

ISU Alumni Association Online Store

Project Number May05-39

Design Report

Client:

Iowa State University Alumni Association

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List of Definitions

ASP	Active Server Pages, a Microsoft technology that allows web pages to be dynamically generated. ASP is commonly used to allow web pages to interface with database systems and other external data sources.
ASP.NET	ASP.NET is the newest version of ASP, implemented as part of the .Net Framework. ASP.NET offers many significant improvements over classic ASP, and allows scripting to be written using several languages including C#. More information: http://msdn.microsoft.com/asp.net/
C#	C# is a Microsoft-created object-oriented programming language similar to Java. C# was created for use with the .Net Framework and has many features designed specifically to interact with various technologies available within the framework.
CSS	Cascading Style Sheets is a simple text-based mechanism that allows style information (e.g. fonts, colors and spacing) to be attached to HTML and XML documents. More information: http://www.w3.org/Style/CSS/
Database server	A database server is a program or computer that allows efficient access to large amounts of data that are systematically stored. There are many database servers on the market today, including DB/2 and MySQL, which are frequently used in conjunction with technologies like ASP to support data-driven web sites.
DB/2	DB/2 is a database server available from IBM. It is one of the most powerful and robust database servers available, with support for many advanced features designed for the next generation of web applications. More information: http://www.ibm.com/db2/
HTML	The HyperText Markup Language is a text language that is used to describe the contents of a file. The markup in a document is processed by a web browser and converted into images and text for the user. More information: http://www.w3.org/Markup/
MySQL	MySQL is an open-source database server that is frequently used in small- and medium-scale web application development. MySQL doesn't support many of the advanced features supported by DB/2, but it is just a robust and has enough features for most applications. More information: http://www.mysql.com/
.Net Framework	The .Net Framework provides a common set of tools for developers on the Windows platform. These tools can be accessed using a variety of languages, including C#. ASP.NET is part of the .Net Framework. More information: http://msdn.microsoft.com/netframework/

Web application	A web application is a collection of dynamic web pages used to perform some function. Over the past several years, web applications have become extremely popular, with uses ranging from online bank applications to web-based poker tournaments. Many web applications are implemented using ASP or ASP.NET.
Web browser	Web browsers read HTML files, style them according to embedded CSS definitions, and present them to the user. There are many different web browsers, the most popular of which are Microsoft Internet Explorer, Netscape, Mozilla Firefox and Safari.
XHTML	The eXtensible HyperText Markup Language is a version of HTML that is compatible with XML, and thus can be parsed and manipulated like any XML document. More information: http://www.w3.org/Markup/
XML	The eXtensible Markup Language is a simple, flexible text format similar to HTML. Since its creation in 2000, XML has become the de facto standard for information interchange on the Internet, particularly between web applications.

Introductory Materials

Executive Summary

Problem

The Iowa State University Alumni Association is an organization meant to promote and publicize Iowa State University. One of the ways that the Alumni Association fulfills its function is by selling Iowa State branded merchandise. The merchandise directly promotes Iowa State as well as providing revenue to fund the organization. This merchandise is marketed through an online store (<http://www.isualum.org/store/>). The current store is barely adequate for the purpose and the Alumni Association would like to have a new system put in place. This senior design project has been created to that end.

Goal

The goal of the project shall be to create three product deliverables:

- ❖ An attractive online storefront
- ❖ An integrated and comprehensive database system
- ❖ A management tool suite

The storefront will present the articles available for sale by pulling appropriate information from the database system. In addition it will provide comprehensive ordering capabilities by interfacing with the same database system.

The database system will replace several disparate databases that are currently required to display merchandise, process orders, and maintain vendor information.

The management tool suite will allow the Alumni Association staff to administer the online catalog after development is complete. They will be able to add, delete, and change items and prices and update vendor information without having to directly interact with the database system.

Approach

The team will use an approach to facilitate successful implementation of the design objectives:

- Improved processing flow for orders
- Easily manageable catalog
- Intuitive storefront

The team has identified certain assumptions and limitations, and has chosen the development environment. The project will continue as planned.

Design

The design follows an object oriented approach that divides the development into three tiers: the presentation tier, business logic tier, and the data access tier. The presentation tier handles interaction with visitors to the store. The layout can be manipulated to best fit the requirements of the team's customer, but it has been modeled after several successful, existing stores. The business logic tier mediates interaction between the presentation and data access tiers, providing objects to represent business entities (vendors, items, etc) and business processes (shopping cart, order processing, etc). Finally, the data access tier provides a common interface to interact with the database system that stores the information needed by the application. This layer of abstraction will allow a more flexible data management solution.

Conclusions and Benefits

Upon completion of the project, the Alumni Association will receive an online store system that is on par with current leaders in the e-commerce field. The new store system will eliminate the data duplication present in the current system, as well as reducing the amount of overhead person-hours required to complete an order. These technical benefits will translate into overhead cost savings for the Alumni Association and will allow the organization to better serve the Iowa State community.

Acknowledgement

The team wishes to thank Dr. Srinivas Aluru for his support and guidance as our advisor. In addition the team would like to thank Kate Bruns and the staff at the ISU Alumni Association for guidance as well as origination of the project.

Problem Statement

The project will assist the Iowa State University Alumni Association in their mission:

“To become the lifetime partner in engaging all alumni, students, and friends with Iowa State University.”

and vision:

“To engage the talents and resources of alumni, students, and friends in the life, work, and aspiration of Iowa State University.”

by creating a new online store system for the organization.

General Problem Statement

The ISU Alumni Association's online store exists to raise money for and directly promote the goal of serving the alumni and promoting the visibility of Iowa State University. The money raised by the sale of Iowa State branded products is used to increase services to the alumni. The products themselves promote the university.

The main goals of this project are to improve the ability of the client's online store to meet its goals. This will be accomplished by redesigning the public store front and implementing a

comprehensive suite of administrative tools to optimize all aspects of the existing ordering process.

The existing store is implemented entirely using static HTML files and several separate databases, each of which must be manually updated whenever the catalog is changed. The project team will create a new store using ASP.NET technology which will dynamically update the store and process orders in conjunction with a new database server.

General Solution Approach

The team will build upon existing C#, ASP, and .NET knowledge in order to implement this new store and tool suite. Considerable effort will also be put into efficient database design in order to minimize data reentry. Great care will be taken to ensure that modifications to the store can be made from a central location and applied to all relevant stages in the ordering process.

Operating Environment

The new online store will be served from the existing Alumni Association server running the .NET Framework. The database will be hosted by a robust database server, possibly on a dedicated database server hosted by the ISU Foundation. The new online store will have similar storage and bandwidth requirements as the existing store.

Intended Users and Intended Uses

This section describes the expected users and uses of the system that will be implemented.

Intended Users

The project has components that are intended for use by one or both of two distinct groups of users:

Online Store Customers

The primary users of the online store will be visitors to the client's web site that wish to browse or purchase from the client's product catalog.

Alumni Association Staff

The sole users of the administrative tool suite will be the staff of the Alumni Association.

Intended Uses

Customers of the online store will expect an experience similar to that found at other online stores. The public store front will be used by customers to browse the product catalog, select items for purchase, manage a "shopping cart" of items selected for purchase, and complete orders by providing shipping and billing information.

The staff of the Alumni Association will use the administrative tool suite to add, remove and update products in the catalog; process orders placed through the public store front; deliver vendor invoices via e-mail; and view reports of sales statistics.

Assumptions and Limitations

This section describes the assumptions under which the developers will be operating, as well as the limitations to which the finished product will be subject.

Technical Assumptions

The team holds certain technical assumptions about the system:

- ❖ The majority of users will access the public store front with a modern web browser. Modern web browsers include Microsoft Internet Explorer 5.0 or later, Netscape 6.0 or later, Mozilla Firefox and Safari.
- ❖ The majority of users will have an Internet connection with bandwidth sufficient to support a graphics-intensive user experience.
- ❖ The client's server will have sufficient system resources to support the web application produced by the project.
- ❖ The server will have ASP.NET 1.1 (or later) installed.

Non-Technical Assumptions

The team holds certain non-technical assumptions about the system:

- ❖ Users of the store will have previous experience with standard online store protocol.
- ❖ Users of non-traditional and legacy web browsers will accept a marginalized yet functional user experience.
- ❖ Users with lesser bandwidth availability will accept a marginalized yet functional user experience.
- ❖ Alumni Association staff will have sufficient experience and ability to operate web-based administrative tools.

Limitations

The team has identified certain limitations to the system:

- ❖ The online store paradigm presents many user experience limitations that will be dealt with using methods most commonly used in similar commercial environments throughout the Internet.

- ❖ The use of a dedicated database server will be limited by the willingness and ability of the ISU Foundation to provide access for the use of this project.
- ❖ If a dedicated database server can not be used, the system resources available on the Alumni Association's server will limit the demands that can be placed on the database solution that is eventually selected.
- ❖ Team members must become proficient with ASP.NET technology.

Expected End Product and Other Deliverables

Upon completion the project will produce an online store capable of presenting merchandise, accepting orders, and maintaining security. In addition, a new database will be constructed to eliminate redundant work, thus streamlining both processes and information. Finally, a comprehensive suite of administrative tools will be produced to allow Alumni Association staff to manage the catalog, process customer orders and gather store data. This system will increase profits for the Alumni Association by eliminating unnecessary work with new management tools and increasing sales with a more attractive and usable public storefront. All code and artifacts shall be the property of the Iowa State University Alumni Association upon completion of the project.

End-product Design

Approach Used

The team will use a defined approach to develop the system, as detailed below.

Design objectives

The team has identified several objectives for the design:

- ❖ The Online Store will improve processing flow for orders.
- ❖ The Online Store's catalog will be easy to manage.
- ❖ The Online Store will be easy to use.

Functional requirements

The following functions will provide users with all the intended uses and benefits of the Alumni Association's Online Store.

- ❖ The system shall allow the customer to view lists of items in the product catalog.
- ❖ The system shall allow the customer to view details about individual items in the product catalog.
- ❖ The system shall allow the customer to add items from the product catalog to the shopping cart.
- ❖ The system shall allow the customer to update the quantity of items in the shopping cart.
- ❖ The system shall allow the customer to view the contents of the shopping cart.
- ❖ The system shall allow the customer to place an order for the items in the shopping cart.
- ❖ The system shall allow the staff to view orders placed by customers.
- ❖ The system shall allow the staff to submit orders to vendors via e-mail.
- ❖ The system shall allow the staff to view statistics about orders received by the system.

Design constraints

The team is constrained by certain design parameters:

- ❖ The majority of users will access the public store front with a modern web browser.

- ❖ Modern web browsers include Microsoft Internet Explorer 5.0 or later, Netscape 6.0 or later, Mozilla Firefox, and Safari.
- ❖ The majority of users will have an Internet connection with bandwidth sufficient to support a graphics-intensive user experience.
- ❖ The client's server will have sufficient system resources to support the web application produced by the project.
- ❖ The server will have ASP.NET 1.1 (or later) installed.
- ❖ Users of non-traditional and legacy web browsers will accept a marginalized yet functional user experience.
- ❖ Users with lesser bandwidth availability will accept a marginalized yet functional user experience.
- ❖ The online store paradigm presents many user experience limitations that will be dealt with using methods most commonly used in similar commercial environments throughout the Internet.
- ❖ The system resources available on the Alumni Association's server will limit the demands that can be placed on the database solution that is eventually selected.

Technical approach considerations and results

Programming language: C#

Language support of needed features and interoperability with other components determined the programming language. While C# is the official language, any language supported by ASP.NET can be used.

Database: MySQL

A relational database that supports transactions was required. MySQL is the most robust, free, and widely supported relational database available. It is available for many different platforms.

Platform: Windows Server 2000

The existing server already runs this operating system. Windows best supports ASP.NET. During project development it may be upgraded to Server 2003

Browser support: Modern web browsers

The public store front will support modern web browsers. Non-traditional and legacy browsers will be supported, but with limited functionality.

Testing approach considerations

The client will provide the primary testers of the end product. Types of testing will include stress testing and usability testing.

Both the front-end and back-end will be tested. Success for the front end will be judged by a user's ability to log in, add items to the shopping cart, and successfully check out. Success for the back end will be judged by the client's ability to successfully process that order.

The most important contribution of a user's experience will be their written comments. These comments will be used to improve usability. The testing forms will also request other information:

- ❖ a rating of how difficult it is to use the system
- ❖ the best and worst of the user's experience
- ❖ if the user might consider ordering again

The user will be asked to verify what he or she thought was purchased against what the system recorded. If there are no discrepancies, the test will be judged as a validation of proper operation.

Recommendations regarding project continuation or modification

The team has evaluated the project status and determined that it should continue as planned. No major changes have been made to the project since inception, and no design issues are unresolved. The team feels confident they can complete the project as specified and on time.

Detailed Design

This section will detail the complete design of the system, beginning with an overview followed by a more complete description of each component of the application.

Design Overview

The system is designed using a typical three-tier architecture. The three tiers are the data tier, the business logic tier, and the presentation tier. Spanning these tiers is a set of common entities that form the business model, objects that are used by all components of the application. A general overview of the system is provided in Figure 1.

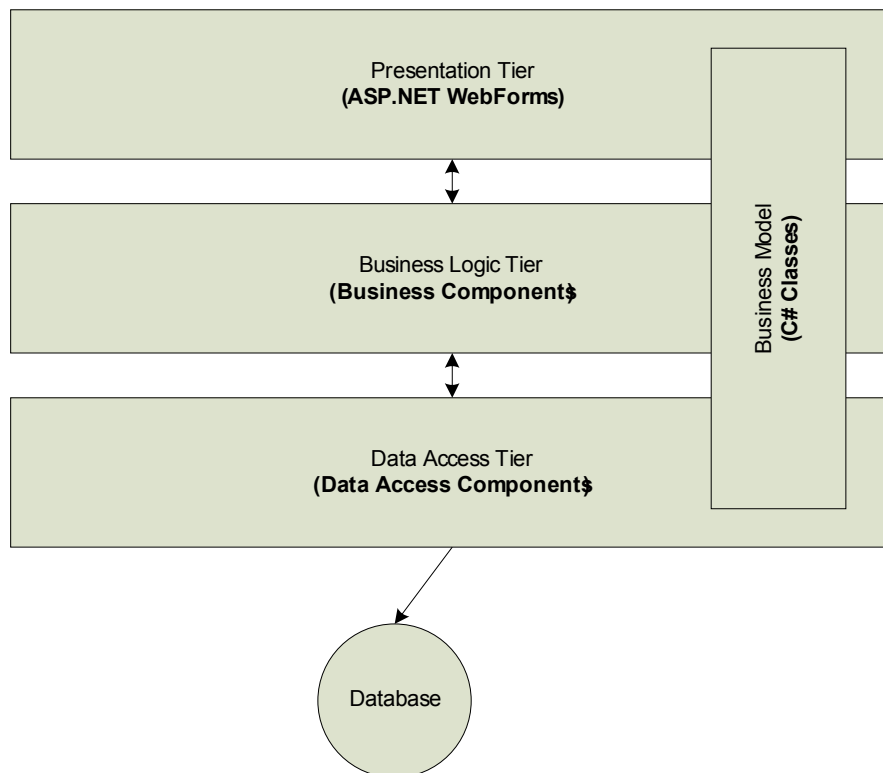


Figure 1: Architectural Overview

Business Model

The business model defines a collection of entities that are used by various components of the system to represent important information. These business entities include objects to represent customers, addresses, items and orders. By providing a set of common objects, the various levels of the architecture are able to communicate without knowledge of their independent functionalities. The objects defined in business model are as follows:

- ❖ AddressInfo
- ❖ CartItemInfo

- ❖ CategoryInfo
- ❖ CreditCardInfo
- ❖ CustomerInfo
- ❖ ItemInfo
- ❖ LineItemInfo
- ❖ OrderInfo
- ❖ PriceInfo
- ❖ ShippingInfo
- ❖ VendorInfo

Database Abstraction Layer

The data tier consists of four main components:

Relational Database System

A relational database will be used to store the product catalog and the orders placed using the system. The database schema is shown in Figure 2.

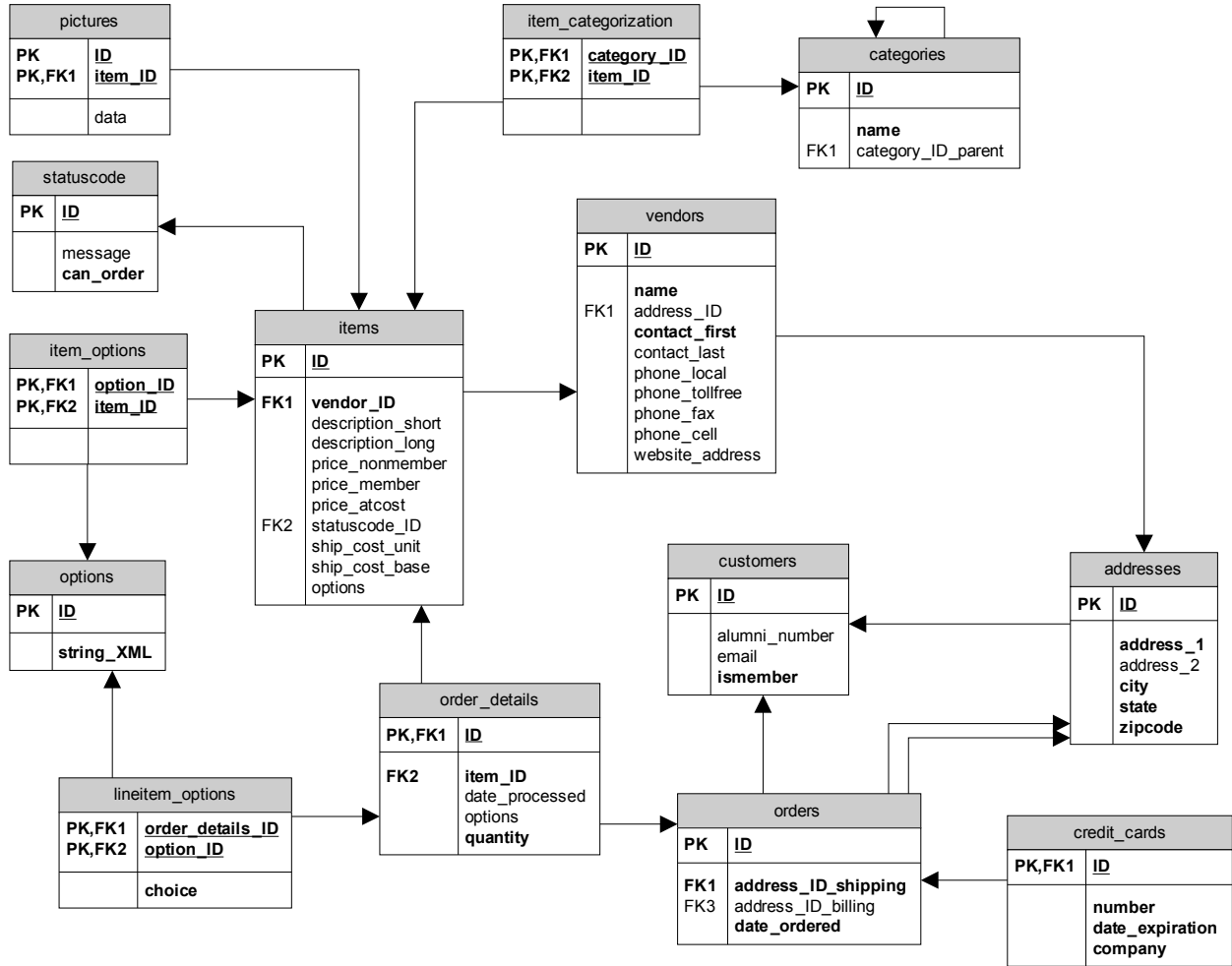


Figure 2: Database Schema

Database Abstraction Layer (DAL) Interfaces

These interfaces function as a façade to hide the database architecture from the business logic tier. There are five interfaces defined in DAL:

- ❖ ICategory
 - Insert(CategoryInfo NewCategory)
 - Update(CategoryInfo ExistingCategory)
 - Remove(int CategoryID)
 - CategoryInfo GetCategory(int CategoryID)
 - CategoryInfo[] GetSubcategories(int Category)
- ❖ ICustomer

- Insert(CustomerInfo NewCustomer)
- Update(CustomerInfo ExistingCustomer)
- AddressInfo GetAddress(int CustomerID)
- CustomerInfo SignIn(string Username, string Password)

❖ IItem

- Insert(ItemInfoNewItem)
- Update(ItemInfoExistingItem)
- ItemInfo GetItem(string ItemID)
- ItemInfo[] GetItemsByCategory(int CategoryID)
- ItemInfo[] GetItemsByVendor(int VendorID)

❖ IOrder

- Insert(OrderInfoNewOrder)
- OrderInfo GetOrder(int OrderID)

❖ IVendor

- Insert(VendorInfoNewVendor)
- Update(VendorInfoExistingVendor)
- Remove(int VendorID)
- VendorInfo GetVendor(int VendorID)

DAL Interface Implementations

An implementation of the DAL interface must be created for each database system that will be used with the system. Initially an implementation will be developed for the testing database, and then additional implementations will be created for the database server used by the production system.

DAL Factory

An instance of the factory design pattern, this static object will instantiate the proper implementation of the DAL interface based on the currently-configured database system.

Business Logic Tier

The business logic tier is responsible for mediating interaction between the data and presentation tiers. These responsibilities include retrieving requested information from the data tier for use by the presentation tier as well as processing and validating information from the presentation tier before it is passed to the data tier. The services provided by each component are illustrated in Figure 3: Class Diagrams for Business Logic Tier, and are described below.

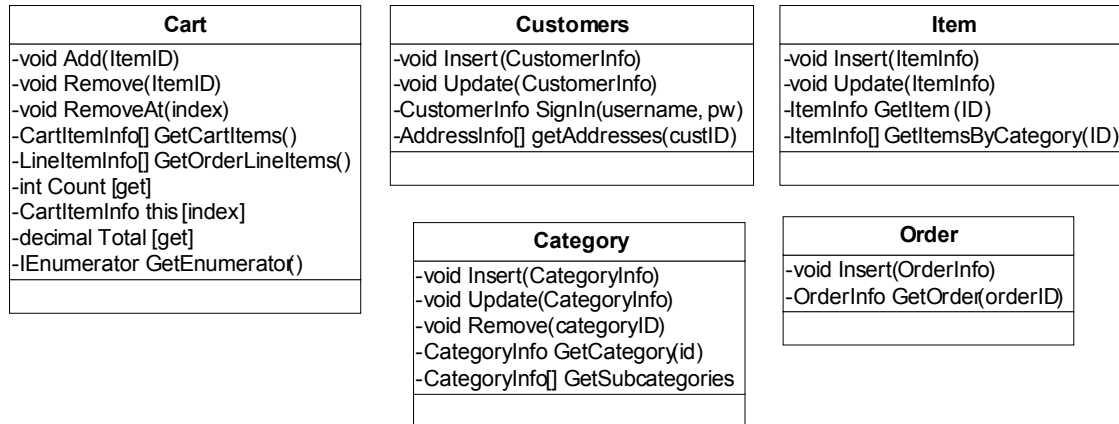


Figure 3: Class Diagrams for Business Logic Tier

Cart

This object is responsible for managing the customer’s shopping cart throughout a session. It also implements the IEnumerable interface to simplify iteration through the items in the cart. Finally, it provides a method to convert the items in the cart into a list of OrderItemInfo objects for use by the order processing facilities.

Customer, Item, Order, Category

These objects all function as a façade between the presentation tier and the data tier, providing access to their respective DAL interface methods. Their only responsibility is to validate data, if necessary, before passing it on to the proper DAL implementation, as provided by the DAL factory. Each method then returns the result as returned by the DAL method.

Presentation Tier

Though the project could not function without the data or business logic tiers, arguably the most important tier is the presentation tier. This is the part of the system with which the users directly interact, and the experience it provides must meet the user’s growing expectations about how the online shopping experience should work. The public storefront has been broken down into six points of customer contact, presented below.

Unified Interface Features

One of the biggest drawbacks to the existing system is the inconsistency found between parts of the shopping experience. The new system will maintain a consistent interface throughout the

process, providing universal access to important features like the shopping cart, the list of categories, and other new features like featured items. These global elements will be implemented using ASP.NET user controls, which will allow changes to the overall design to be made in a single place instead of updating several pages individually.

Front Page

The front page is essential to the online shopping experience, and must invite the user into the store. The current front page, shown in Figure 4, provides access to every item in the store, but with only minimal organization.

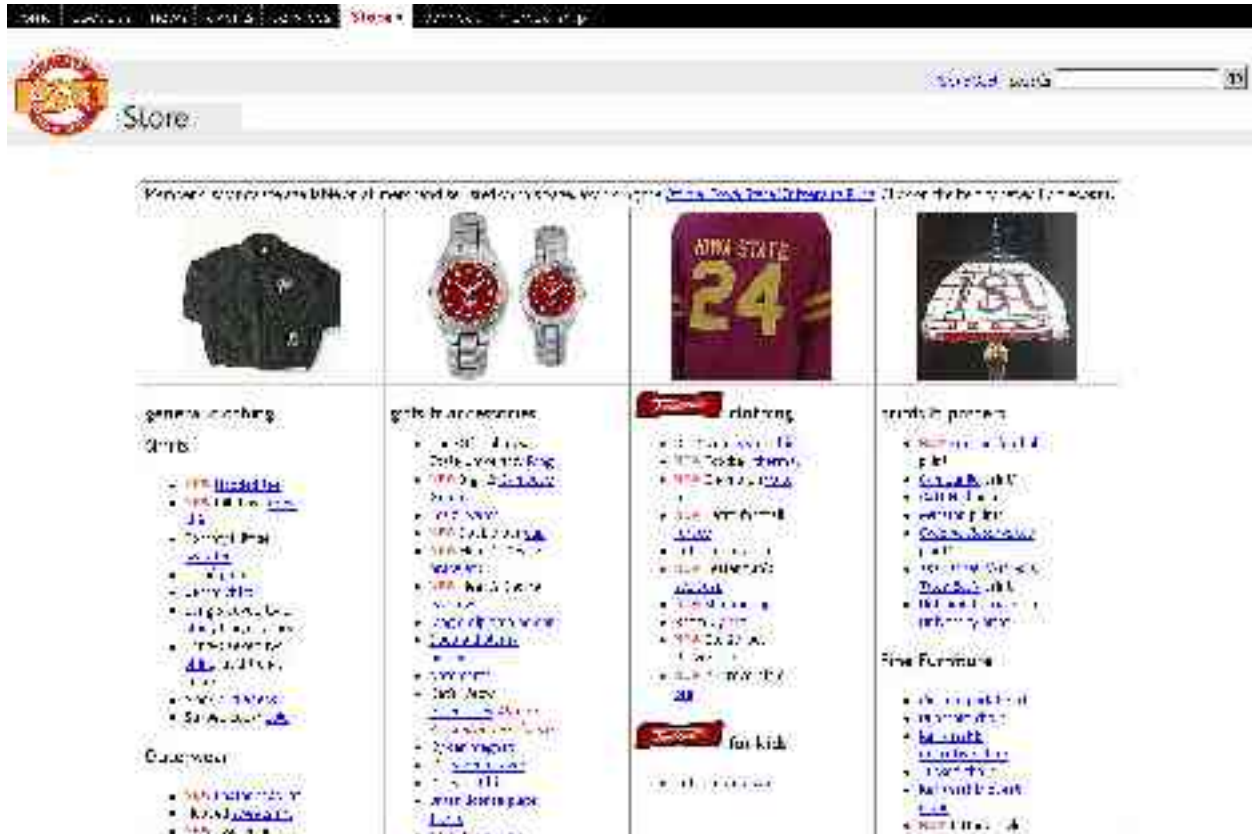


Figure 4: Existing Front Page

The new front page will confront the user with a much cleaner interface, presenting a few “Featured Items” and inviting the user to explore their respective categories. The front page will also introduce the user for the first time to the interface they will use for the remainder of their shopping experience.

Item Category Pages

A user’s likely “next step” will be to visit a category page. Category pages will allow the user to view all the items within a category. The exact display of these items is up to the client, but will probably include a thumbnail image, the item name, and the item price.

Item Description Pages

The existing item description pages, as shown in Figure 5, have many limitations which will be remedied by the new system. As stated before, all pages of the new store will have a consistent look and feel. This will extend to the item pages as well. Item pages will also place more emphasis on the benefits of membership, showing precisely how much a nonmember could save, or a member is saving, with membership to the association. There will also be an enhanced image gallery for each item, allowing several shots of a single item to be viewed from the page.



Figure 5: Existing Item Description Page

Shopping Cart Page

The shopping cart page will be designed to emulate many of the popular shopping cart systems in use by stores like Amazon.com and Orvis.

Order Completion Page

The order completion page will show a summary of the order, complete with the final charges, payment method, and shipping address. The page will provide contact information for customers with questions about their order.

Estimated Resources and Schedules

Estimated Resources

Estimated personal and financial resources predictions are given below. These figures have been revised from figures first presented in the project plan and are presented with the old data for purposes of comparison. The original figures are given in Table 1 and Table 3, and the revised figures are given in Table 2 and Table 4. Project definition and technology considerations were initially well-defined; the majority of the team's efforts will be devoted to the design, testing and implementation phases of the project.

Personal Effort Requirements

The personal effort required by members of the team has been subject to a few changes based on the needs that have developed given the members' experiences with ASP.NET, the .NET Framework and

Estimated personal effort shown in total hours during the 2004–2005 academic year.

Table 1: Previous Estimated Personal Effort

Member	Classes	Meetings	Deliverables	Coding	Presentation	Total
Keith Dahlby	30	55	15	120	10	230
Jordan Jump	30	50	20	100	10	210
Andrew Kirpalani	30	50	35	90	10	215
Jonathan Ruhnke	30	50	25	95	10	210
Total	120	205	95	405	40	865

Table 2: Revised Estimated Personal Effort

Member	Classes	Meetings	Deliverables	Coding	Presentation	Total
Keith Dahlby	30	55	25	120	10.5	240.5
Jordan Jump	30	50	20	100	11	211
Andrew Kirpalani	30	51	25	90	10	206
Jonathan Ruhnke	30	49	20	95	9.5	203.5
Total	120	205	90	405	41	861

Financial Requirements

The estimated budget for the project has changed for two reasons. First, printing the poster was more expensive than anticipated. Second, the revised personal effort estimates yield a slightly decreased estimated labor cost.

Labor estimates based on labor at \$12 per hour.

Table 3: Previous Estimated Financial Budget

Item	Estimated Cost
Project poster	\$60.00
Printing & copying	\$10.00
Binding	\$5.00
Total without labor	\$75.00
Labor at \$12.00/hour	\$10380.00
Total with labor	\$10455.00

Table 4: Revised Estimated Financial Budget

Item	Estimated Cost
Project poster	\$75.02
Printing & copying	\$10.00
Binding	\$17.49
Total without labor	\$102.51
Labor at \$12.00/hour	\$10332.00
Total with labor	\$10434.51

Project Schedules

The following Gantt charts summarize the proposed schedules for the project. For legibility, the charts are split between the fall and spring semesters.

Fall 2004 Schedules

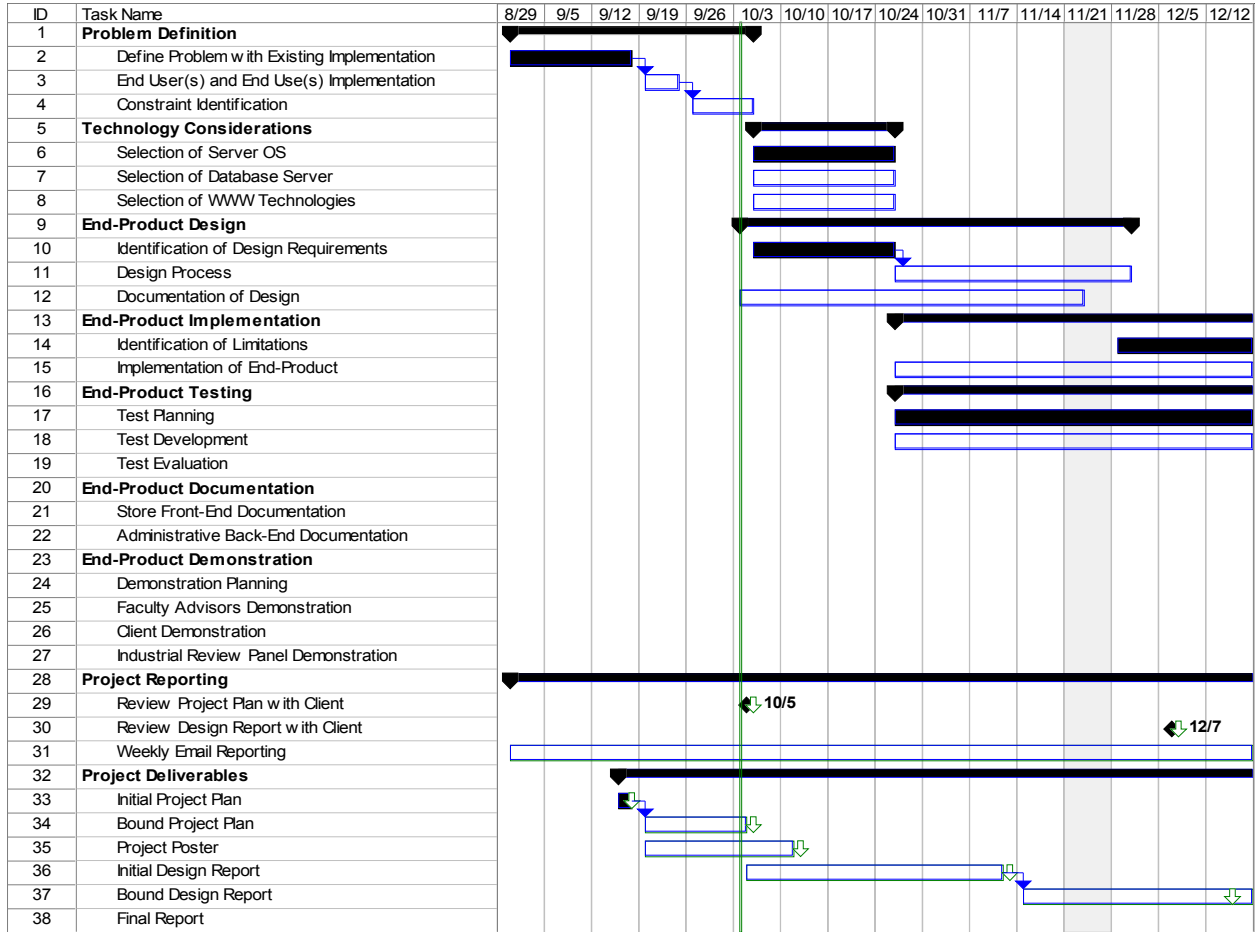


Figure 6: Project Schedule — Fall 2004

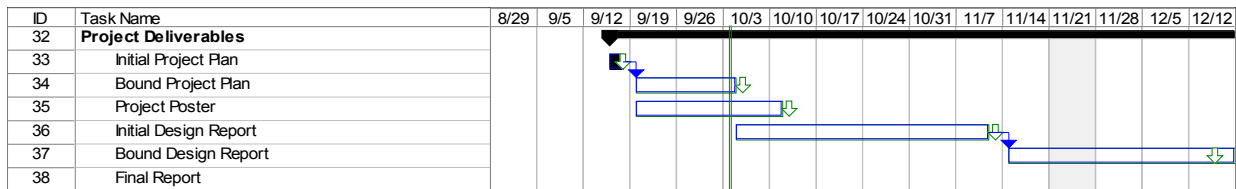


Figure 7: Project Deliverables — Fall 2004

Spring 2005 Schedules

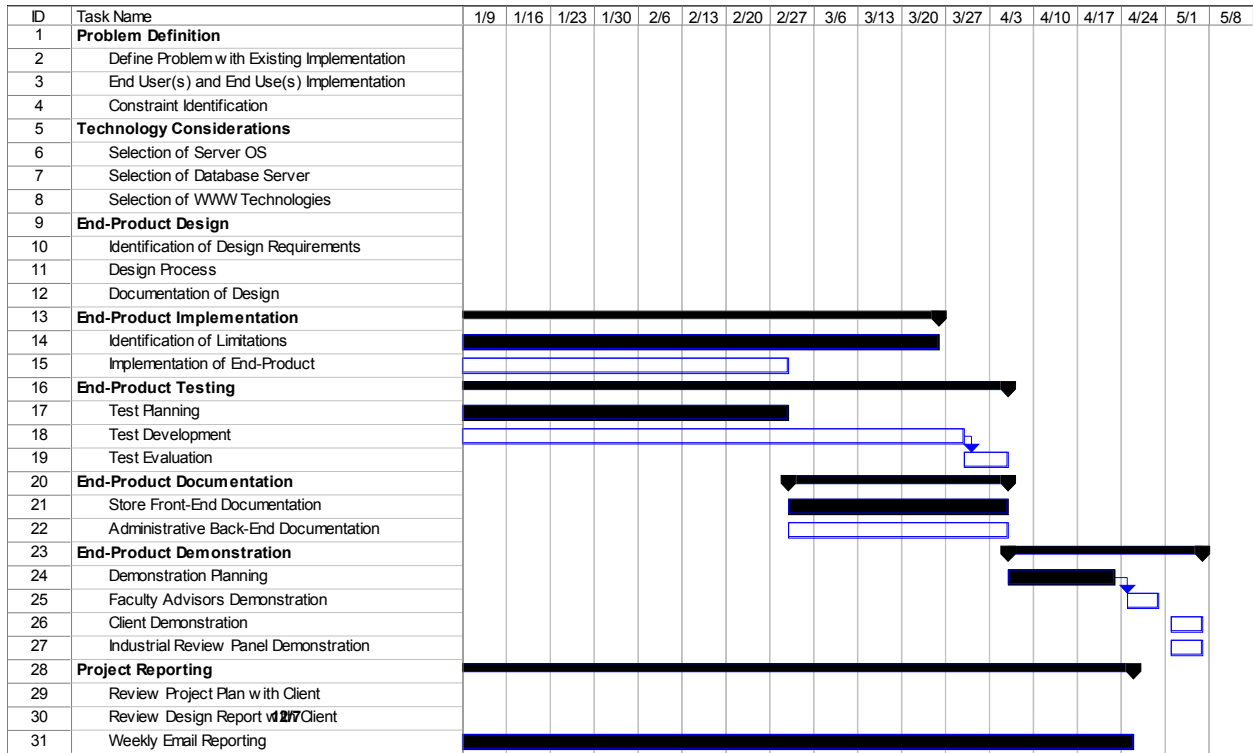


Figure 8: Project Schedule — Spring 2005

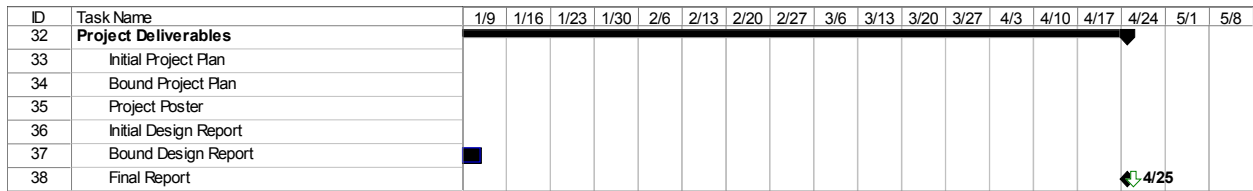


Figure 9: Project Deliverables — Spring 2005

Closure Material

Project Team Information

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Closing Summary

The Iowa State University Alumni Association maintains an online store in order to sell Iowa State branded merchandise that both promotes ISU and raises money for the Alumni Association. Currently, this store is written in a very inefficient manner and requires a great deal of work and data duplication. This project will redesign and implement the store in order to save the Alumni Association time and money. The online storefront will be both attractive and functional. The new database design will minimize data duplication. Finally, the back-end tool suite will make order processing and filling much easier and more cost-effective. With these improvements the Alumni Association will be able to concentrate the efforts of its staff in other areas, as well as enjoy a larger profit margin from its merchandise.