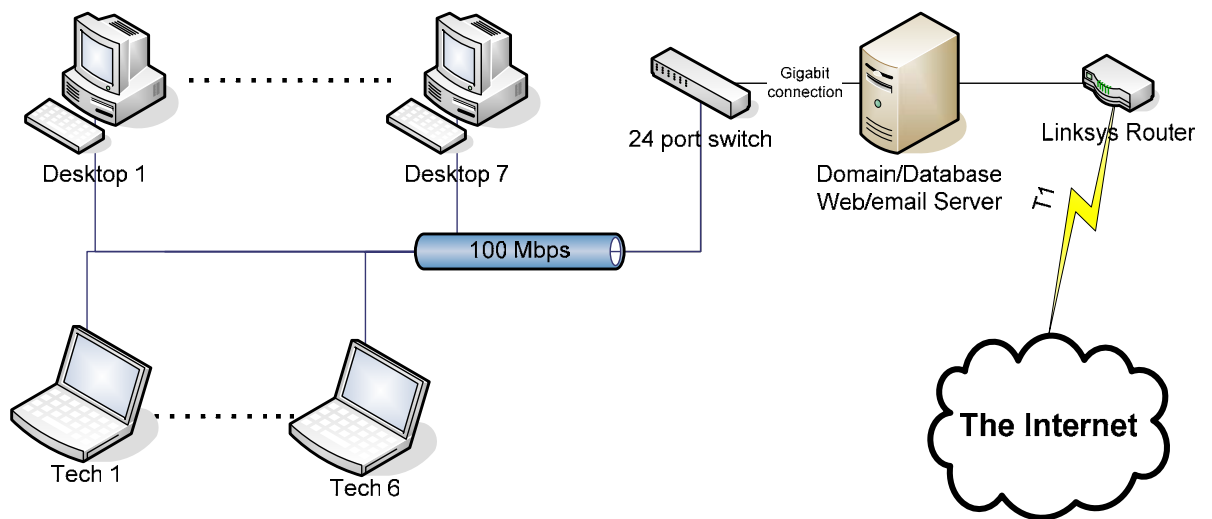
Drawing 3. New System Architecture

1.3.3. TechHelper software

The TechHelper software is to be developed in house. When done it will reside on the server and work in parallel with the TrackIt (MS Access based database) during the first revision. During the following revisions, Access database is to be eliminated leaving only the TechHelper with expanded functionality to take care of all the business needs. Following is the list of requirements for the application to have when first revision is complete:

- Store/edit/retrieve the customer information

- Store/edit/retrieve the machine information (same customer may have multiple machines)

- Store/edit/retrieve information about the accessories for every machine

- Store/edit/retrieve maintenance information about every machine

- Print work orders with the following information included:

  - Customer Information

  - Date

  - Machine Information

  - Corrective Action

  - Copy Count

  - Parts Names

  - Quantity

  - Price

  - Taxes

  - Totals

- Automatically update maintenance history from the work order data

- Manage the parts inventory

- Generate parts used report by date and technician

- Generate closed calls report by date and technician

- All of the above functionality must be available via the local network or through the Internet

- The access to the system has to be secure preferably with multiple levels of clearance

Several choices are available as far as the development language, platform and database solution for the TechHelper. All of these options are going to be discussed in detail in the Chapter 2 of this document.

1.3.4. Required resources

Since Premiere Copier does not have a dedicated software development staff. The existing IT department will have to tackle this project. This department has other responsibilities in the company so only fifteen to twenty person/hours a week can be dedicated to the project. All of the following schedules and estimations are based on this assumption.

1.3.4.1.Budget

The pre-approved budget for the project is $2500.00 for the hardware and software plus the staff for the development.

1.3.4.2.Resources for software development

An estimated 400 person/hours is required to complete revision one of the TechHelper software. Following is the estimated timeline for the application development:

ID		Task Name	Duration
1		**Gather Project Requirements**	3 days
2		Requirements for hardware	2 days
3		Requirements for software	3 days
4		**Analysis (Technical Research)**	6 days
5		Feasibility reasearch	1 day
6		Research and choose server hardware	1 day
7		Research and choose server Software	1 day
8		Reserch and choose development software	1 day
9		Summarize + Present to management	1 day
10		Order hardware and software	1 day
11		Software Design (Iterative)	150 days
12		Software Build (Iterative)	150 days
13		Software Testing (Iterative)	150 days
14		Project Implementation	10 days

Project: Timeline.mpp
Date: Sat 7/22/06

Task	Milestone	External Tasks
Split	Summary	External Milestone
Progress	Project Summary	Deadline

Page 1

Drawing 4. Project Timeline.

1.3.4.3.Hardware for development

The following hardware is needed for the application design and development:

- 1x Dedicated Complete Desktop computer with the following installed:

    o Operating System chosen for the project

    o Chosen Integrated Development Environment

    o Chosen Database solution

1.3.5. Comparative analysis of using TechHelper vs. the current system

The TechHelper application will mitigate all of the shortcomings of the current system. It is going to be faster, more robust and more scalable. Because it is going to be developed in house, the functionality can be expanded or changed on demand. Following is the summary of the new system's benefits:

Comparative Points	TrackIt	TechHelper
Database Solution	MS Access 2.0	One of the major database vendors (MySQL, Oracle, etc.)
Scalable	Poorly – steep performance degradation as number of users increases	YES
True Client/Server application	NO	YES
Customized to business needs	Somewhat – application developed for the whole industry, not the particular business	YES – Custom built application.
Functionality can be expanded as needed	NO (off the shelf application)	YES In house development – can be expanded as needed
Can be accessed locally and through the Internet	NO Local shared access only	YES Web based GUI front end and true Client/Server architecture
Security Enabled	NO	YES Multiple security levels for database itself and the GUI front end

1.3.5.1.Estimated monetary benefits

Using the current business process, it takes an average of twenty minutes for a technician to close a call and be dispatched to the next call. Usually a technician is able to complete four calls per working day. Using the TechHelper system the time to close the call and get the information for the next one can be cut in half, thus saving about forty minutes a day per technician, plus allowing the dispatcher more time to take care of customers' needs. Even though each technician's laptop will have to be equipped with an additional Wireless Internet Card, the savings of just one week will compensate the monthly fee. Due to the Wireless Internet not being available everywhere the calculations will have to incorporate a conservative coefficient reducing the overall benefits of the system.

Taking all of the above facts into consideration the following bottom line can be reached:

Technician Average Pay Rate	$23/Hr
Estimated Monthly Time Savings when using TechHelper	13.2 Hr
Estimated Monthly Savings	$303.6
Internet availability coefficient 85%	$242.88
Wireless Internet Cost(per month)	$60
Estimated Saving per Technician per Month	$182.88
Number of Technicians	7
Total Estimated Monthly Savings	$1280.16

1.3.5.2.Conclusions

Premiere Copier's system has been due for a major update for a long time. Even with all the updates, the Access 2.0 based TrackIt application cannot compete with the modern database solutions in any aspect. Therefore, it has to be entirely replaced with the latter.

As far as the hardware goes, peer-to-peer networking is only good when the number of users is very limited and the network is only used for sharing small amounts of information. Premiere Copier is a fast growing company, which is why it is essential for it to switch to a client/server based architecture. Such a move will provide additional functionality, reliability, performance enhancement and easier scalability.

2. Chapter II – Technical Research
2.1. General guidelines used to choose the right solution.

This chapter describes some of the technological alternatives for the TechHelper project. In cases that involve several viable choices, a simple point method was used to select the right one. When using this method, products in each category are evaluated based on a number of characteristics which in turn are assigned weights to match their importance to the project. According to a product's performance, it is assigned a grade on a scale of zero to ten for each characteristic. The product that gets the most points is the clear winner.

2.2. TechHelper software

2.2.1. <u>Methodology</u>

Due to a limited project staff, most of the project duties fall on one man's shoulders. That is why the waterfall method with some variations was chosen. This method allows for a systematic approach, which is very convenient for a one-person team. Requirements gathering and initial analysis can be done in a traditional manner – one following the other. The designing, building and testing can be done in an iterative manner employing some of the Rapid Application Development (RAD) and Iterative Development (ID) practices. The product revisions, mentioned earlier in this document, come from the RAD where the first revision will only have limited functionality but will mitigate many of the current system's shortcomings. Iterative Development will be used to move the project from phase to phase relying on the following principle:
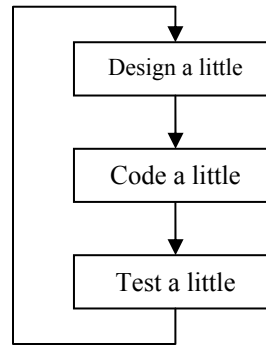
Drawing 5. Iterative Development

The remaining phases of implementation and maintenance will be completed in a traditional manner one following the other. The future revisions of TechHelper will be implemented gradually into the working system as updates during the maintenance phase.

2.2.2. Development Language

The two biggest contenders in this category are the JAVA and C#. The following table summarizes the comparison:

Characteristic	Weight	C# with .NET		JAVA	
		Score	Comments	Score	Comments
Familiarity with the product	0.3	2	Only familiar with general concepts of the language. No practical skills using it.	8	Good familiarity with the language, APIs and IDEs. Some practical skills.
Availability of readymade APIs	0.1	10	APIs available from Microsoft and other vendors	10	Many API available from Sun Microsystems or other vendors (mostly open source and free)
Compatibility with multiple Operating Systems	0.1	8	Generally Compatible with Windows, Mac and Linux	10	Platform independent due to the use of JVM (Java Virtual Machine)
Cost	0.3	4	According to Microsoft's web site, Visual Studio Professional is $799. There are other versions that are cheaper, but functionality is then limited	10	Open Source. Available for download from the website free of charge
IDE availability	0.2	4	IDE is included in the Visual Studio suite and is usually not free	9	Wide variety of open source IDEs available for free (Eclipse, NetBeans, etc...)
Totals:	1.0	4.4		9.2	

The JAVA programming language is the clear winner in this category. Developer's familiarity with the language plus the cost considerations made JAVA the first choice for the project.

2.2.3. Development Framework

After Choosing JAVA as the development language for the project, the Development Framework needs to be chosen:

Characteristic	Weight	JAVA with STRUTS		JAVA with Java Server Faces	
		Score	Comments	Score	Comments
Framework Maturity	0.1	10	Mature and proven framework with a lot of documentation and support available	5	Young framework that is just getting momentum
Tool and IDE support	0.1	9	Widely available	5	As more and more new projects use JSF the support for the framework grows as well
Flexibility and extensibility	0.2	7	Older more mature framework with some flexibility	9	This framework was built with integration and extensibility in mind.
Familiarity with the product	0.3	8	Some practical experience with the framework	4	Theoretical knowledge only
Strategically viable for future	0.3	5	Old and proven framework that is eventually going to be replaced by a more agile JSF	10	JSF is slowly becoming the new standard for web development and probably going to replace STRUTS
Totals:	1.0	7.2		7.0	

Java with STRUTS Framework is the winner in this category. Even though JSF is said to be the new future of Web development frameworks, it is still too young and is lacking in good documentation and community support. STRUTS is a time-tested, reliable framework. Additionally the developer for the TechHelper project is familiar with the latter, which will reduce the learning curve and allow more time for other important tasks. Besides, using the proven technology will facilitate easier maintenance and upgrades in future.

2.2.4. Development Environment

Preliminary research showed a great number of available Integrated Development Environments available for JAVA. The top results are presented in a table below:

Characteristic	Weight	Eclipse	IntelliJ IDEA	NetBeans
Familiarity with the product	0.2	8	0	6
Plug-in Availability (Web development, UML, J2EE)	0.3	8	3	9
Price	0.3	10 Free	0 $499	10 Free
Support	0.2	7 Forums and Documentation	8 Customer Service and Documentation	10 Documentation, Online Demos, Updates
Totals	1.0	8.4	2.5	8.9

NetBeans from Sun Microsystems and Eclipse from Eclipse Foundation finished pretty close to each other and beat the IntelliJ IDEA by at least six points. The two winners are widely supported by the community and are free. Numerous plug-ins are available for both products at no charge, which can greatly expand the functionality of the product.

2.2.5. Database Solution

Due to a relatively small size of the TechHelper Project, it was decided to opt for an Open Source database solution. These solutions are known to perform as well as the commercial ones as long as the total size of the database does not exceed one hundred gigabytes. The following table summarizes the comparison of well-known Open Source database solutions:

Characteristic	Weight	MySQL	PostgreSQL	Ingres
Familiarity with the product	0.1	7	2	1
Availability of tools from vendor	0.1	7	8	5
Database speed	0.3	8	6	8
Security features	0.3	9	6	9
Feature set	0.2	8	7	7
Totals:	1.0	8.1	6	7.1

When evaluating the Feature sets for the above three solutions the following characteristics were considered:

- Stability

- ACID (Atomicity Consistency Isolation Durability) Compliance

- Data Integrity

- Views Support

- Transaction Support

- Replication Support

- Hot Backup support

- Load balancing

MySQL is the clear winner in this category. Developer's familiarity with the product as well as other impressive characteristics played a big role in choosing it.

2.3. Hardware
2.3.1. Server

The following configuration was proposed as the acceptable minimum when choosing the server for the TechHelper project:

Processor	Dual Core Intel® Pentium® D 930, 2X2MB Cache, 3.0GHz, 800MHz FSB
Operating System	MS Small Business Server 2003, Standard edition
Memory	1GB DDR2 533MHz
Hard Drive Configuration	RAID 1 Mirroring
Hard Drive Capacity	160GB x 2
Network Cards	2x Gigabit Ethernet Adapters
Optical Drives	CD-RW/DVD±R Combo Drive
Keyboard / Mouse	Standard Keyboard and Mouse
Monitor	15 inch VGA Monitor
Support	1 year onsite service + 24h phone support
Price	Around $2000.00

According to the above requirements, the following contenders were selected (winning characteristics are highlighted):

Characteristic	Dell PowerEdge 830	Gateway E-9220T	IBM xSeries 206m	PowerSpec Server 300
Processor	Intel Pentium D 930 3.0 GHz 800MHz FSB	Intel Pentium D 930 3.0 GHz 800MHz FSB	Intel Pentium D 930 3.0 GHz 800MHz FSB	Intel Pentium D 820 2.8 GHz 800MHz FSB
Memory	1GB (2x512MB)	1GB (2x512MB)	1GB (2x512MB)	1GB (2x512MB)
Hard Drive Configuration	RAID 1 (Mirrored Array)	RAID 1 (Mirrored Array)	RAID 1 (Mirrored Array)	RAID 5 (3x Hard Drives)
Hard Drive Capacity	2 x 250GB for a total of: 250GB	2 x 250GB for a total of: 250GB	2 x 250GB for a total of: 250GB	3 x 250GB for a total of: 500GB
Network Cards	2 x Gigabit Adapters	2 x Gigabit Adapters	1 x Gigabit Adapter	2 x Gigabit Adapters
Optical Drives	CD-RW/DVD combo	CD-RW/DVD combo	48x CD-ROM	CD-RW/DVD±R/RW Combo Drive
Keyboard Mouse	Standard Keyboard, Mouse	Standard Keyboard, Mouse	Not Included	Standard Keyboard, Mouse
Monitor	15 inch flat panel	15 inch flat panel	Not Included	Not Included
Support	1yr on site next day parts and labor	1yr on site next day parts and labor	3yr on site parts and labor warranty	1yr limited on site server warranty
Price	$2110.00	$2439.00	$1959.00	$1999.99
Customizability	Highly Customizable: from hardware to support and installation.	Highly Customizable: from hardware to support and installation.	Not Customizable. Preset Configuration & Support	Not Customizable. Preset Configuration & Support
Accessory availability	Backup hardware & software, Switches, Network Storage, Routers, wireless, Network Security etc.	Switches, backup hardware & software, network storage.	Backup hardware & software, network storage.	Not Available
Total winners:	6	5	3	5

After considering the results in the above table, the Dell PowerEdge 830 was chosen. Dell offers highly customizable configurations and support options as well as the best price to value ratio. Even though the systems from IBM and PowerSpec are cheaper, but they do not include the monitor and are not customizable. Dell also offers a wide range of networking and backup accessories all covered by the same award winning service and support.

2.3.2. Network

After choosing the server system from Dell, it was decided to get the network switch from Dell as well. The PowerConnect 2324 Unmanaged 24 port Fast Ethernet switch is an ideal fit for the project. For only $114.00 this product offers 24 100 Base-T ports for all the office desktops with plenty of room for expansion, plus two Gigabit ports for backbone connection (server and another switch for future expansion).

2.3.3. Wireless Internet

As mentioned in section 1.3.5.1., each technician's laptop will have to be equipped with a Wireless Internet Card. There are four major wireless broadband providers in Colorado. The following table summarizes the findings:

Characteristic	Sprint PCS	T-Mobile	Cingular	Verizon Wireless
Equipment cost	$49.99	$149.99	$99.99	$49.99
Plan monthly cost	$79.99 for unlimited access	$49.99 for unlimited access	$59.99 for unlimited access	$59.99 for unlimited access
Speed	400-700 Kbps	100-130 Kbps	400-700 Kbps	400-700 Kbps
Coverage	Good	Average	Excellent	Excellent

The two deciding factors in this category are speed and availability. Cingular and Verizon Wireless have similar characteristics, but because Premiere Copier currently is using Cingular cell phones, it is more convenient to add more services to an existing account. Therefore, Cingular's data plan was chosen.

2.4. Server Software

As mentioned already TechHelper is a small project with a limited budget. Because the new system has to work in MS Widows environment on the local network, the Server Operating system had to be from Microsoft as well. The legacy TrackIt system based on MS Access 2.0

has to run on the server at least during the first phases of the project. In addition to it, MS Windows Server 2003 will allow users to use the MS Exchange, file sharing, printer sharing and other services common to MS Windows environment.

As far as the Web Server Software, the choice is not limited to commercial Microsoft products. The open source Apache Tomcat 5.5 is free to use and has all the latest functionality and security needed for the project. According to Netcraft.com Apache Web Server market share is around 61%, so it is very widely used, accepted and supported by the community.

3. Chapter III – Project Methodology
3.1. General information about the chosen methodology

As mentioned already in Section 2.2.1 the Waterfall method with some variations was chosen for

the TechHelper project. The variations include using iterative approach during the design, build

and test phases of the project and the RAD (Rapid Application Development) practices of

splitting the requirements into multiple revisions for quick results. This approach is also very

convenient for a very small team, providing the convenience of moving in small steps towards

the big goal at the end.

3.2. Project TechHelper Requirements

The requirements for the project were gathered using the following methods:

- Interviewing the users of the current system (see Appendix A)

- Gathering the feedback on the prototypes via questionnaires (see Appendix B)

- Reviewing the current documentation and reports generated by the current system (see Appendix C)

- Observing the current procedures for call handling and dispatch

The questionnaires were distributed between all the users to establish the satisfaction level with

the current system. The user group included multiple people from sales, administrative and

service divisions. Each department had their priorities for the new system, but overwhelming

majority was dissatisfied with the current setup. Based on the answers and current

documentation the following requirements were compiled for the first revision:

- Store/edit/retrieve the customer information including:

  o Name (Text field, 75 characters)
  o Address (Text field 100 characters)
  o City (Text field, 25 characters)
  o Zip code (Numeric Field, 5 characters)
  o Phone Number (numeric field with format placeholders)
  o Fax Number (numeric field with format placeholders)

- o E-mail (Text field, 50 characters)
- o Terms of payment (Text field, fixed selections)

- Store/edit/retrieve the machine information (same customer may have multiple

  machines):

  - o Type (Text field, fixed selections)
  - o Model (Text field, fixed selections)
  - o Serial Number (Text field, 30 characters)
  - o   Contract Type (Text field, fixed selections)

- Store/edit/retrieve information about the accessories for every machine:

  - o Type (Text field, fixed selections)
  - o Model (Text field, fixed selections)
  - o Description/Notes (Text field, 75 characters)

- Store/edit/retrieve technician's information:

  - o Number (Numeric field, 3 digit)
  - o Name (Text field, 50 characters)
  - o Phone Number (numeric field with format placeholders)
  - o Email Address (Text Field, 50 characters)

- Store/edit/retrieve maintenance information about every machine

  - o Machine Serial Number (Text field, 30 characters)
  - o Date of the call (Date field)
  - o Technician who performed the work (Text field, fixed selection)
  - o Copy Count (Numeric field, 10 characters)
  - o Problem (Text field, 50 characters)
  - o Solution (Text field, 200 characters)

- Store/edit/retrieve Parts Information:

  - o Part Number (Text field, 10 characters)
  - o Description (Text field, 50 characters)
  - o Model (Text field, 10 characters)
  - o Price (Numeric field, currency format, 6 characters)

- Generate and print work orders with the following information included:

  - o Customer Information
  - o Date
  - o Machine Information

- o Corrective Action
- o Copy Count
- o Parts Names
- o Quantity
- o Price
- o Taxes
- o Totals

- Automatically update maintenance history from the work order data

- Generate parts used report by date and technician

- Generate closed calls report by date and technician

- Perform system backup/restore functions

- All of the above functionality must be available via the local network or through the
  Internet

- The access to the system has to be secure preferably with multiple levels of clearance

The above requirements are visually summarized in a UML (Unified Modeling Language) Use

Case diagram below:
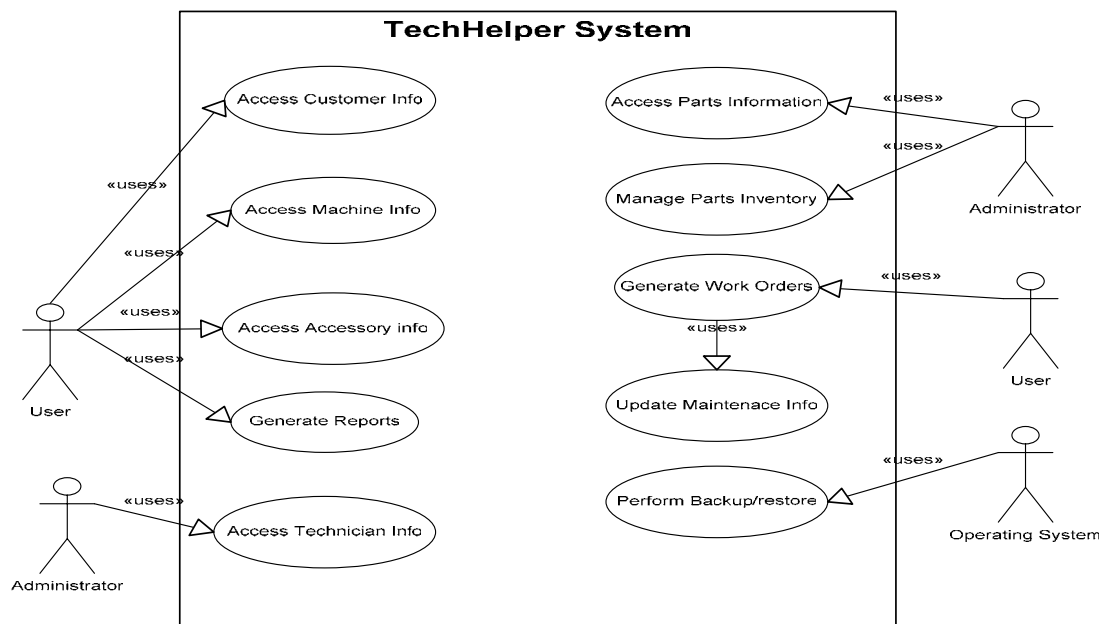
Drawing 6. TechHelper Revision One Use Case Diagram.

The descriptions for all of the above use cases in a form of user/system interactions are included in the Appendix D.

3.3. Analysis

The analysis for the TechHelper project was performed using mostly the Internet, which both sped it up and provided multiple alternative solutions to every area of research. The results of this phase are presented in Sections 2.1 through 2.4 as well as feasibility analysis presented in Section 1.3.5.1.

3.4. Design

3.4.1. General information

Design, build and testing phases were combined into one iterative process. Due to the fact that TechHelper is the first development project undertaken by Premiere Copier, such method of handling the bulk portion of the work by a very limited staff is the best solution. According to the best industry practices when engineering a new web application it is crucial to use the n-tiered design approach in conjunction with design patterns to facilitate the robustness, extensiveness and reliability of the final product. Using this approach also helps to keep the project on schedule and under budget. Following is a basic representation of an n-tiered application:

Presentation Layer

Business Layer

Service Integration Layer

Data Layer
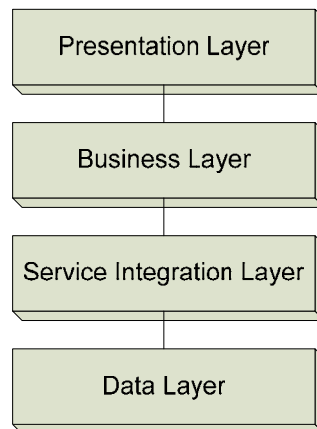
Drawing 7. N-Tiered Application

The fact that the project is using the Java STRUTS framework eliminates the need to design the presentation layer. Only some configuration, coding and HTML (Hyper Text Markup Language) pages are needed to create the GUI (Graphical User Interface) for the application.

3.4.2. The Data Tier

The first step in designing an n-tiered application is to create the data tier. This layer is responsible for handling and representation of data object. After reviewing the requirements for the system, the following list of data objects was compiled:

- Customer
- Machine
- Accessory
- Part
- Call

- Work Order
- Report
- Technician
- Login

To better understand the relationships between all the data objects the class diagram of the Data Layer was created (See Appendix E).

3.4.3. The Service Integration Tier

The next part to be designed was the Service Integration Tier. The purpose of this tier is to encapsulate and hide all of the technological aspects of the application such as database connectivity, links to other data sources, etc. TechHelper will use this tier mainly for JDBC (Java Database Connection) connection to the MySQL database. The following design patterns were used to engineer this part of the application:

- Factory – looks up and instantiates service objects by its names

- Separated Interface – application is written to use interfaces. At the same time, the implementations can be easily swapped out in order to change or expand functionality.

- Singleton - Ensure a class has only one instance, and provide a global point of access to it (loading application properties, factory, etc.)

- Data Mapper – facilitate the moving of data between the application and the database, keeping them independent of each other.

The Class Diagram for the Service Integration Layer can be found in Appendix F.

3.4.4.   The Business Tier

The purpose of this Layer is to incorporate all the business rules into the application. For example it is up to this layer to make sure users are authenticated before accessing any functions or when a new user is created all the needed information is collected and stored and etc. This tier is also the one that the Presentation layer communicates to in order to store or retrieve data.

All the manager classes in this layer extend the Manager superclass that is able to request services from the Service Integration tier:
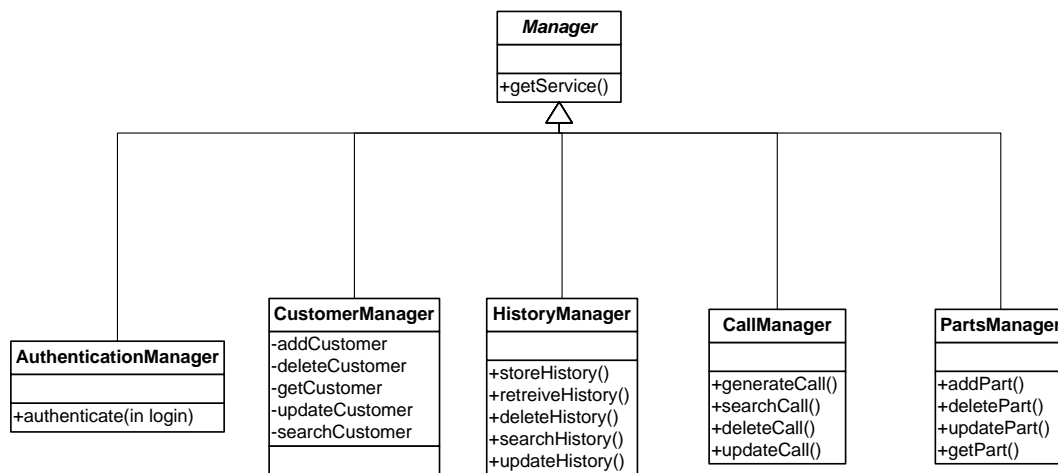
Drawing 8. Business Layer.

3.4.5.   The Presentation Tier

This layer is to be implemented using the Apache STRUTS framework, which will facilitate the use of the MVC (Model View Controller) design pattern to make the application more reliable, robust and easily extensive. STRUTS will take on a challenge of navigating user from page to page according to defined rules, representing the role of Controller. The View

will be created using the HTML JSP pages and finally the model is the remaining three tiers

of Data, Service Integration and Business. After introducing STRUTS into the TechHelper

the top-level design of the application first introduced in Drawing 7 starts looking like this:
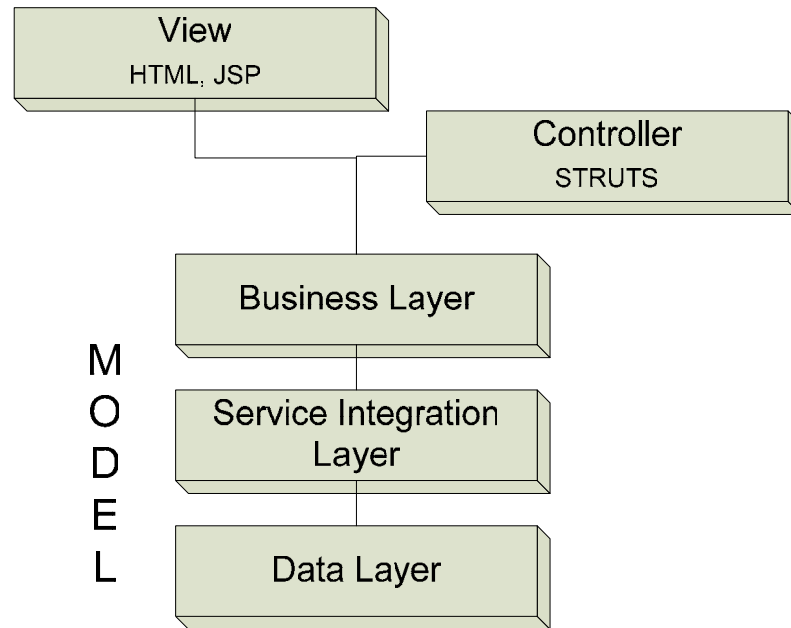
Drawing 9. MVC and STRUTS in TechHelper.

In addition to controlling the navigational flow of the application presented in the

APPENDIX G, STRUTS framework will also handle the sessions and the information

exchange between the View, the Controller and the Model as well as initial validation for

that data. The illustration mentioned above only represents the main success path. It does not

cover the error messages, confirmation dialogs or details on every data entry screen. Fuller

description of the navigation for each of the use cases can be found in Appendix D.

In order to accomplish the navigational tasks Apache Tomcat forwards all the HTML

requests to the STRUTS framework's Action classes, the light weight gateways to the rest of

the application. These Action classes all extend the Action Servlet class that is one of the

main building blocks of the STRUTS framework.

The HTML form data is passed on using the Action Form beans, which are simple objects containing a set of getters and setters (special operations used to get and set values to object's attributes).   After processing the form data Action Classes communicate to the Business Layer to fulfill the request, get the results back and forward a HTML page containing results to the client's browser.

3.5. Build

As mentioned before the project TechHelper has very limited staff, therefore the build phase began as soon as the design process started for the first tier, which was the Data Tier. All three processes of designing, building and testing have to go hand in hand due to that same limitation of personnel available.

3.6. Test

Testing is performed at unit, tier and application levels whenever possible. Unit and tier testing is done by the developer, application testing is done by both the developed and the users. During testing users are asked to perform their daily tasks using the system and then comment on the experiences using a questionnaire presented in Appendix B. After gathering all of the testing results the iteration goes back to design, building and testing again.

3.7. Prepare Documentation

Parallel to designing, building and testing another very important task had to be performed – preparing the documentation for the project. It consists of the following:

- Project Analysis Documentation

- Research Documentation

- Requirements Documentation

- Design Documentation

- Code with comments

- Revision History

TechHelper project's documentation is prepared as the project moves along through the phases and is updated as changes and additions take place. All the past revisions of the documentation are saved as well to keep track of the development.

3.8. Implement

Implementation of the project started with the introduction of the server and new networking hardware into the infrastructure. The current legacy TrackIt application now resides on server. The company website is also hosted on the server with the help of Apache Tomcat. The TechHelper web application is deployed to the server and submitted to user testing every time a major milestone is reached. During the first development stages, the application is not open to the Internet and is only available on the internal network.

3.9. Maintain

Since this paper only covers the first revision of the project, the maintenance phase is going to come down to continuation of work on the project adding more functionality and features as well as eliminating errors and tweaking the application for better performance.

3.10.   Future Revisions

The following features are already planned for future revisions of the TechHelper project:

- Inventory management for each technician with minimum stock and restocking alerts

- Full Call management features

- Additional Reports

- Adobe PDF document generation for easy emailing

- Interface with a major mapping/guidance website to provide driving directions and maps

- Developing a more attractive graphical user interface

- Automatic emails about new calls to technicians cell phone

- Sales Leads Management by retrieving and storing information from yellow pages and/or other sources

- And more features as needed/required by users

4. Chapter IV – Project History

4.1. Project's Background

The TechHelper project was started due to two main reasons. First, Premiere Copier IT infrastructure was long due for an update. The current system was purchased 7 years ago and is outdated, unreliable and lacking functionality. The new infrastructure would provide new hardware foundation for the company as well as the new software to facilitate faster, more robust business process and flexible enough to accommodate any future changes that might be needed. Most of the software and packages used for the development are open-source and would not be a heavy burden on company's budget.

Second reason was educational experience for the developer as he was finishing the Master's Program at Regis University. Such project would allow him to use all the skills acquired during the program and provide invaluable real-life experience.

4.2. Project's actual timeline

At the time this document is prepared the TechHelper project is undergoing the iterations of design, building and testing. Several prototypes have been submitted to user testing already and most of the functionality required for the first revision of the project is completed. The features that still need to be completed are the Report generation and Work Order Generation. The preliminary timeline presented in section 1.3.4.1 was followed pretty closely and the following chart represents the current progress of the project (red line marks the current date):
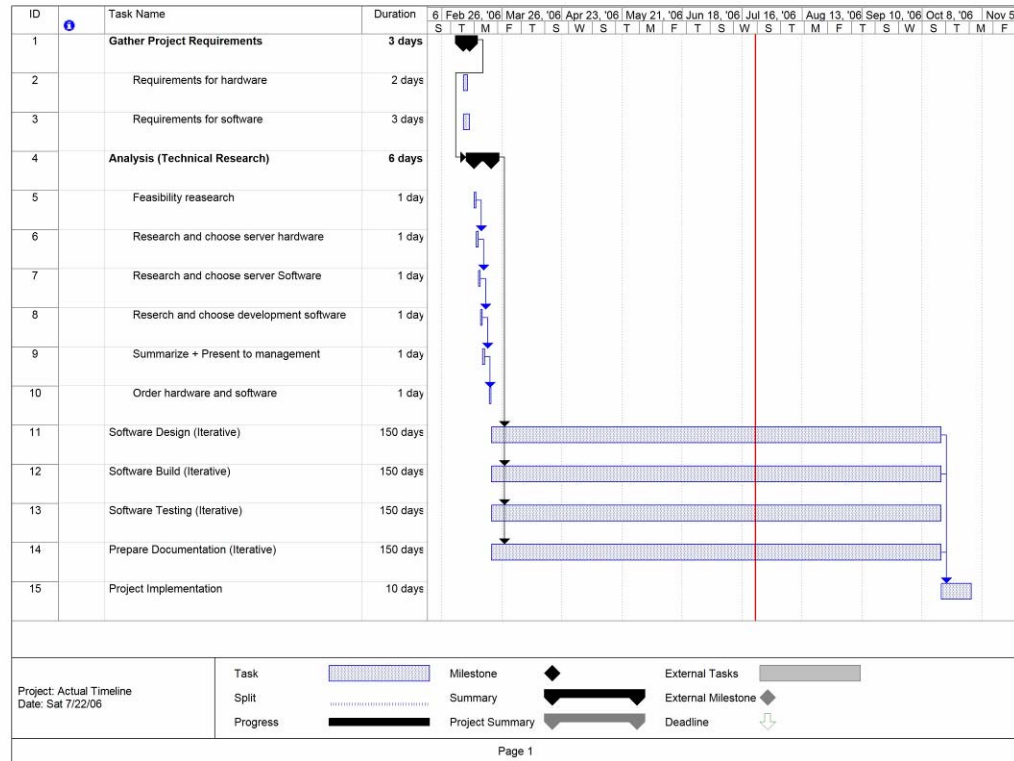
Drawing 10. Project's actual timeline.

4.3. Project's budget

As mentioned in section 1.3.4.1 a total of $2500 was pre-approved for the purchase of hardware

and software. The following table presents the actual expenses:

Component	Price
Dell Sever PowerEdge 830 with MS Windows Server 2003	$2110
The PowerConnect 2324 Unmanaged 24 port Fast Ethernet switch	$114
Wireless Internet cards for laptops	6 x $99
Total:	$2818

The TechHelper project's actual budget exceeded the estimation by $318 due to a couple of

reasons: the server was a little more expensive than anticipated and the wireless internet cards

were not included in preliminary estimations. However, as mentioned in section 1.3.5.1 the cost of the cards will be compensated by the time saved when using the new system in less than a month.

4.4. Project's goals and deliverables

The main goal of the first revision of the TechHelper project was to create a more reliable, scalable, robust and faster infrastructure for the company. The software part of the project – the TechHelper web application during this revision is mainly used to show the executives the benefits of switching from a legacy-outdated system to a fully customizable web based solution. Just implementing the server-based architecture already resolved many of reliability and speed problems even when still using the old TrackIt application.

After demonstration of the first prototypes of the TechHelper web application and explanation all of the features that can be integrated into it, the executives of the company gave the rest of the project a green light. When the first revision of the project is completed, it is going to be deployed to the server. From that point on, the new system will be used in parallel with the old one complementing each other. The future revisions of TechHelper applications will be replacing more and more features of TrackIt gradually phasing the latter completely out.

Currently the hardware part of the project is already in place. The TechHelper web application is in the final stages of building and testing. According to estimations, the first revision of the application is going to be ready to deploy ahead of the schedule by the end of September 2006.

4.5. Project's Experiences (Positives and Negatives)

As mentioned above the TechHelper project was the first real life project undertaken by the one-man developing team, that's why its educational value is as important as the business value. From the very conception of the idea that Premiere Copier needs to upgrade the current system the project became an exciting journey of new discoveries, challenges and research. Due to the

lack of practical experience especially in the very beginning of the project challenges arose all the time and were resolved one by one, providing invaluable lessons to the developer.

The first step to designing the new system was figuring out what it was supposed to accomplish; in other words gather and organize the requirements, which quickly became the first challenge. Even though Premiere Copier is a small company, requirements were piling up very fast. It was quickly realized that it is impossible to satisfy all of them in a reasonable timeframe. The method of dividing and conquering was suggested, so the project was split into revisions. Revision one, described in this document was supposed to serve as the basic framework and a prototype for the rest of the TechHelper project. It also included the much needed upgrade of the hardware to provide a firm foundation for the existing applications as well as the new application. Such strict limitation of what is to be included in the first revision prevented the scope creep and allowed the project to stay on track even with the limited resources.

After forming a list of requirements for the first revision, there came the next challenge of choosing the right solutions to implement them. Because the company never undertook a project of this nature before, there were no internal procedures or policies for system development; therefore a research was conducted to find the most appropriate ways to satisfy the requirements. Section 2.1 describes the weighted method used to choose the right alternative for the project. The majority of the research was conducted using the Internet search engines like www.google.com, which not only saved time but also uncovered many more solutions than was expected. Even though there was only one winner in each category, the information was gathered for all the contenders, which may be found more suitable for the future projects. The only downside to the above method was that the whole research and the evaluations were done by the same person which might have introduced some biased judgments.

Estimating the time schedule was not an easy task as well. With no experience of similar projects the only way to judge the length of a task is guessing. Using such a vague technique is

one of the main reasons that the project is actually ahead of the schedule – most of the tasks were assigned longer durations than they required. However, now that the actual times for the tasks are known, it is going to be much easier to estimate schedules for the future projects.

When the winning solutions were picked out in each of the major categories, it was time to start the first iteration of designing, building and testing. Due to only one person being the designer and the developer it was decided that such iterative approach would be the best fit for the project. The industry's best practices such as n-tiered architecture and design patterns were used as the main building blocks of the application. The stumbling stone for this phase was actually transferring from theoretical design to writing code as all the design elements had to be actually coded, tested and implemented into the project by the developer with almost no experience building applications of this scale. The Internet and the advice of Regis University professors came to the rescue when difficult situations arose.

When it came time to perform the testing, the developer had only himself to perform most of it. Only the working application could be tested by the end users, so the unit testing and integration testing had to be performed by the developer. It is said, that testing your own code is one of the worst practices, but in this case it was the only way out. Many times it took longer to track down and eliminate the errors that were not caught during the unit and integration tests, but were caught during the system tests; however that is the price that had to be paid due to having very limited staff working on the project.

As mentioned above, the hardware portion of the project is already implemented in place. It is currently used to run the legacy application more efficiently. The system tests are also performed by deploying the latest build to the server and letting the users interact with it and basically perform their everyday tasks using the functionality of the new application.

5. Chapter V – Conclusions
5.1. Lessons Learned

In addition to being a much needed upgrade to the current business process project TechHelper turned out to be a very valuable learning tool. Filling the shoes of the project manager, developer and designer was challenging for one person but gave very valuable insights to each of those roles.

Using a formal methodology to design and manage the project was a new experience as well. All the smaller projects done in the past were just thrown together at the last minute and fixed as they went along. A formal methodology allowed to develop the basic structure of the project using the best practices from the industry and at the same time made the system more stable, robust and scalable.

Approaching the project in this new and different way did introduce its share of problems as well. Learning curve of the formal method did delay the first results, but in the long run provided far too many advantages to ignore.

5.2. Next Steps

This document only covered the first revision of the TechHelper application. The future revisions will introduce more and more functionality and features. Some of those features were already extracted from the initial questionnaires when first researching the requirements for the project. Most of them had to be removed from the revision one to eliminate the scope creep and keep it simple enough to produce quick results. Some of the main future features are listed below:

- Inventory management for each technician with minimum stock and restocking alerts – this function will replace the similar one in the legacy TrackIt application and begin the process of phasing the latter out.

- Full Call management features – more functionality to replace that of TrackIt

- Additional Reports – fully customizable reports to facilitate any kind of research and data mining the executives are interested in

- Adobe PDF document generation for easy emailing – optional function to facilitate electronic delivery of documents to customers directly from within the application

- Interface with a major mapping/guidance website to provide driving directions and maps – new feature to facilitate faster travel times from one call to another

- Developing a more attractive graphical user interface – more eye-pleasing web page design

- Automatic emails about new calls to technicians cell phone – another convenient way to eliminate paperwork and receive all the information in electronic form

- Sales Leads Management by retrieving and storing information from yellow pages and/or other sources – new sales tool allowing to keep track of the potential leads and preventing multiple sales people from calling the same company.

- Sales Man's Corner – a new function, that will help sales force organize their records and keep their customer and sales information safe and easily accessible (Contact information, notes, proposals, etc.)

- Financial Functions – tools to keep track of charges and past dues, automatically generate monthly bills for copy counts and etc.

- And more features as needed/required by users – as already mentioned, TechHelper is fully customizable solution, allowing to add any functionality that might be required by users

5.3. Project summary

Overall the first revision of the project is a success. It is still a work in progress and judging from the list in Section 5.2, there is still plenty of work to do. Being the first project of this kind for the company, it has provided very valuable educational experience and business benefits to Premiere Copier already, and more is still to come. The most difficult part of the endeavor was the staff limitation. One man developing team, and only fifteen to twenty hours a week to dedicate to the project did delay the results that could be seen much faster with adequate staff. It will be recommended to the company executives to assign the current developer to this project full time and possibly hire some temporary help to get the TechHelper to the point when the legacy application can be completely eliminated. From there on the system will only require minimal maintenance and functionality upgrades as the need for those arises. At that point in time project staff can be reduced to part-time again.

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Device&deviceType=Wireless%20PC%20Cards&cm_re=Home%20Page-_-Personal%20Box-_-

Phones

APPENDIX A
Current System User Interview

Name: _____

1. What functions of the current system are you using:

   _____

   _____

   _____

   _____

2. What additional functions would you like to see in the future system:

   _____

   _____

   _____

3. Please rate the current system (1- very bad , 10 – excellent)

   - Ease of use _____
   - Reliability _____
   - Ease of access _____
   - Ease of backup/restore ____
   - Functionality ____

   - Operations Accuracy _____
   - Speed of operations_____
   - Quality of Support_____
   - Access Restrictions _____

4. What additional information about clients, machines etc. would you like to store and have access to:

   _____

   _____

5. Which of the following functions would you benefit from most in everyday use:

   - Remote access to system ☐
   - Restricted Access Groups ☐
   - Ease of use ☐

   - Ease of maintenance ☐
   - Operation speed ☐

6. Additional comments and suggestions:

_____

_____

_____

_____

_____

_____

_____

_____

APPENDIX B
TechHelper prototype evaluation

Name _____

1. What did you like most about this release?

_____

_____

_____

_____

2. What did you NOT like about this release?

_____

_____

_____

_____

3. Please rate the current release (1- very bad , 10 – excellent)

- Ease of use _____   • Operations Accuracy _____

- Reliability _____   • Speed of operations_____

- Ease of access _____   • Quality of Support_____

- Ease of backup/restore ____   • Access Restrictions _____

- Functionality ____

4. Did the current release meet you expectations (requirements) Yes/ No + explain:

_____

_____

_____

Additional comments Suggestions:

_____

_____

APPENDIX C
Current Work Order Form (manual)

Premiere Copier

7442 S. Tucson Way #170

Centennial, CO 80112

Tel. 303-751-7307 FAX. 303-751-0635   Tech: Markas

www.premierecopy.com   Date:_____

Customer_____   Model #_____

Address_____   Serial #_____

City_____Zip_____   Copy Count_____

Problem_____

Corrective Action_____

_____

Qty.	Unit	Part #	Description	Price	Total

ALL UNPAID BALANCES WILL BE ASSESSED A 10% FINANCE CHARGE PER MONTH

SubTotal	
Tax	
Total	

Supplies Needed?   Y   N (Circle one)   On Hand_____

Clear Counts?   Y   N (Circle one)   Contract _____

History Sheet?   Y   N (Circle one)   PM Counter _____

Surge Present?   Y   N (Circle one)   Start Time_____

Parts Needed_____

_____   End Time_____

Accessories:_____

Please note that repairs as a result of electrical problems on machines that are not protected by a UL1449 rated surge suppressor will not be covered by the maintenance agreement.

Customer Signature_____

Comments or Suggestions_____

APPENDIX D
Use Case Descriptions

1. Access Customer Info

Main Success Scenario	1. Technician types a URL address for TechHelper in the web browser. 2. A login page is displayed and prompts the user for User ID and Password. 3. The Technician enters the User ID and password. 4. The TechHelper <u>Authenticates User</u> and displays the Main Menu. 5. Technician Selects Access Customer Info option. 6. The System displays the list of all customers and a search field as well as an option to add a new Customer. 7. Technician Selects the Customer from the list. 8. The System displays Customer Details (including options to edit and delete information and details about all the machines owned by Customer) 9. Technician Logs Out. 10. TechHelper system goes back to Login screen.
Alternate Scenarios	4a. The System fails to authenticate user: 1. The System displays the initial Login screen. 2. Technician enters the User ID and password again 7a. Technician enters a search string 1. System displays a list of customer names that match the search string or a message that no customers matched the search. 2. Technician selects the Customer from the list or is taken back to step 6 of main success scenario if no customers were found. 3. System resumes at step 8 in main success scenario. 7b. Technician chooses to add a new customer. 1. System prompts for all needed information 2. Technician types information in 3. System validates entries and saves information or prompts again for incomplete/incorrect information and resumes the main success scenario at step 6.

2. Access Machine Info

Main Success Scenario	1. Steps 1-8 from Access Customer Info are repeated 2. Technician selects the machine from the list to view further details 3. System displays machine details and accessories (if any) associated with selected machine. 4. Technician Logs Out. 5. TechHelper system goes back to Login screen.
Alternate Scenarios	2a. No machines are registered with the Customer or Technician needs to add a machine: 1. Technician chooses to add a machine

	2. System prompts for all needed information
	3. Technician types information in
	4. System validates entries and saves information or prompts again for incomplete/incorrect information and resumes the main success scenario at step 2.
	2b. Technician needs to delete a machine:
	   1. Technician chooses to delete a machine
	   2. System displays confirmation and forwards to customer details page

3. Access Accessory Info

Main Success Scenario	1. Steps 1-8 from Access Customer Info are repeated 2. Technician selects the machine from the list to view further details 3. System displays machine details and accessories (if any) associated with selected machine. 4. Technician Logs Out. 5. TechHelper system goes back to Login screen.

Alternate Scenarios	3a. No Accessories are registered with the selected Machine or Technician needs to add an accessory:
	   1. System displays a message that no accessories were found
	   2. Technician chooses to add an accessory
	   3. System prompts for all needed information
	   4. Technician types information in
	   5. System validates entries and saves information or prompts again for incomplete/incorrect information and resumes the main success scenario at step 2.
	3b. Technician needs to delete an accessory:
	   1. Technician chooses to delete an accessory
	   2. System displays confirmation and forwards to customer details page

4. Access Technician Info

Main Success Scenario	1. Administrator types a URL address for TechHelper in the web browser. 2. A login page is displayed and prompts the user for User ID and Password. 3. The Administrator enters the administrative ID and password. 4. The TechHelper <u>Authenticates User</u> and displays the Administrative Menu. 5. Administrator Selects Access Technician Info option. 6. The System displays the list of all the Technicians as well as an option to add a new Technician. 7. Technician Selects the Technician from the list. 8. The System displays Technician's Details (including options to edit and delete information) 9. Administrator Logs Out. 10. TechHelper system goes back to Login screen.

Alternate Scenarios	4a. The System fails to authenticate user:
	   1. The System displays the initial Login screen.
	   2. Administrator enters the User ID and password again

	7a. Administrator chooses to add a new Technician.
	1. System prompts for all needed information
	2. Administrator types information in
	3. System validates entries and saves information or prompts again for incomplete/incorrect information and resumes the main success scenario at step 6.
	8a. Administrator needs to delete a Technician:
	1. Administrator chooses to delete a Technician.
	2. System displays confirmation and resumes the main success scenario at step 6.

5.   Generate Reports

Main Success Scenario	1. User types a URL address for TechHelper in the web browser.
	2. A login page is displayed and prompts the user for User ID and Password.
	3. The User enters the ID and password.
	4. The TechHelper <u>Authenticates User</u> and displays the Main Menu.
	5. User Selects Generate Reports option.
	6. The System displays the list of available reports (for revision one they are Closed Call Report and Parts Used Report).
	7. User Selects the Closed Calls Report.
	8. The System prompts for the starting and end dates for the report
	9. User enters dates or accepts the default for the day before
	10. System displays all closed calls for the time period specified (Customer name, problem, solution, copy count, machine model and serial)
	11. User reviews/prints results
	12. User Logs Out.
	13. TechHelper system goes back to Login screen.
Alternate Scenarios	4a. The System fails to authenticate user:
	1. The System displays the initial Login screen.
	2. Administrator enters the User ID and password again
	7a. User selects Parts Used Report
	1. User Selects the Parts Used Report.
	2. The System prompts for the starting and end dates for the report
	3. User enters dates or accepts the default for the day before
	4. System displays all used parts for the time period specified (technician's name, part name, part number and quantity)
	5. User reviews/prints results
	6. User Logs Out.
	7. TechHelper system goes back to Login screen.

6.   Access Parts information

Main Success Scenario	1. Administrator types a URL address for TechHelper in the web browser. 2. A login page is displayed and prompts the user for User ID and Password. 3. The Administrator enters the administrative ID and password. 4. The TechHelper <u>Authenticates User</u> and displays the Administrative Menu. 5. Administrator Selects Access Parts Info option. 6. The System displays the drop down list of all the Parts, a search field as well as an option to add a new Part. 7. Administrator Selects the Part from the drop down list. 8. The System displays Part Details (part number, description and price) as well as options to edit and delete the information. 9. Administrator Logs Out. 10. TechHelper system goes back to Login screen.

Alternate Scenarios	4a. The System fails to authenticate user:
	   1. The System displays the initial Login screen.
	   2. Administrator enters the User ID and password again
	
	7a. Administrator chooses to add a new Part.
	   1. System prompts for all needed information
	   2. Administrator types information in
	   3. System validates entries and saves information or prompts again for incomplete/incorrect information and resumes the main success scenario at step 6.
	
	7b. Administrator searches for a part.
	   1. Administrator types in a search string
	   2. System displays the search results
	   3. Administrator selects the part (or if none were found enters a different search string)
	   4. System resumes the main success scenario at step 8
	
	8a. Administrator needs to delete a Technician:
	   1. Administrator chooses to delete a Technician.
	   2. System displays confirmation and resumes the main success scenario at step 6.

7.   Manage Parts Inventory

Main Success Scenario	1. Administrator types a URL address for TechHelper in the web browser. 2. A login page is displayed and prompts the user for User ID and Password. 3. The Administrator enters the administrative ID and password. 4. The TechHelper <u>Authenticates User</u> and displays the Administrative Menu. 5. Administrator Selects Manage Parts Inventory option.

	6. The System displays the drop down list of all the Technicians
	7. Administrator Selects the Technician from the drop down list.
	8. The System displays all the Parts in Technician's inventory and their quantity as well as an option to add new parts.
	9. Administrator Logs Out.
	10. TechHelper system goes back to Login screen.
Alternate Scenarios	4a. The System fails to authenticate user:
	1. The System displays the initial Login screen.
	2. Administrator enters the User ID and password again
	8a. Administrator chooses to add a new Part to Technicians inventory.
	1. System prompts for all needed information
	2. Administrator types information in
	3. System validates entries and saves information or prompts again for incomplete/incorrect information and resumes the main success scenario at step 8.
	8b. Administrator needs to delete a Part from Technician's inventory:
	1. In the quantity field for the chosen part the Administrator enters zero and chooses to update the list
	2. System resumes the main success scenario at step 8.
	8c. Administrator needs to update a Part quantity in Technician's inventory:
	1. In the quantity field for the chosen part the Administrator enters the quantity and chooses to update the list
	2. System resumes the main success scenario at step 8.

8. Generate Work Orders

Main Success Scenario	1. User types a URL address for TechHelper in the web browser.
	2. A login page is displayed and prompts the user for User ID and Password.
	3. The User enters the ID and password.
	4. The TechHelper <u>Authenticates User</u> and displays the Main Menu.
	5. User Selects Generate Work Order option.
	6. The System displays the list of open calls
	7. User Selects the call to be closed by the customer name
	8. The System prompts for the following information
	• Copy Count
	• Solution to the problem
	• Parts used to solve the problem
	• Additional notes
	9. User enters all the information.
	10. System displays the confirmation screen (actual work order form)

	11. User reviews/prints results
	12. User Logs Out.
	13. TechHelper system goes back to Login screen.
Alternate Scenarios	4a. The System fails to authenticate user:
	3. The System displays the initial Login screen.
	4. Administrator enters the User ID and password again

APPENDIX E
TechHelper
Data Layer Class Diagram
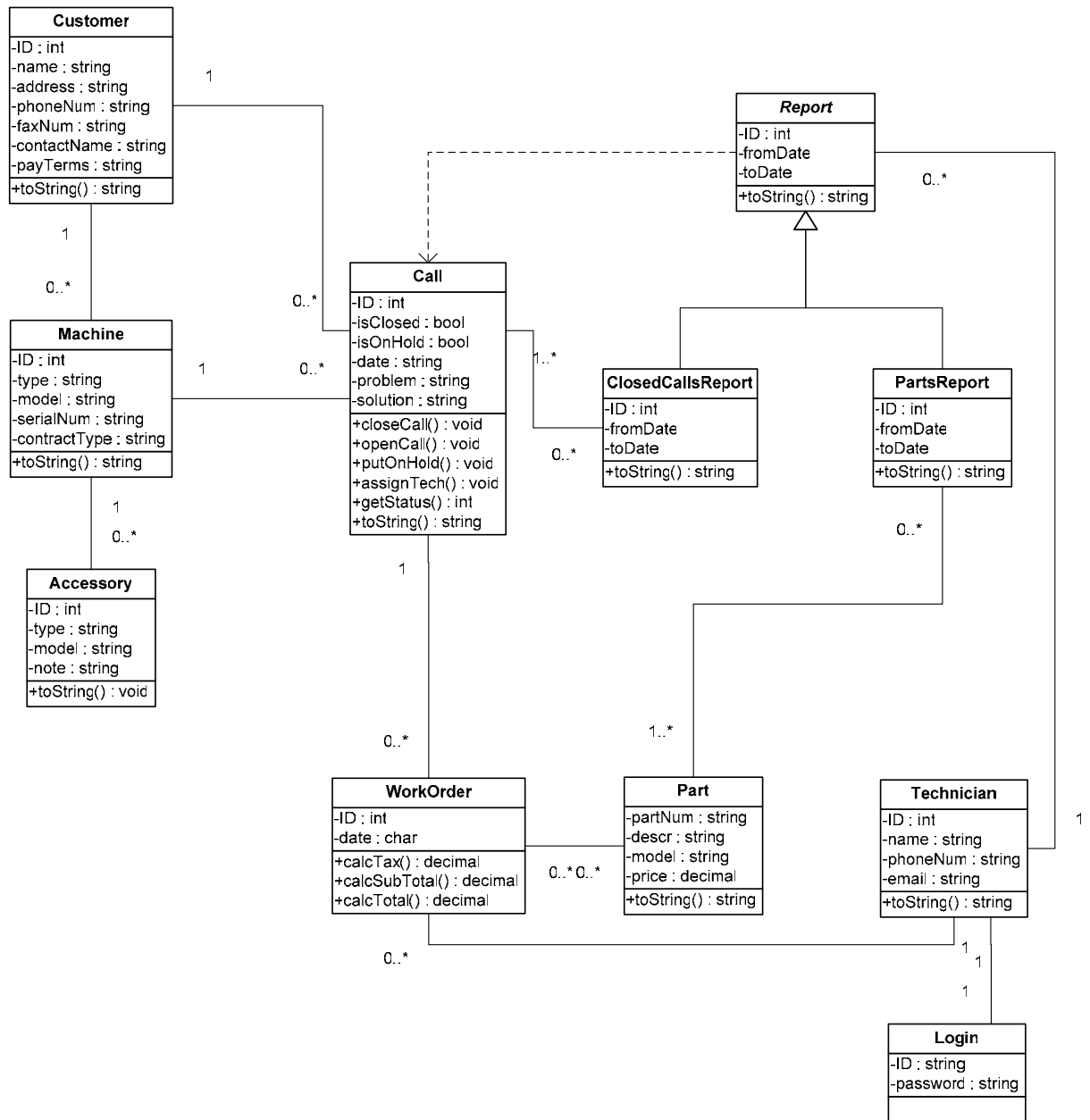
APPENDIX F
Service Integration Layer Class Diagram
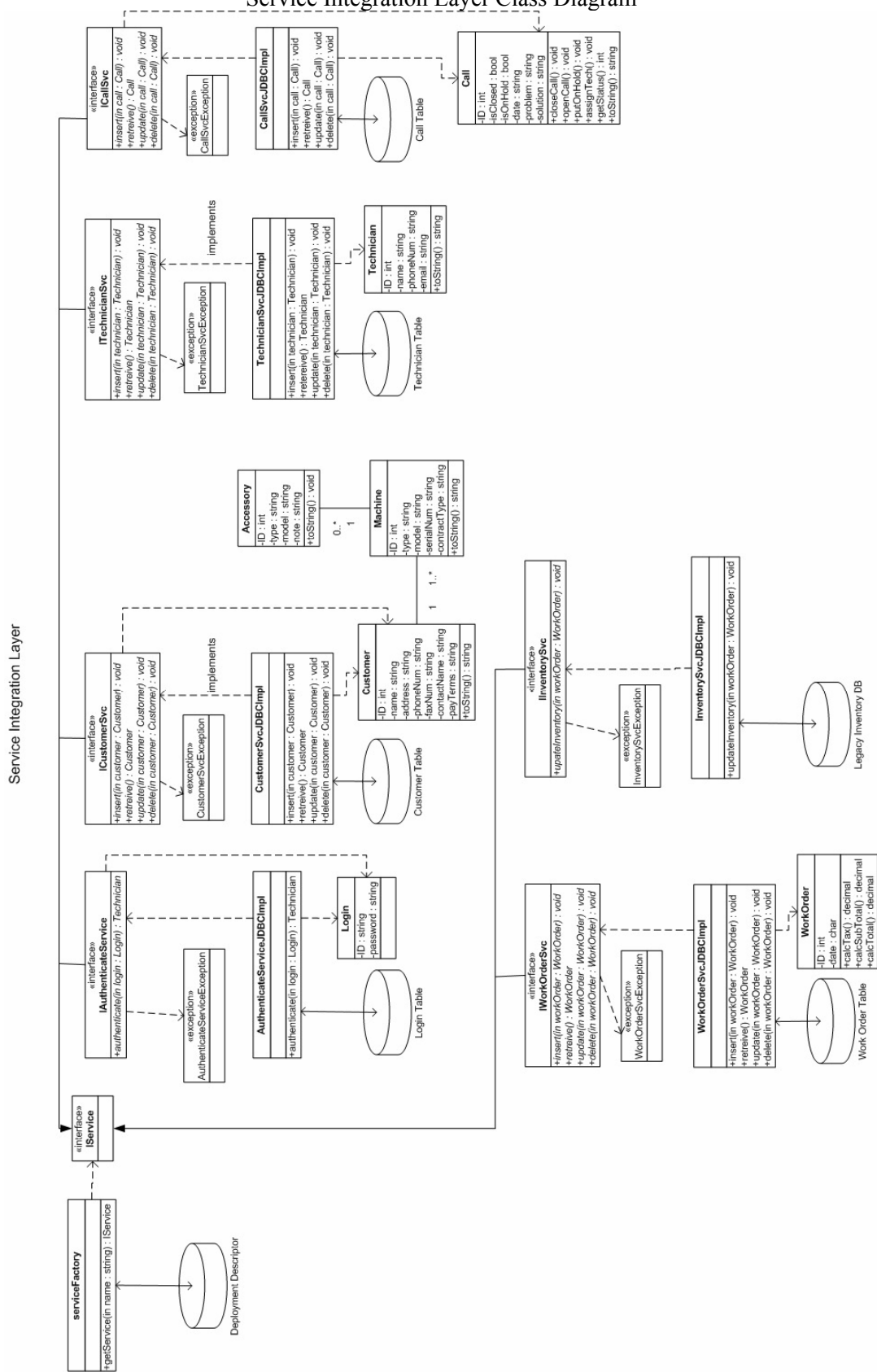
APPENDIX G
Basic Navigational Flow of TechHelper Revision 1.

```
┌──────────────┐                              ┌──────────────┐
│              │                              │   Access     │
│  Login Page  │                              │ Technician's │
│              │                              │ Information  │
└──────────────┘                              └──────────────┘
        │                                             │
  NO    │                                             │
        │         ◇                    ┌──────────────┐         ┌──────────────┐
        │    ╱  Login  ╲   YES -       │              │         │   Access     │
        └──╱ Successful? ╲─Administrative│Administrator's│────────│  Inventory   │
           ╲            ╱    Login      │    Menu      │         │ Information  │
            ╲        ╱                  └──────────────┘         └──────────────┘
              ◇                                │
              │                                │
   YES – Normal Login                          │
              │                                │
        ┌──────────────┐                       │
        │              │                       │
        │  Main Menu   │                       │
        │              │                       │
        └──────────────┘                       │
              │                                 │
   ┌──────────┼────────────────────┬───────────┴───────────┬────────────────┐
┌──────────────┐  ┌──────────────┐  ┌──────────────┐  ┌──────────────┐
│   Access     │  │ Generate Work│  │   Generate   │  │    Logout    │
│   Customer   │  │    Orders    │  │   Reports    │  │              │
│ Information  │  │              │  │              │  │              │
└──────────────┘  └──────────────┘  └──────────────┘  └──────────────┘
      │                                    │
┌──────────────┐                   ┌───────┴────────┐
│Access Machine│            ┌──────────────┐  ┌──────────────┐
│Information for│           │ Generate Used│  │Generate Closed│
│selected Customer│         │ Parts Report │  │ Calls Report │
└──────────────┘            └──────────────┘  └──────────────┘
      │
┌──────────────┐
│Access Accessory│
│Information for│
│selected Machine│
└──────────────┘
```