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Development of a Web Based Inventory Management System for a Small Retail Business

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MASTER OF SCIENCE
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Development of a web based Inventory Management System for a small retail business

PROFESSIONAL PROJECT

Chiranjib Sanyal

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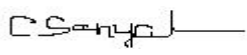
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Project Title: Development of a web based Inventory Management
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and subsequent documentation.

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Abstract

This project proposes a technical solution that will improve the inventory management for a small business company. The project envisions a situation where a company currently uses a client server based inventory management system in each store. The current system depends upon the store managers for inventory control functions like purchase order creation and inventory usage recording. Currently, each store sends the inventory consumption and ordering information to the corporate office on a weekly basis. As a result, the corporate office doesn't get up-to-date information on inventory level in the stores on a daily basis. Also, there is no established process to transfer items from one store to another.

To improve the inventory management process, this project aims to analyze the current inventory management processes and determine the possible areas of improvement. The project would also analyze whether the current system should be migrated to a different architecture like web-based system or ERP based system or Vendor Managed System etc. At the end, the project would pick an architecture that would suit the needs of the small-business company and demonstrate its implementation.

After project discovery and analysis phase it was established that a web based inventory management application would be a suitable solution for the project. The web based solution would allow multiple users to access the system from varied locations and perform the business functions. This system would allow the corporate office to easily gain access to the up-to-date store information

as well as perform maintenance functions on the system. The system would allow the corporate office to easily implement business rules and update business data through the application.

The inventory management system would be a tremendous boost to the store managers since the system would help the store managers to find items that should be ordered first. Thus store managers would spend much less time on inventory management functions and spend more time on managing the daily business activities of the store. To satisfy urgent requirement, the store managers could also request to transfer items from neighboring stores. As a result, the customer service and customer satisfaction would also increase, resulting in increased revenue for the company.

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1 Chapter One: Introduction and Background

1.1 Introduction

In the retail industry, the ability to maintain constant access to information can determine whether the company would survive the competition or not. An Inventory Management System is needed to provide accurate information to all levels of the organization, from top management located at the corporate headquarters to the individual store managers. For example, corporate management may need to monitor same-store sales, where as store managers may need real-time access to inventory and ordering information (Intellisync).

The project envisions that a small retail company is facing difficulty in managing the inventory level among the different stores. Since, currently the management of inventory in the store is a manual process, the Store Managers are frequently failing to order items that are needed most. The lack of control on the inventory level of the stores is resulting in significant loss of revenue for the company. The company is also loosing money by over stocking certain items.

The goal of the current project is to build an inventory management system that would centralize the inventory data and facilitate the availability of inventory related information of any store.

The current inventory control system can be summarized as follows. The store manager manually verifies the inventory level of all the items available in the store. The store manager decides whether the item

is an active item that needs to be stocked in the store. When the store manager finds an item that needs to be stocked, the available quantity is compared against the reorder level. When the available quantity is less than the reorder level, the item is added to the list of items to be ordered. The ordering clerk creates purchase order for the item and forwards the purchase order to the approved vendor. When the vendor supplies the item, the receiving clerk receives the order and adds the number of items received to the inventory level for the item. The store manager sends the inventory level and purchase order created and received order information to the corporate office on a weekly basis. The corporate office updates the vendor list on a weekly basis.
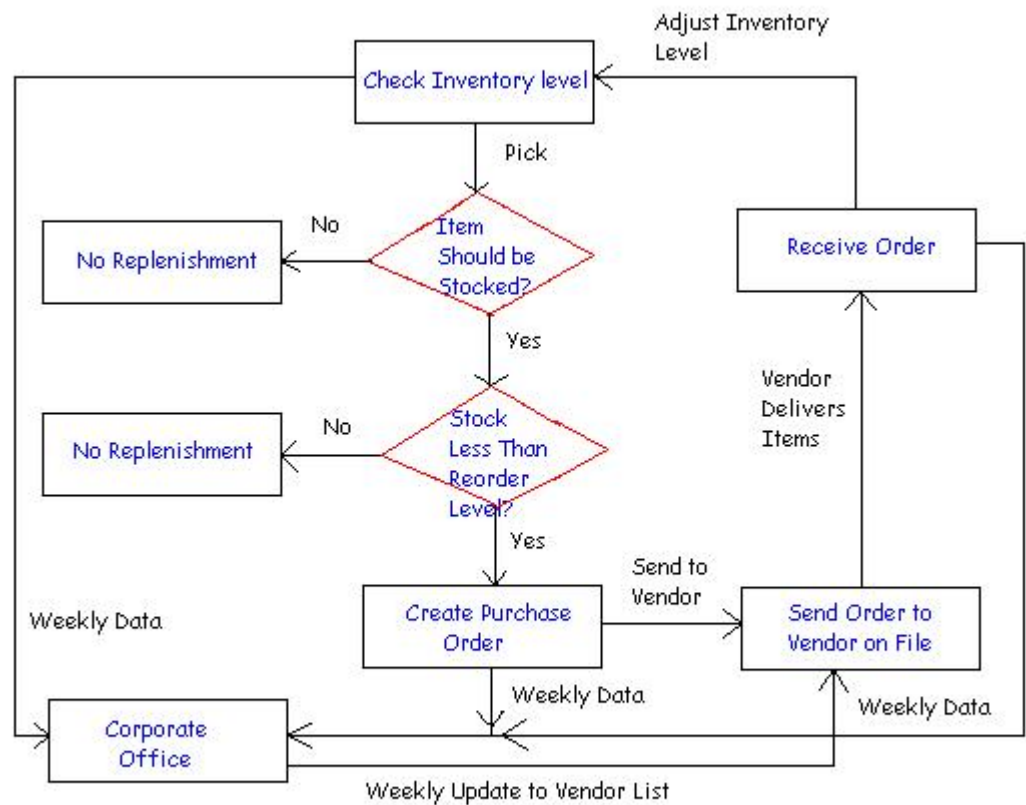
Current Context Diagram

1.2 The Inventory Management Industry

Various configurations of inventory management systems are available in the market. They can be summarized as follows:

1. In-Store Inventory system.

2. Mainframe based Inventory Management System.

3. Web-based Inventory system.

4. Inventory Management integrated with supply chain management.

5. Vendor Managed Inventory.

The in-store inventory management system constitutes of a client server based system that resides within each store. Generally, these systems use a relational database on the back end and a GUI front end. The system is accessed and maintained in the store. In this configuration, no expensive network needs to be built outside the store environment. Generally, the response of the system is also faster. Little or no connectivity exists between these systems in the store and the corporate office. Hence, inventory data needs to be transported to the corporate office on a regular basis. The architecture is preferred by small businesses since the technology is affordable to small businesses.

The mainframe based inventory management system is used by large organizations. The architecture uses central mainframe based relational or networked database on the backend and mainframe based or GUI screens on the front end. Only large corporations can afford the cost to acquire the mainframe and build and maintain the applications on the same. Many such companies are moving away from this configuration to the newer generation of ERP or supply chain management types of applications.

In the web based inventory management system, the system is created using a web-based application that is housed on a web server. The database is housed in a database server that uses relational database. The front-end application contains HTML pages embedded in

Microsoft's Active Server Pages (ASP) or Java based Java Server Pages (JSP). The architecture is cheaper to build than the mainframe based systems, but it gives the company the benefit of using a common database that is accessible by the users as well as the corporate management on a real-time basis.

Inventory management plays a crucial role in supply chain management, since the success of supply chain management depends upon accurate information of the product availability. The first step of supply chain management is building electronic catalogues for the product line, so that accurate product data can be obtained. The second step of supply chain management is to create an inventory-tracking infrastructure thorough the inventory management system. The third stage of supply chain management shares the above information with the trading partners to build a collaborative planning, forecasting and replenishment infrastructure as the ultimate level of inventory management. (Jeff). Supply chain management aims to bring down the cost of inventory management by decreasing the working capital needs. (Donovan). Supply chain management poses challenges to the manufacturers by having to quickly respond to customer demands in spite of reducing the stock at hand as well as order-to-delivery cycle times. (Donovan). In spite of the challenges, the corporations are attracted to the benefits of high return to investment and freeing up business capital that can be invested on the growth of the business. The supply chain management system is needs considerable

amount of investment to build and maintain the system. The system needs to be monitored and fine tuned constantly in order to function as desired.

In Vendor Managed Inventory system, the retailer provides the adequate information to the vendor so that the supplier can manage and replenish the inventory directly in the store or the warehouse. In this model, the vendor manages the inventory instead of the retailer. The success of the vendor managed inventory process depends on the accuracy of the data being sent to the vendor. The automated control to the process is done by using electronic data interchange (EDI) transactions that needs large investment on the software development, testing and maintenance. Most retailers are not comfortable with the concept since in this process the vendors control the inventory management process. (Kumar).

1.3   The problems of the current process

It has been envisioned that currently, each store maintains a large amount of inventory in its stock. The level of inventory is very crucial for the successful business of the company. It has been observed that in the current process the company is loosing money since some items go out of stock. Also, quite a few items are over stocked in some stores. Either the company is blocking money by holding excess inventory or the company is losing money by the inventory going past the expiration dates. Since

currently individual store manager is responsible for maintaining the level of stock in the store, very often it is depends upon the efficiency and expertise of the store manager. Even though the company policy might be clear regarding the reorder level of each item, it is not maintained properly because it is a manual process. Lack of real time information creates difficulty for the corporate management to find out the level of stock available in each store. There is a need to know the stock level of each store so that the items may be transferred from one store to another for quick replenishment of stock.

The problems of the current system can be summarized as the following:

- The current inventory management system doesn't have any functionality to maintain stock level. The store manager keeps track of the inventory level of the store and creates new purchase orders as needed. Currently the stock level management process depends mostly on the expertise and efficiency of the store manager. But in many cases, it becomes hard to identify the items that are needed most.

- Since this is a manual system, some items are becoming over stocked and some items are going beyond expiration dates.

- Currently, the inventory level information of the stores is sent to the corporate office on a weekly basis. This means the accurate and up-to-date inventory level information is not available to the corporate office.

- For the above reason, it is difficult to make transfers of inventory to other stores.

1.4 Project Goals

This inventory management project would investigate the current inventory management processes and determine the possible areas of improvement. The project would also analyze whether the current system should be migrated to a different architecture like web-based system or ERP based system or Vendor Managed System etc. At the end, the project would pick an architecture that would suit the needs of the small-business company and demonstrate its implementation. The proposed system would result in significant cost savings for the company by streamlining the inventory control, distribution and reporting functionality. The proposed system would satisfy the following business goals and objectives:

1. Increase Revenue:

   - Increase the availability of items in the stores.
   - Reduce excess inventory in the stores.
   - Provide accurate stock availability information.
   - Faster replenishment of stocks.
   - Transfer of stock between stores.

2. Improve Customer Service:

- Expired items to be replenished by new items.

- Better availability of stock.

- Fulfil customer needs by transferring items from another store.

- Better utilization of resources at the store level.

3. Automate Inventory control functionality:

- System to provide list of items that are needed most.

- Automate the purchase order generation and order placement process.

4. Strategic information management:

- New business rules set by the corporate management can be easily implemented at the system level and implemented at all the stores at the same time.

5. Speed of information availability:

- Ready availability of inventory related information to the corporate management.

1.5   Summary

For this project, it has been proposed to write the thesis about a technical project in which system analysis and design techniques would be applied to analyze, design, and build an inventory management application. In the project, apart from creating the technical product,

special attention would be given to the aspects of the thesis. For this purpose, the project would include activities like performing critical assessment of the project, researching similar work done by others, analyzing the choice of project methodology, researching the project development technique that would be most suitable for the project, analyzing the lessons learned in the project etc.

2 Chapter Two: Research Method

2.1 Review of potential solutions

The in-store inventory management system requires investment in client server based hardware and software equipment. The system is easily accessible and maintainable in the store. The main difficulty for the corporate management is that in this architecture it is difficult to access real-time data of what is happening in the store.

The mainframe based inventory management system requires very large investment to create and maintain the infrastructure. Only large corporations can afford the cost to acquire the mainframe and build and maintain the applications on the same.

The web based inventory management system is a good solution for medium or small businesses. The amount of investment is within affordable range for the company. The system gives the company the benefit of using a common database that is accessible by the users as well as the corporate management on a real-time basis.

Creation of inventory management system within supply-chain management environment requires a large investment to build and maintain the supply chain management system. Very large and robust system could be built in this configuration. This environment is generally suitable for large organizations.

Vendor Managed Inventory system requires very good understanding between the vendor and the retailer since the inventory control activity is the responsibility of the vendor. Potentially this configuration can be set up for a medium or small business.

2.2 Choice of solution

The in-store inventory management system cannot be replaced by a mainframe-based system since the system is beyond the affordability of the company. The supply chain management system is not selected due to the same reason. The vendor managed inventory system puts too much control outside the organization, so it is also ruled out. The web based inventory management system seems to suit the inventory management needs of the small business. Hence the web based inventory management environment is selected for the current project.

2.3 Review of similar products available in the market

Boudin Sourdough Bakery & Cafes company in San Francisco replaced the current in store inventory management system with web based product named EatecNetX (Accuvia). The company envisions that EatecNetX would help to reduce costs and improve operational efficiencies resulting in significant return on investment. The EatecNetX product performs activities like inventory management, purchasing, receiving orders, requisitions and transfers, reports etc. The EatecNetX's single source of data for the entire company instead of in-store systems

eliminates the need to upload or download data and provided a realtime view of the performance of the store and the company (Accuvia). The web-enabled system eliminated the need to visit the stores in order to fix the problems in the system. (Accuvia).

Newsuite Small Business helps companies slash inventory cost by providing tighter control on the stock levels. The inventory features are integrated with the sales department and Web Store and sales team can view real-time inventory and pricing information. (Newsuite). The inventory management features include customer and volume pricing and customization of pricing according to the customer. Integrated inventory features enable the sales representatives and customers have the full view of the inventory levels and the orders on a real-time basis. Additional inventory management features include costing and profit margin analysis. (Newsuite)

2.4 Development Life Cycle

The project was be implemented using the Software Development Life Cycle (SDLC) over a period of four months with an expected completion date of August 31, 2005. The project used waterfall method of development method. The project can be divided into the following phases:

Phase I – Analysis Phase

- In the Analysis phase it will be investigated what would be done in the project and how it will be done. The objectives of this phase includes the following:

o Analyze the project goals to define business rules and application requirements.

o Define the scope of the project.

o Analyze the problem, define the problem, analyze the solution and define the project goals and success criteria.

o An initial Requirements Analysis document will be formulated at the end of this phase. The requirement analysis would incorporate data requirement, interface requirement and specification as well as the process requirement.

Phase II – Design Phase

The objectives of Design Phase will include the following:

o Perform preliminary Use Case Analysis and create preliminary Use Case diagrams.

o Improve and finalize the Use Case Diagrams.

o Finalize the screens and user interfaces.

o Create the database design.

o Develop the Data Flow diagrams.

o Create project documentation that incorporates the following:

  ▪ Problem definition.

  ▪ Analysis and Design Method.

- User interface specification.

- Data validation and error checking.

- Testing.

- Source code control.

- Data fields, types, field lengths and constraints.

Phase III – Construction Phase

The objectives of Construction Phase will include the following:

o Create development environment.

o Build the database.

o Create Web Application in Internet Information Services (IIS) web server.

o Create screens and web pages in ASP.NET.

o Update project design document.

o Create maintenance plan.

o Formulate test strategies.

o Create implementation plan.

Phase IV – Testing Phase

During this phase, the application will undergo the following testing phases:

o Unit Testing.

o Functional Testing.

Phase V – Implementation Phase

o The final product will be deployed to a company.

Phase VI – Maintenance Phase

o Once deployed, the maintenance plan created during the Construction Phase will be put into place where the application will be monitored for application problems and dealt with accordingly.

2.5   Format for presenting results / deliverables

The project documents would be written using Microsoft Word. The project plan will be created using Microsoft Project. The software product will be created in ASP.NET product. Microsoft Visual Studio .Net would be used as the development environment. Microsoft Access 97 will be used as the database product.

2.6   Review of the deliverables

The outputs of this project will include:

1.   A Requirements Document.

2.   Use Case Analysis and Use Case diagrams.

3.   A Design Document (Data base design and System interface design).

4.   A test results document.

5.   A Project Plan.

6.   Final Product.

7.   A Summary of the Project upon Completion.

In addition, the project presentation would also include the following:

1.   Project History.

2.   Summaries of the phases of the project.

3.   Analysis of project successes.

2.7   Resource requirements

The resource requirements for this project are as following:

PC

LAN (Local area network)

Internet connection

Web Server - Internet Information Server (IIS)

SQL Database - Microsoft Access Database

2.8   Terminology

IIS - Internet Information Services 5.1 is windows XP web-service that can be used to create Web Application and publish web pages. In the current project, the Web Application was created and hosted in IIS.

ASP - Active Server Pages is a server-side scripting environment that contains HTML tags, text and script commands. In the current project, ASP files were used to create Web pages and web application.

HTML - Hyper Text Markup Language is a simple markup language that is used to created hypertext documents that are portable from one platform to another. HTML files are ASCII text files with embedded markup

tags that indicate formatting and hypertext links. The screens of the current application were created using HTML.

ADO - ActiveX Data Objects is a high-level data access programming interface to an underlining data access technology (such as OLE DB), implemented by using the Component Object Model (COM). In the current project, ADO was used to develop the data access services that fetched data from Microsoft Access database to the ASP.NET application.

SQL - Structured Query Language is the international standard language that is used for defining and accessing relational databases. In the current project, the SQL queries were embedded in ASP.NET application in order to query and modify the data in the Access database.

LAN - Local Area Network is a network of computers connected by communications link to any other device available in the network.

2.9   Summary

The current project encompasses all the phases of software development life cycle. The project puts special emphasis on evaluation and analysis of the system design in order to determine whether the design met the goals of the project.

3   Chapter Three: Project Analysis

3.1   Business Rules

The business requirements define how the business participants participate in high-level business processes or activities. The business processes can fit in three categories:

1. Core business functionality. These are commercially critical activities for the business.

2. Supporting business functionality. These are not commercially important activities for the business.

3. Business Management functionality. These are activities performed to manage and monitor the performance of the business.

The business requirements provide non-technical details for the business needs identified for the project. Typically, the users of the system provide the business requirements for the system. Since the current application has been developed as a prototype inventory management solution, there are no actual business users to interact in the process of gathering business requirements. Hence the author served the role of a business user and analyzed the business needs of an inventory management solution. It was envisioned that the business users would be presented with a login screen when the application is launched. The user would provide the user authentication information and also the store

number where the user intends to log in. Once logged in, the user would be presented a Main Menu screen that would allow the users to select a choice of action. Based on previous experience, it was decided, to create an application that would support the following basic business processes: Inventory procurement and transfer inventory from one store to another. In addition, it was decided that the application would allow the user to run maintenance activities as the supporting business functionality. The application would also include reporting features to provide management functionality.

Once the basic features of the application were identified, the business functionality was analyzed to get to a list of sub activities that need to be accomplished for the business processes. For example, for the inventory procurement process, it was observed that first thing the user needs to see is a list of items that needs to be ordered. The user can drill down on an item from the list and create a purchase order on the same. In order to receive the order, the user needs to be presented with a list of purchase orders so that the user can select the purchase order and change the order to received state. It was evident from the above analysis that the inventory procurement requirements could be divided into areas like view reorder level, create purchase order and receive shipment. The user would need separate screens to carry out the business functionality discussed above. It was also decided that the corporate office would have

the ability to control or setup the reorder level of the items, since that would allow the corporate office to easily apply the business rules to all the stores. It was also decided that the inventory usage recording functionality would be out of scope of the current project.

In order to transfer inventory from one store to another, the sending store needs to see a list of items, pick an item from the list, and put the item quantity and receiving store information and confirm the transfer process. Once the item arrives at the receiving store, the receiving store needs to go through the same process as receiving any other order.

The supporting functionality of the application would be the capability of authorized users to maintain the set up data of the system. This includes item data, store data, department data, user data etc. The users need to be presented a list of items from where the user should be able to pick one particular item and either change or delete it. The user should also have the ability to create a new item altogether if the item is not shown in the list of items.

The managerial functionality of the application needed to be the ability to get the status reports of the stores like report of expense by item, report of expense by store, report of expense by vendor etc. The user

should be able to restrict the search on certain items so that the reports could be restricted by store or item or month etc.

Based on that above system analysis, the business requirements were documented and finalized. Subsequently, the business requirements were analyzed in order to determine the functional requirements of the system.

3.2   Functional Requirements

The functional requirements specify the functional behavior of the system in response to an external event. The external event may be a user action, another system or a timed event. In the current project, the baseline of the functional requirements was developed from the business requirements. Since the project was developed as a web application, the web site design requirements were added in the subsequent section of the functional requirements. The requirements of the login page were identified first. The system responses for invalid login attempts were documented in this section. The main menu is displayed when the user logs on successfully. As a security measure, it was decided that when the user doesn't have any activity for ten minutes, the user would be logged off automatically and the login page will be displayed. When the user is already logged on and the user clicks the logout link, the user is logged

out and the login screen is redisplayed. When the user successfully logs on to the system the system displays the Main Menu screen. It was decided that the Main Menu should provide the links for the user so that the user could perform the business functions discussed previously. It was decided that the links in the Main Menu would be divided into four functional areas. Purchase Order section would contain the 'View Reorder Level' link, 'Create Purchase Order' link, 'Receive Shipment' link, 'View Purchase Order History' link. The Transfer Stock link would contain 'Transfer Stock' and 'View Transfer History' links. The Miscellaneous Reports section would contain links for 'Expenses by Item' Report, 'Expenses by Store' report and 'Expenses by Vendor' report. The Miscellaneous Maintenance section would contain links for 'Item Maintenance', 'User Maintenance', 'Vendor Maintenance', 'Department Maintenance' and 'Store Maintenance'.

It was identified that when the user would click the 'View Reorder Level' link on the main menu, the View Reorder Level screen would be displayed with the list of items in ascending order of the items so that it will show the items that need to be ordered first. In accordance to the business requirements, it was decided that the items displayed in view reorder level screen should have a link where the user would be able to click when the user wants to create a purchase order. This means, the system should navigate to create purchase order screen when an item

description is clicked. Next, thorough analysis was done to decide what kind of information would be present in create purchase order screen. It was found that, in order to create a purchase order, the system needs to know the originating store information, so that the billing and shipping address could be determined. Hence the requesting store details would form part of the screen. Since the receiving store information is available to the system, the store information should be populated automatically by the system when the create purchase order screen is displayed. In create purchase order screen, the user needs to provide the vendor information so that the purchasing department knows from which vendor the item should be purchased. The other piece of information needed for a purchase order is the item details, so that the correct item could be purchased. The user can add multiple items in one purchase order. A new purchase order would be in 'Open' status. Based on the above understanding, the purchase order detail information were documented in create purchase order functional requirements.

Next, the functional requirements for 'Receive Order' were analyzed as follows: When a shipment is received, the receiving clerk would open the purchase order to verify the items received against the order. If the item received doesn't match the purchase order, the receiving clerk would contact the store manager. If the store manager decides to receive the orders, the store manager would click the 'Change Order' link to update

the purchase order. The system would first prompt the manager to login. If the store manager decides to return the order, the store manager can either change the order or return the order. The store manager can change the status of the order and the system records the date of change or return of the order and the status of the order in the purchase order table. Once the items received matches the items in the purchase order in the system, the receiving clerk would click the 'Receive Order' link and confirm that the items has been received. At this time, the system would change the status of the order from Open to Closed and update the date delivered field to the received date.

The functional requirements of the 'Transfer Stock' functionality were analyzed as follows: In order to transfer inventory from one store to another, the Ordering clerk would click the Transfer Stock link on the main menu. The current stock level would be displayed. The screen would be similar to reorder level screen. User would click an item to transfer it to another store. At this time the Transfer Information screen would be displayed. The item name and source store fields would be already filled. The user would enter the destination store number and quantity to be transferred and click the 'Transfer' link. Item quantity transferred cannot be greater than the on hands item quantity. The system would remove the item quantity from the sending store's Item table and put the item on the receiving store's purchase order table. When the item is received by the

receiving store, the receiving store goes through the normal purchase order receiving process. A transfer order cannot be returned or canceled.

The functional requirements of the item maintenance functionality were analyzed as follows: When the user clicks the Item Maintenance' link, the current items for the store will be displayed. The user can click an item description to change the item details. Since only corporate users can create new items, for corporate users, this screen would show a link to create new item in the system. The user would have search capability to search for particular items in the list of items. All the other maintenance functionality follows the same pattern of the item maintenance functionality stated above.

The functional requirements for the web site design include the design of the home page and the main menu. The home page contains greeting to the user and a page title. The home page would contain fields where the user would input the login information. The home page would also have links for the user to display 'About Us', 'Contact Us', and 'Help' information. The 'About Us' page would display the information what the application is about. The 'Contact Us' page would display contact information for the company. The functional requirements of the main menu include that the appropriate links should be displayed in the main

menu. The main menu and any other page would have links to go back to the previous page, go to the home page and logout.

The links displayed on the main menu depend on the role of the user. In order to restrict the user from performing actions that are not allowed for the user, four roles were defined in the application. Ordering Clerk role was created for the users who can create purchase orders or transfer items only. The ordering clerks would be able to view reorder level of items, create purchase orders and view order history. The ordering clerks would not be able to receive orders. Receiving Clerks would be able to view open purchase orders and receive the order. The receiving clerks cannot create new orders. The Store Managers would be able to perform both the above actions as well as they can run reports on the data in the store and view purchase order and transfer history. The store managers would also be able to access a view only list of The Corporate users would be able to perform maintenance actions as well as run reports. The corporate users cannot create purchase orders, receive orders or transfer items to another store.

3.3   Summary

In the discovery phase, the business requirements were analyzed to identify the business functions that the application would support. The inventory management functionality was identified as the core business

function. It was identified that the procurement of items and transfer of items are the core business functions. The various maintenance activities were identified as the supporting business functions. The reporting activities were identified as the business management functionality. The identification of the business requirements gave a clear understanding of the services the application would support. Once an understanding of the business functions was established, the functional requirements were analyzed. First, the business requirements were analyzed to identify the various stages of information that the user should be presented by the application. The above analysis gave the understanding of the screens that are needed for the application flow. Once the basic screens were established, the functional requirements were written to provide the details of the information needed by the user to perform the business functionality as well as the responses of the system for each business function. Hence the process of business requirement and functional requirement analysis gave rise to a detailed understanding of the business functions needed to satisfy the project goals, as well as how the business functions would be implemented by the system. The analysis of the functional requirements provided very good framework for the use case analysis in the subsequent phase.

4 Chapter Four: Use Case Analysis, Database and Application Design

4.1 Overall System

The users of this system work in the stores and they are responsible for creating purchase orders, transferring inventory and running reports. The corporate users have the capability to perform various maintenance functions on the system. The computers used for this purpose are standard Windows 2000 or Windows XP based computers with an Internet Explorer browser and access to the LAN and Internet is needed.

The users use Microsoft Internet Explorer web browser application located on the user's desktop to logon to the web site and perform the business functions. The web application resides on Microsoft Internet Information Services (IIS) based web server. When a user performs a request for a web page from the application, the request is transferred as HTTP request to the web server. The web server finds the page in the web application and executes any 'Page_Load' event that needs to be executed and returns the page to the client browser. When the client enters data and submits the page back to the server, the ASP.NET code in the web application performs the event handling, database updates and business logic. The result of processing is returned to the web browser as HTML code. The overall architecture of the system is shown in the following diagram:
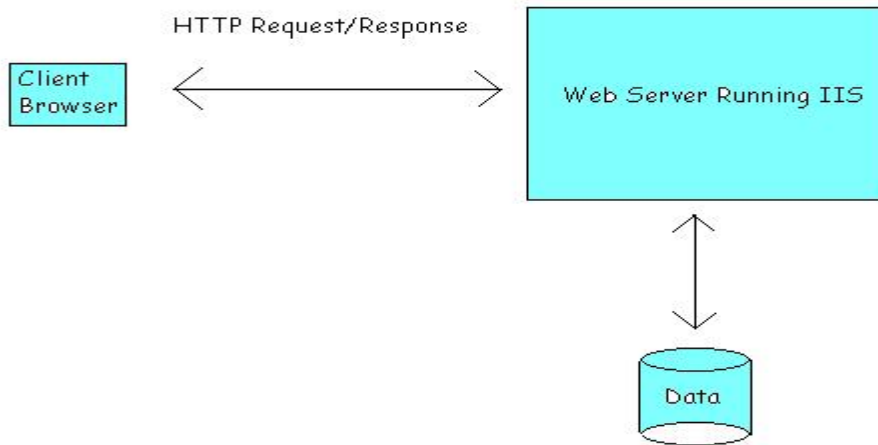
Figure 2: System Architecture

4.2   Use Case Analysis

Use cases were created to identify how the business users intend to use the system. All the business requirements and functional requirements were converted to use cases. The use case diagrams were created to depict the interaction of the users with the system. A user of the system who initiates a business function is called a primary actor. In some cases, one system may also become an actor since it may initiate an action on another system. The use cases were created to document the primary flow of the system as well as the alternate flow of the system. In the first phase, the primary actions performed by the users and the responses of the system were documented in the use cases. In the second phase, the use cases were refined to add the details of pieces of information entered by the user, and the pieces of information returned by

the system. The identification of the details of information provided by the user as well as retrieved by the system gave the application designer the information needed to create the application screens, screen fields, as well as screen flow. Next the prototype of the screens was designed and built using ASP.NET and HTML. The information required by the screens was mapped to database tables. The table design is discussed in the next section.

In the following pages, three different use cases are shown to illustrate the use cases developed in the use case analysis phase.

1. LOG001 - Login
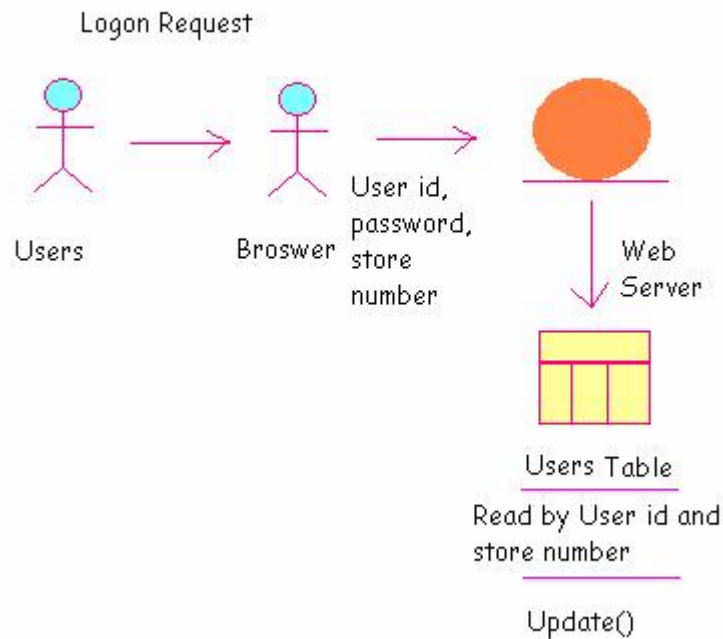
Login Use Case

The above figure shows the use case for user logging in the application. The user opens a web browser and navigates to the inventory management web site. The user provides the user id, password and store number as login information and clicks the 'Login' button. The browser sends the request to the web application located at the server. The web application queries the Users table and verifies the login information. If the login information provided is correct, the application updates the login status for the user and returns the Main Menu page, otherwise the application returns the login page with appropriate message. The above use case shows that the login page is required by the application as well as the users table is needed to store the user information in the database.

2. ROR001 - View reorder level
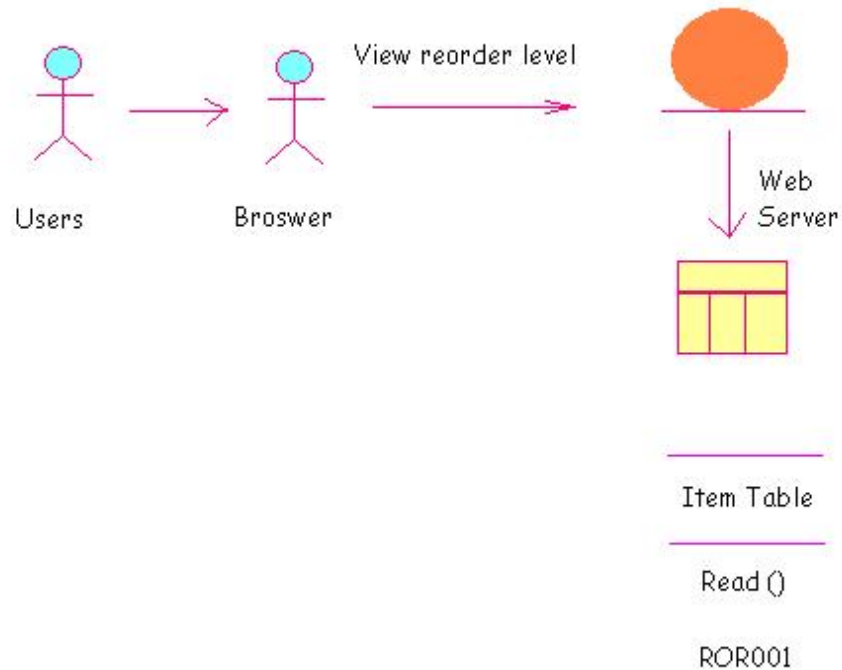
View Reorder Level Use Case

The above figure shows the use case for view reorder level. The use case starts when the user intends to view the reorder level of items in the inventory. The user clicks the 'View Reorder Level' link on the Main Menu. The browser sends the request to the web application located at the server. The web application queries the Item table and returns the item information to the web browser. The user can pick an item and place an order on the item. The above use case shows that the reorder level page is required by the application in order for the user to retrieve the reorder level of the items in the store.

3. PO001 - Create purchase order
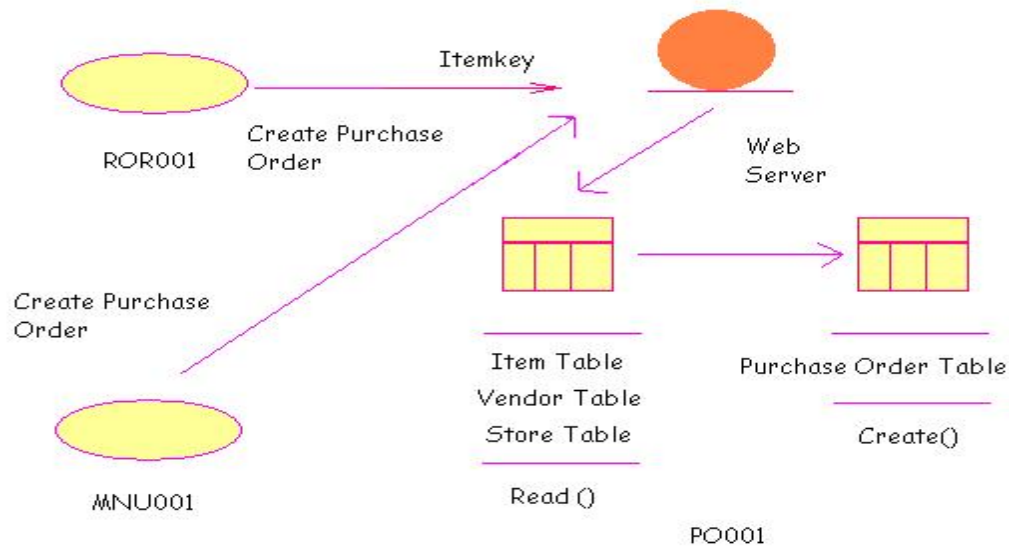
Create Purchase Order Use Case

The above figure shows the use case for create purchase order. The use case starts when the user intends to create a new purchase order. The user performs the action specified in the ROR01 use case mentioned above. The use clicks an item in the list of items. The user also has the option to click the 'Create Purchase Order' link on the Main Menu. In both cases, the browser sends a request to the web server to display create purchase order screen. The web application queries the Item table, Vendor table and Store table and returns the purchase order screen to the web browser with the appropriate information. From this screen, the user can provide item information and buyer information and place an order on the item. The above use case shows that the create purchase order page is required by the application in order for the user to create new purchase orders of the items needed in the store.

4.3   Overall Screen Flow

The home page is displayed when the user connects to the web site. The home page accepts the login information from the user. The Main Menu is displayed when the user successfully logs on to the application. As observed in the Business Requirements analysis section, the core business functionality supported by the application is inventory procurement and transfer of inventory. As found in Business Requirements analysis and Functional Requirements analysis, the application would also provide maintenance features and reporting features. It was analyzed that the user could view the inventory level and then select an item to order or the user may directly go to create purchase order screen if the item information is available to the user. In order to accommodate the above features, it was decided that the inventory procurement section would contain separate links to go to the view reorder level screen and create purchase order screen. Also the Main Menu would contain links to receive order screen and view purchase order history screen. Hence, by the above design, the user would have the ability to view the items that need to be ordered, order items, receive order and view historical information of orders that were purchased. Hence these links were grouped and put under Purchase Order section in the Main Menu.

Since the Transfer Stock functionality would require transfer of items, but the receiving of items would be covered by receive stock screen, it was decided that the Transfer Stock section would only need links to Transfer Stock screen and View Transfer History screen. Hence the design would allow the user to transfer the stocks and view historical information of items transferred to another store. It should be noted here that the Transfer Stock process would present a series of screens to the user. The first screen would be an item selection screen where the user would select an item to transfer and the next screen would be a Transfer Information screen that would accept the destination store number and quantity to be transferred.

All the maintenance screens would follow a similar pattern. The user would first get to an item selection screen where the user can pick an item from the list. When an item is clicked, the item details screen would display where the user can update or delete the item.

The above discussion shows how the overall screen flow was analyzed and designed in the inventory application. The above screen flow can be depicted in the following diagram:
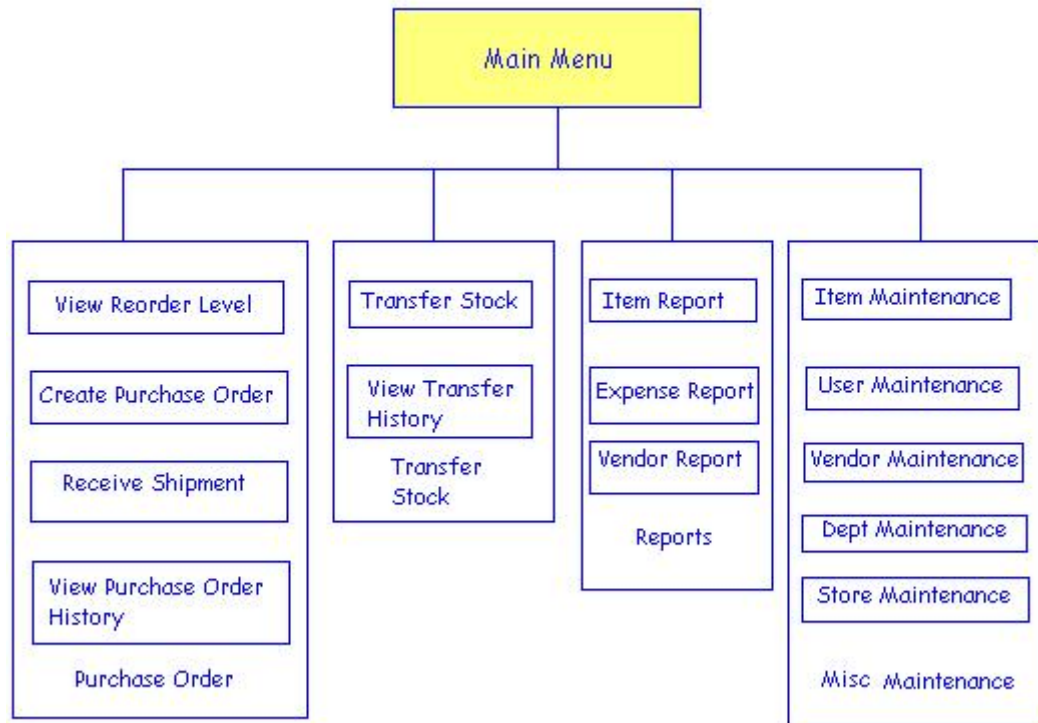
Figure 3: Screen Flow

4.4 Application Functionality

The functionality of the new inventory control system can be summarized as follows. The store manager or ordering clerk views the reorder level of all active items available in the store. The system displays the items in ascending order of reorder level, so that the user can easily find the items that need to be order first. The ordering clerk clicks an item to create purchase order for the item. The user can add more than one item in the purchase order. When the vendor supplies the item, the receiving clerk receives the order. The system automatically adds the

number of items received to the inventory level for the item. The corporate users have access to the inventory level and purchase order created and received order information to on a real-time basis. The corporate users and store managers can run various reports on the purchase orders created and received. The corporate users perform maintenance functions on the application like user maintenance, vendor maintenance, store maintenance etc., and the data becomes immediately available to the stores. The new context diagram for the system is shown below:
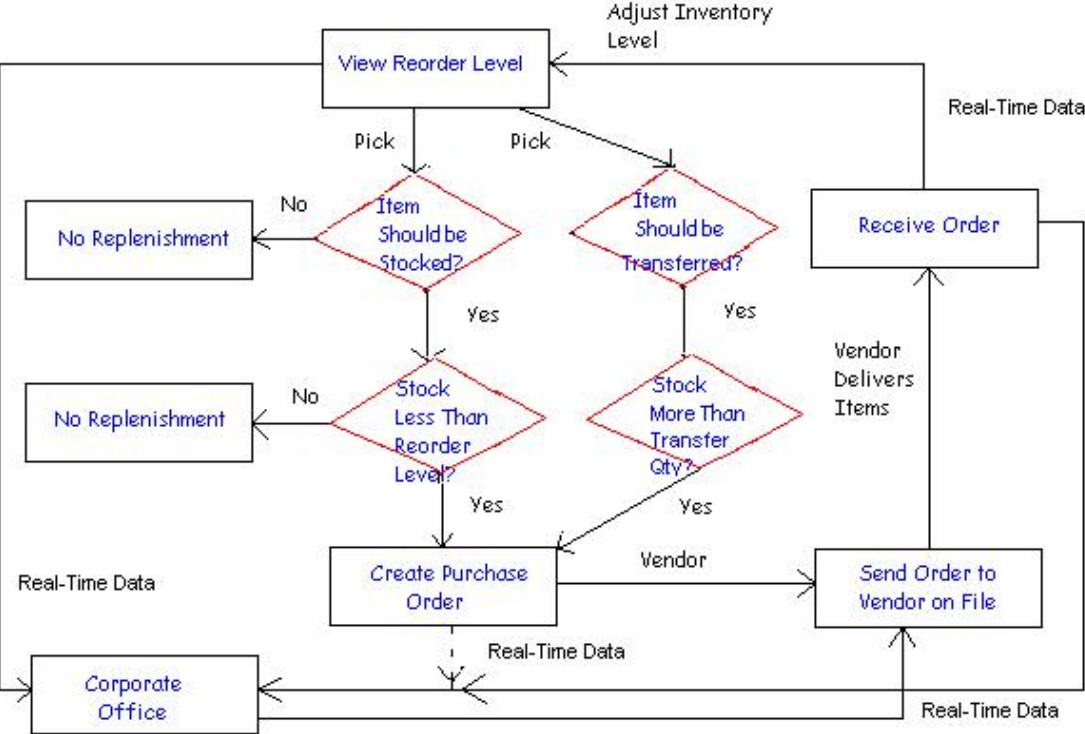
New Context Diagram

4.5   User Interface Design

The application runs on a web browser on the desktop of the user. In the application all the screens were developed using a template approach. On the top left side of the screens, the user name, store number and the role of the user is displayed. On the top portion of the screen, the company name, application name and screen name is displayed. On the line after the screen name, three navigational links are displayed. The links are 'Back', 'Home' and 'Logout'. On the Main Menu screen, only the 'Back' and 'Logout' links are displayed. The center of the screen contains the data related to the corresponding screen. After logging to the system, the user clicks a link on the Main Menu and the corresponding screen is displayed. Some screens may display lots of data. In order to help the user to search for records in the screen, search options are provided on particular screens. In the list screens, the user may click on certain linked data fields in order to display a single record view of the data. The user may change the data at that point or click a link like 'Back' or 'Home' to come out of the screen without changing the data.

The user interfaces were clearly identified when the use cases were refined and details were added to the use cases. In the following paragraphs, some sample screens are discussed to illustrate the user interface design of the application.

Logon Screen: The diagram below shows the design of the 'Logon' screen. The Logon screen contains three input fields: 'Username', 'Password' and 'Store Number'. All the three fields are required fields. The Logon screen also has three links on the left side of the screen: 'About us', 'Contact Us', and 'Help'. When the login is successful, the system creates a session variable on the user's computer and displays the 'Main Menu'. If the user doesn't have any activity on the system for more than ten minutes, the system logs the user off automatically and if the user clicks a link on the page at that time, the logon page is redisplayed.
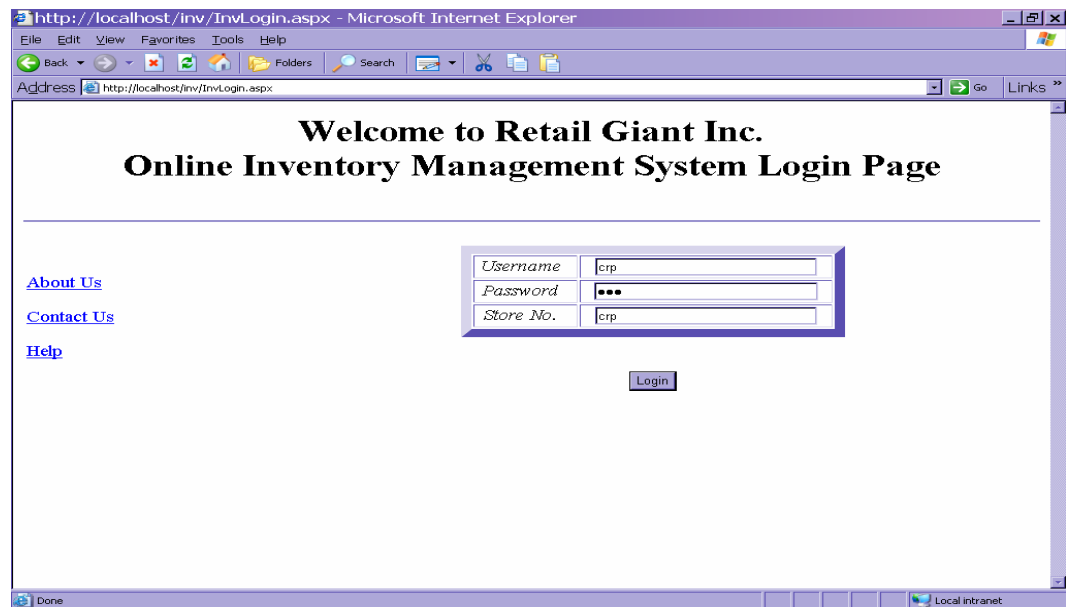
Main Menu: The functionality available at the Main Menu depends upon the role of the user. As per use case analysis, the main menu shows links that would allow the user to perform activities like purchase order creation, transfer stock, run reports as well as perform maintenance activities. The main menu for Store Manager is shown in the following screen shot:
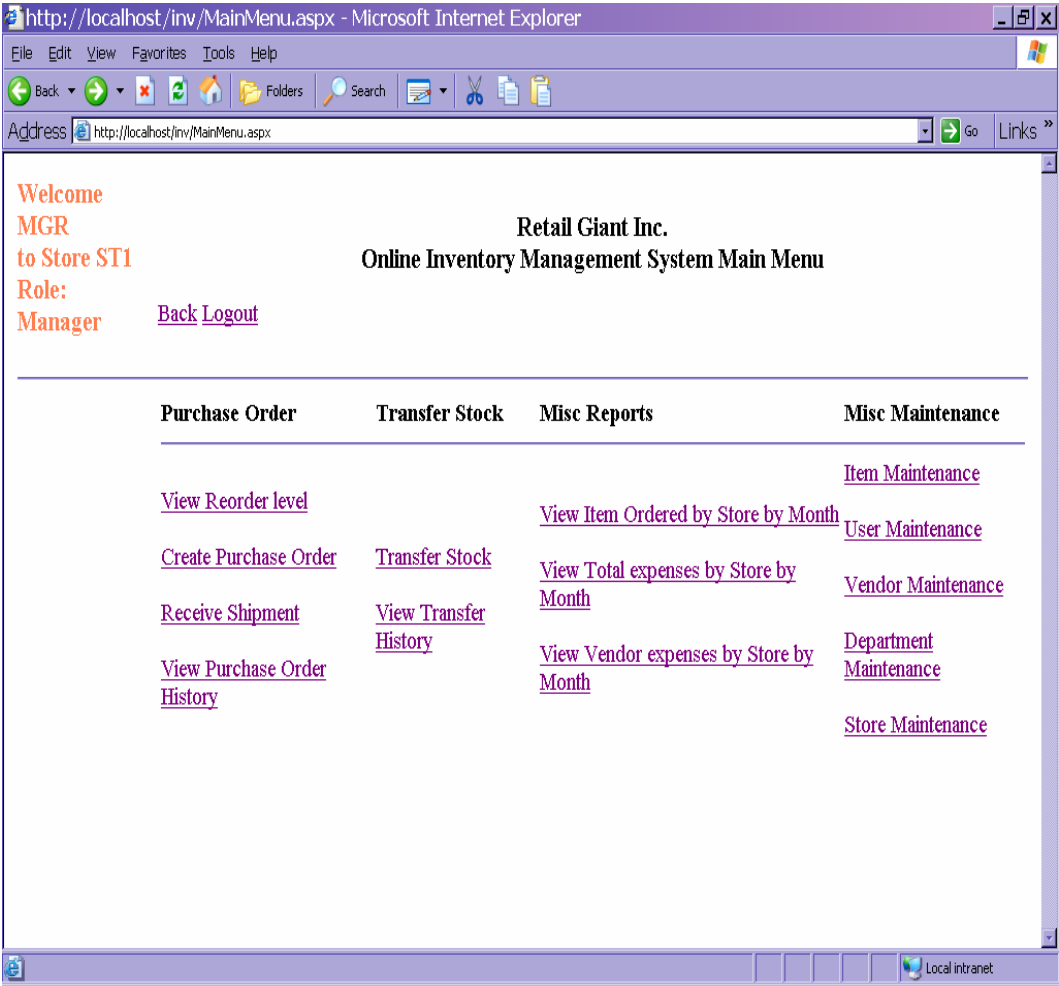
Purchase Order Screen: The Purchase Order screen is divided into three logical sections: Store information, Vendor Information, Item Information section. The store information pertains to the store the item is ordered for. The store information section is populated by the system. The user may select a supplier from the drop down list of suppliers and the application populates the supplier details. The item information section is already populated by the system if the user navigates to this screen from the 'View Reorder Level' screen. The user would be able to select an item from the item selection drop down. When the user selects an item, the 'Add another Item' link appears, so that the user can click on that link and add another item in the purchase order. In the item information section, the user can change data only on the 'Order Quantity' and 'Item Price' fields, which contains the default value for the item. The following screen shot shows the user interface of the 'Purchase Order' screen:

Screen shot of purchase order screen:

4.6   Screen Navigation

Purchase Order Screens: From the Main Menu, the user has two options to reach the Create Purchase Order screen. On the Main Menu the user can either click the 'View Reorder Level' link to view a list of items or the user can click the 'Create Purchase Order' link to directly go to the create purchase screen. Once a purchase order is created, the user can click the 'Receive Order' link on the Main Menu to receive the order. When the order is received, the purchase order is put in the purchase order history table. The user has the option to view the Purchase Order History from the Main Menu.
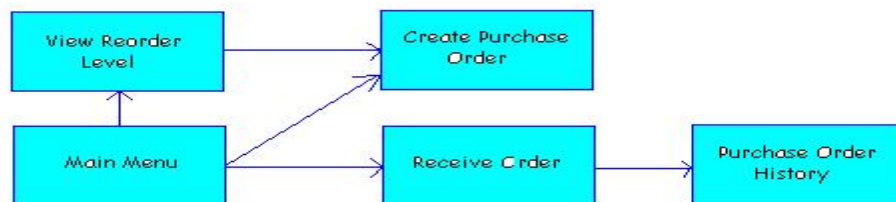
Figure 5: Screen Navigation - Purchase Order Screens

Transfer Stock Screens: On the Main Menu the user can click the 'Transfer Item' link to first view a list of items. The user can then click an item description to go to the Transfer Information screen and complete the item transfer process. To receive a transferred item, the user can click the 'Receive Order' link on the Main Menu. When the order is received, the purchase order is put in the purchase order history table. The user has the option to view the Purchase Order History from the Main Menu.
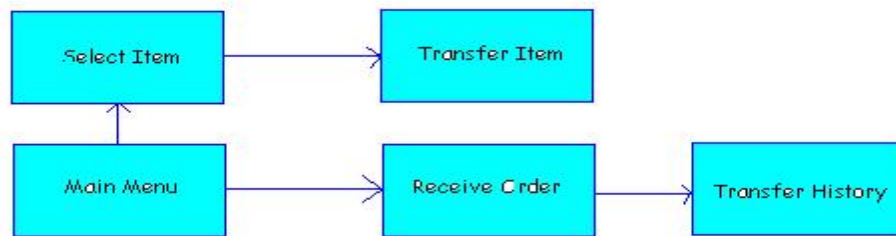
Figure 6: Screen Navigation - Transfer Stock Screens

Item Maintenance Screens: On the Main Menu the user can click the 'Item Maintenance' link to go to the 'View Items' screen. In this screen, the use can click an item description to navigate to the change or delete item screen. The user can also click the 'Add Item' link to create a new item in the database.
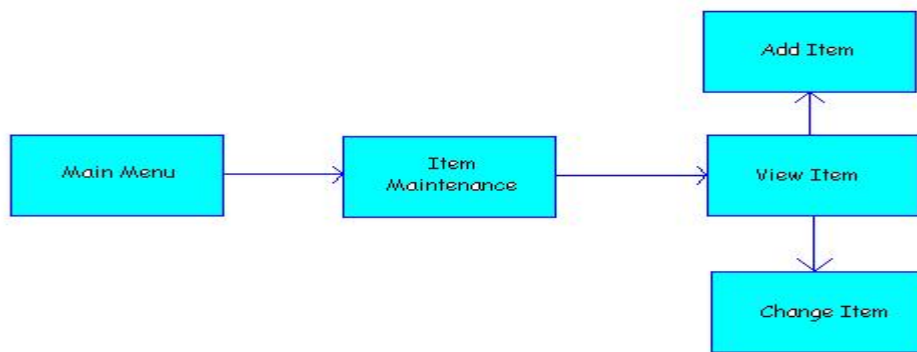
Figure 7: Screen Navigation - Item Maintenance Screens

Vendor Maintenance Screens: On the Main Menu the user can click the 'Vendor Maintenance' link to go to the 'View Vendors' screen. In this screen, the use can click a vendor description to navigate to the change or delete vendor screen. The user can also click the 'Add Item' link to create a new item in the database.
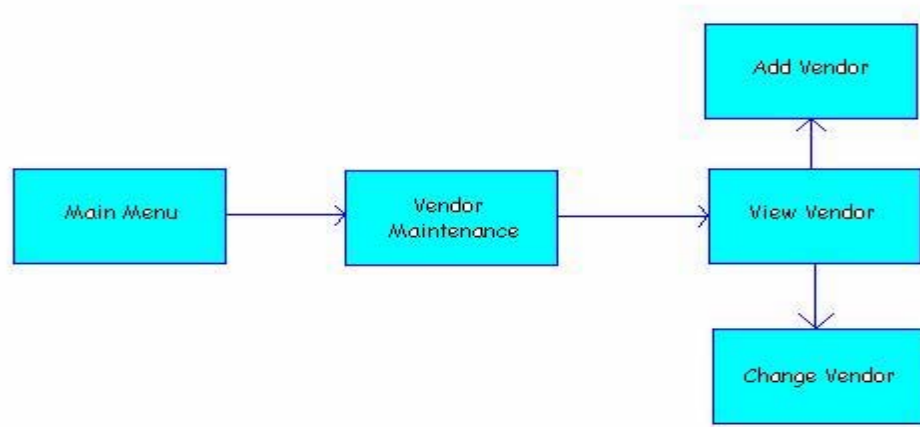
Figure 8: Screen Navigation - Vendor Maintenance Screens

4.7   Database Design

The business rules and functional requirements defined above provide the basis to develop the database design for the web based inventory management system. The Microsoft Access tables are designed to store data for the following purposes:

Sr. No.	Table Name	Primary Key	Type of Information Stored
1	Users	Employee Number	User Validation
2	AccessLevel	User Role	Security level information to access to the application
3	Item	Item Code and Store Code	Item Master Table
4	Store	Store Code	Store Master Table
5	Vendor	Vendor Code	Vendor Master Table
6	Purchase Order	Purchase Order Number, Item Code and Store Code	Details of each purchase order
7	Purchase	Purchase Order	Historical information of

	Order History	Number, Item Code and Store Code	each purchase order
8	Transfer Stock	None	Details of each item transferred to another store
9	Transfer Stock History	Purchase Order Number, Item Code and Store Code	Historical information of each transfer

List of Database Tables

A new record is created in the Purchase Order table for each item in the purchase order. Initially, the purchase order is kept in 'open' status. When the item is received, the purchase order record is changed to closed status and the purchase order record is removed from the purchase order table and a new record is created in the purchase order history table from the item that has been received. The transfer stock process is handled like the purchase order creation process. When a transfer order is created, a record is created in the transfer stock table with the order information, as well as a record is created in the purchase order table with the status of 'transferring'. When the item is received by the receiving store, the purchase order record is set to closed status and the record is deleted

from the purchase order table and a new record is created in the transfer stock history table. The corporate users can maintain the data in the item, store, vendor, users and department tables as needed.

Once the base tables were built, the tables were normalized to eliminate repeated information or dependencies within the tables. The data normalization is carried out to minimize the duplication of data in the tables. Data normalization also eases maintenance of data. For example, the state information is stored in both the Store table and the Vendor table. Both the tables need to save state code and state name information. But the state name is repeating information that is not related to information content of either the Store or Vendor table. Also, if there is any change in the state name, all the affected records in both the tables need to be updated due to the change in state name. Instead, if the state code and state name is stored in a separate table, each state needs to be saved only once. Any change to state name can be easily updated in the State table instead of updating all affected records in Store and Vendor table. The above process of breaking one base table to two separate tables and establishing a primary key foreign key relationship between the tables is called normalization. The State table, Dept table and POStatus table was created by the normalization process.

Relationships of the tables in MS Access database:
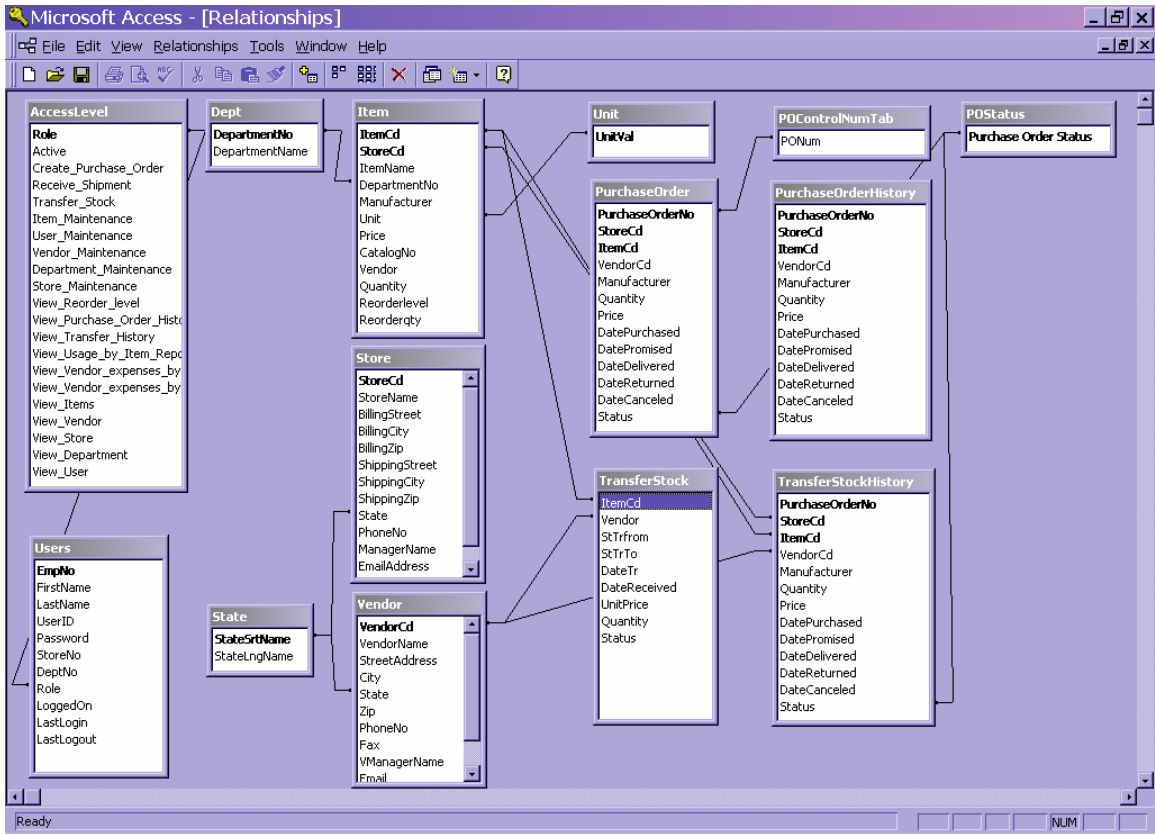
Figure 9: Table Relationships

4.8   Application Design
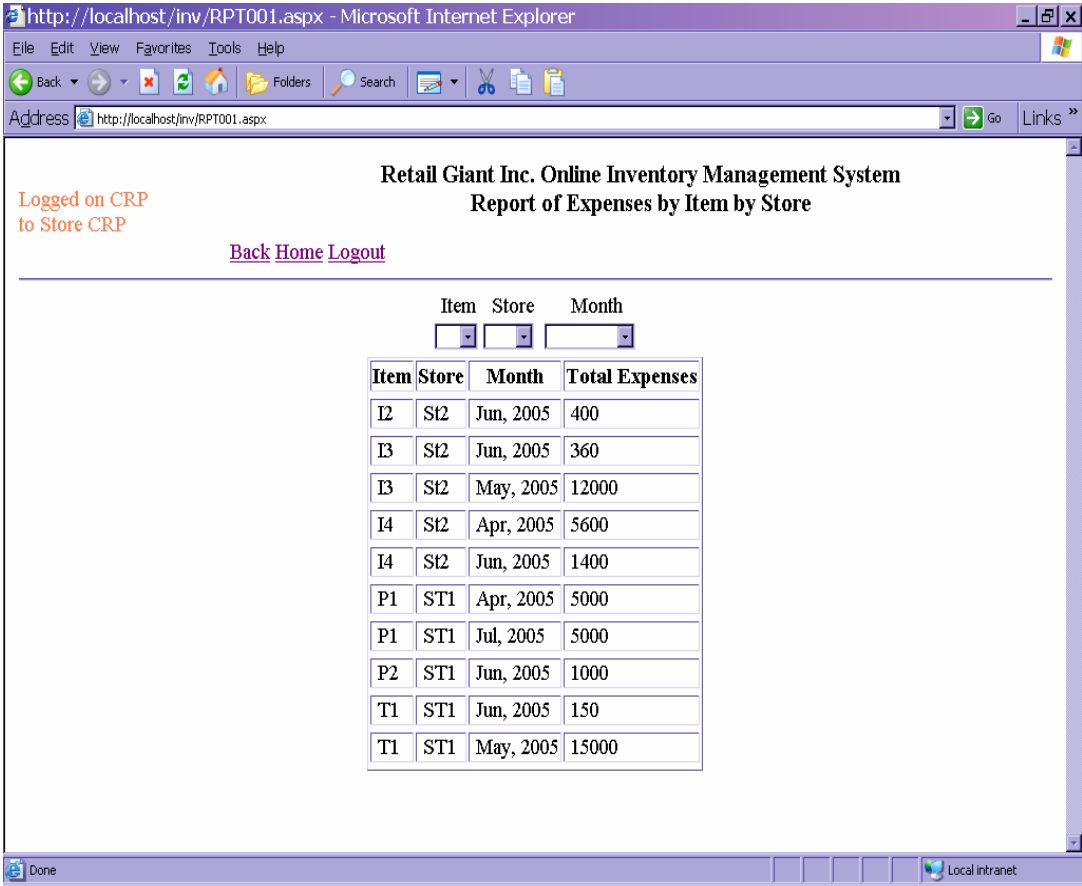
The application runs on a web browser on the desktop of the user. The application was developed using HTML pages embedded in ASP.NET.

The program logic was modularized. Template programs were developed with features like screen field validation, select, insert, update and delete logic and error handling so that the coding can follow an established framework. This framework in turn increased the speed of code development and tremendously reduced the amount of bug fixes needed. A common approach was taken for error handling. In order to make sure that invalid data is not accepted by the application, the application code performed edit checks on the screen fields like required field validation, field length checks, data type check, data range check depending on the particular case. The application also handled program level errors and database level errors. The database connection and database queries were developed in such a way that the back end database might be easily substituted with a different database and minimum code changes will be required.

4.9   Reports

Online report screens were created so that the users can run reports as needed. The application contains three reports: Item report, expense report by store and expense report by vendor. The reports provide search capability, for example the Item report allows the user to select data based on item code, store code and month. An example of the item report is shown in the screen shot below:

4.10   Summary

In the design phase, the use cases were analyzed to identify the response of the application as the user interacts to the system. The analysis of the use cases clarified the different screens needed by the users to interact with the application. The data requirements for the users gave understanding of the database tables needed by the application. Once the use case analysis was complete, the knowledge gained was mapped to show the application flow from the Main Menu. The screen flow was detailed out in screen navigation diagrams. In order to create a standard look and feel of the application, the user interface design process was performed. In this phase, the placement of various components in the screens were determined and finalized. At the same time the database tables were designed and sample data was populated. The design phase was very critical to create a system that closely matched the requirements and project goal.

5 Chapter Five: Project History

5.1 How the project began

The project began with a goal to develop an Inventory Management solution for a small retail business. The new system would facilitate store operations by providing an interface to quickly find the inventory level, manage the ordering of new products, receive items, transfer stock to other stores and generate reports. In order to achieve the above functionality, the current business processes of the stores were researched. It was observed that the geographical challenges posed by the distribution of the stores could be overcome by using web base technology. The store operations could use a web application to create purchase orders, manage stock and transfer stock. The data created by the store operations could be saved to a web-based database, therefore the corporate office would have ready accessibility to store data. Also, web-based reports could be created and accessed from any location. Another advantage of the web-based solution is the application could be easily customized for the stores by managing from one location. For example, all the stores would have access to the most current vendor list as soon as the corporate office upgrades it. Hence it was decided that a web based Inventory Management system would be an appropriate solution for the business needs. Based on the above, it was decided to build a prototype application using Microsoft ASP.net application on the

front end and Microsoft Access database on the back end. It was decided to host the web application on a Microsoft Internet Information Services (IIS) web server.

5.2   Scope of the project

Scope of the project:

Investigate, design and develop a web based inventory management system that is capable of carrying out the following business functions:

1. Listing of items by reorder level

2. Generate purchase orders.

3. Receive orders.

4. Transfer stock from one store to another. Transfer history to be maintained.

5. Reporting expenditure by product, category, store and supplier.

Out of scope:

1. The Inventory Usage recording is done manually by each store manager.

2. Re-order levels have already been established for each item.

3. Billing and accounting functionality is out of scope of the current project.

4. Monitoring the expiry date of the inventory.

5.3   How the project was managed

In order to manage the project, the project was divided into six phases. They are:

a. Analysis phase - Since, the project was worked by only one resource, the timeline provided for each phase of the project was sufficient enough to cover that phase by one person. A project plan was prepared based on the detailed list of tasks that needs to be completed in that phase of the project. A project time line was prepared in Microsoft Project in order to keep the progress on schedule (Appendix G). After getting an understanding of the job at hand, the requirements gathering phase was started. The analysis phase was initiated by analyzing the business needs and business goals for the organization. A Business Requirement document was produced at the end of the requirement-gathering phase (Appendix A). The functional requirements of the application were documented in the Functional Requirements document (Appendix B).

b. Design phase - The system flow needed to satisfy the business requirements was mapped to use cases. The Use Case analysis

phase was documented in systems requirements document. Use case to user matrix was prepared to identify the user of the business functions. The above activity helped to identify the various roles of the users of the application. (Appendix C). The design document was prepared to document the components of the system under construction, including the databases, the user interfaces, reports etc. The look and feel of the application was designed first. The screen flow, screen navigation and individual screens were designed next. Next, the database tables were designed and test data was populated in the tables. The report layouts were designed in the next phase.

c. Construction phase - A pilot project was done to decide the development environment. The first combination tried out was JSP based web application on Apache web server. MySQL database was used in this environment. The second combination used as ASP.net based web application on Microsoft Internet Information Service (IIS) web server. Microsoft Access database was used in this configuration. It was observed that the first environment was facing configuration issues since the version of MySQL database available used was not compatible with the version of Apache web server available from the Internet. Due to time constraints, it was decided to select the Microsoft environment for the development purpose of this project. Also, due to the availability of Visual Studio

Dot Net development environment, the development process would be quicker with Microsoft environment. Hence a web application was setup in IIS and the system was developed using HTML embedded in ASP.Net. Once the development environment was established, an application design framework was prepared in order to create program templates that can be used for the application development. Next, the task of creating the user interfaces was undertaken along with the links among the screens. The screens were developed using one module at a time. After the screen navigation was prepared, the business logic was developed. A CRUD Matrix was developed to document the application processes responsible for performing selects, inserts, updates and deletes on the database tables (Appendix E).

d. Testing phase - Unit testing was done along with the construction phase. During testing phase, the information of the design documents was used to create test scenarios. The test scenarios were used to perform functional testing of the application.

e. Implementation phase - In this phase the application is prepared for deployment in the production environment. The specific activities include set up of the production environment and deployment of the application in the production environment. The development team has not worked on this phase yet.

f. Maintenance phase - In this phase the maintenance of the application needs to be done in the production environment. A maintenance plan needs to be prepared in order to document the maintenance activities done in this phase.

5.4   Significant events / milestones in the project

The milestones of the project are as follows:

1.   Creation of the project plan and the project deadlines.

2.   Selection of the development environment for the project.

3.   Creation of the databases.

4.   Creation of the user interfaces.

5.   Creation of the business logic.

6.   Functional testing.

7.   Creation of project documentation.

5.5   Summary of project work

The project work could be managed since the project tasks were separated into distinct phases and each phase was tasked with a specific goal. There was little bit overlap at the end of design and beginning of construction phase when the screens and databases were constructed and some changes in design were necessary as per lessons learnt in the construction phase. Overall, the separation of project tasks to the six phases worked out well and it helped to keep the project on time schedule.

6 Chapter Six: Analysis of the Project

6.1 Discussion of what went right and what went wrong in the project

The web based Inventory Management System succeeded in delivering the business goals of providing the ability to manage inventory level of the stores. The analysis, design and development activities were on time and they met the objectives of the project. The user interface screens were developed using HTML code embedded in ASP Dot Net application. All the screens were developed using a template approach. Each the screen contained page title at the top of the page, generic links, and the user id and store number showed up at the top left section of the page. The data area shows up at the middle section of the page. The template approach increased the speed of development of the screens. The program logic was also modularized. Template programs were developed with features like screen field validation, select, insert, update and delete logic so that the coding can follow an established framework. This framework in turn increased the speed of code development and tremendously reduced the amount of bug fixes needed.

The project did face some challenges. It was hard to decide the development environment of the project. Considerable time and resource was spent earlier on the project in order to develop a working prototype using JSP and MySQL on an Apache web server. But this environment kept of generating different kinds of error messages. Finally this was abandoned in favor of Microsoft environment. Since the environment

selection was not the critical part of the project, and the business goals could be met by using the Microsoft environment, it was an acceptable solution for the project. The other major challenge faced was that due to the isolated development of this system, some features of the system could not be created like a real time system. For example, the inventory usage recording has been excluded from the scope of the current system. In a real time environment, the inventory use would be recorded by a front end application like Point of Sales (POS) system and as the sales transactions take place, the on hands inventory should be reduced by POS from the actual inventory level. Due to the absence of this functionality, system integration tests could not be performed to test the above scenario.

6.2   Findings / analysis of the results

It was observed that the proper understanding of the goals of the project and clarification of the business requirements earlier on the project is very much essential for the success of the project. Considerable time was spent on the requirements gathering phase of the project in order to understand what needs to be the solution for the business needs. The analysis of the requirements resulted in proper choice of the software environment, development tools as well as it outlined the scope of the project. This in turn helped to develop a system that satisfies the business needs.

The web based inventory management system is a very good solution that provides the functions of inventory control, easier and more controlled process of purchase order creation, receive goods, transfer stocks, reporting and various maintenance actions. The web based inventory control system can significantly impact the performance of the stores by increasing revenue, improving customer service, better inventory control and increased information management. Hence the web based inventory management system is highly recommended to augment the performance of the organization.

7 Chapter Seven: Conclusion

7.1 Evaluation of whether or not the project met project goals

The Inventory management system met the business goal of better inventory control by providing the ability to view the inventory by the items that are needed most. This screen provided the ability to quickly view the inventory level of the store. New purchase orders can be easily created from the 'View Reorder Level' screen. The application provided the ability to receive orders as well as view past orders. The system fulfilled the goal of better customer service by providing the ability to transfer stock from one store to another. The system fulfilled the information management needs of the corporate office by providing the ability to run online reports on the data that is up-to-date all the time. The system provided the ability to be easily customizable by letting the corporate user to perform maintenance functions on the system. The above discussion shows that the system developed met the business goals of the project.

As discussed above, the project definitely met the initial project expectations. The project was aimed at the opportunity to provide information management and store operations management through a thin client application. The project met this goal since the web-based solution could be accessible from the store as well as the corporate office. The application allowed the store to perform the inventory control functions as well as it allowed the data sharing among the stores and the corporate office. The various maintenance functions allowed the application to be

easily customizable. The application also supported various reports that are needed by the management. Over all, the application met the project expectations.

7.2 What we learnt from the project experience

The project work provided very good opportunity to apply the system analysis and design knowledge the author acquired at the classes at Regis University. It was observed that the proper understanding of the goals of the project and clarification of the business requirements earlier on the project is very much essential for the success of the project.

The author learnt to appreciate the importance of definition of the scope of the project and to adhere to the scope of the project. As a project manager, the author learnt to identify the project tasks earlier on the project. The author learnt that the tasks need to be identified even though they may appear to be minor. The tasks need to be analyzed to determine the sequencing of the tasks. The task analysis would make the timeline of the project more realistic. The author learnt that the project would be successful only when the tasks that need to be performed are identified correctly and appropriate resources are allocated to the task.

The project provided a great opportunity to work on all the phases of the software development life cycle, like requirement analysis, design, development and testing. The creation of documents like business

requirements document, use case diagrams, design document etc. was very challenging and provided great learning opportunity.

The system design aspects like user interface design and development of framework for coding the programs was gathered from the knowledge obtained through courses done at Regis University. This project effort was also a very good opportunity to gain expertise of web development using IIS, ASP Dot Net and ADO.NET.

7.3   What could have been done differently in the project

In the current project, the system environment could have been chosen differently. The basic application functionality could have been separated from the presentation layer by creating web services at the back end. The web services would have encapsulated the data access layer of the application. In this way, the application would have been converted to a highly scalable, robust and secure architecture. Another change that can be done is that if the web server resided on a dedicated server and if other applications like POS would feed data to the system, the messaging of the applications could have been created in XML messaging format. The above discussion shows that the current application presents a simplistic view of the solution since the current application doesn't consider the complex hardware and software environment that is normally encountered in a production system. Hence as discussed above, it would be beneficial to adopt features like web

services and XML messaging as the number of interfaces grows in the production system.

7.4 What the next stage of evolution for the project would be if it is continued

As discussed in the previous sections, the next stage of development would be to develop a web services framework that would supply appropriate data to the front-end applications. Also, the inventory usage recording functionality needs to be incorporated to the application. In order to incorporate inventory usage recording, the front end Point Of Sale application must communicate to this application though a standard messaging format like XML messaging format. The application needs to incorporate the ability to track inventory by expiry date. Currently, the application employs role-based security, but the data is transmitted using HTTP connection to the web server. The next phases of the project would need to add additional security features to the system like creating secured HTTPS connection or creating security based on an established encryption key based technology. The security feature of the application is very important for the success of the organization. In order to improve security and scalability, a production level robust database product like Oracle database may be used in the next phase. Apart from the above, the next phases would also need to evaluate the performance of the

application when the application is being accessed by multiple users from varied locations. Test plans could be developed to perform load testing on the application so that it could be confirmed that the application would respond within a reasonable period of time when large number of requests are being submitted to the application. The system environment and the system design may have to be reworked based on the findings of the load testing.

7.5   Conclusions / recommendations

The web based inventory management system is highly recommended solution for the business needs of a small business retail company. The web based inventory management system would automate the inventory control function of the Store Managers so that the time can be better spent on managing the day to day functions of the stores. The application would also provide the real-time information to the corporate office. In order to use it the production system, the web based inventory management system needs to incorporate additional features like security, scalability and it needs to be integrated to other business critical applications in the organization.

7.6   Summary

The current project was a very good opportunity to use the structured system analysis and design methods on a real time business scenario. This project presented a very good opportunity to learn how to

write the documents like business requirements, system requirements, use cases, system design document etc. The project experience taught us the Project Management aspects like task management, time line management etc. The project taught us the importance of defining the business requirements and controlling the scope of the project so that there is no scope creeps. Working on this project enabled us to perform analysis tasks on how the business requirements could be transformed to system requirements and eventually the design. The designing of the user interface and coding framework is another learning experience from the project. On further analysis of the system developed, it has been observed that even though the system meets the business goals, there are many aspects of the system that could be enhanced to improve the performance, scalability and security of the system. Hence it is recommended to perform analysis of the above facts in order to improve the system in the future releases of the project.

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9 Appendices

9.1 Appendix A: Business Requirements

<u>Assumptions:</u>

1. Each store has only one warehouse.

2. New items would be added to the item table by the corporate office.

<u>Business Requirements:</u>

1. Since Online Inventory Managed System is critical for the business, the system should be available online during the hours when store is operational (6:00 AM to 12:00 AM).

2. <u>User Interface requirements</u>

    2.1.   **General Requirements**

        2.1.1.   The system shall provide a login screen to authenticate the users of the system.

        2.1.2.   Each user will be associated to a particular store. In other words, same user id may exist in different stores.

        2.1.3.The system shall provide access to the screens and functionality based on the access level of the user. Based on the access level, the users will have update capability on some screens and view only access to others.

        2.1.4.   The system shall provide a way to retrieve information by using the following id's:

            2.1.4.1.   Purchase Order - Purchase Order number

            2.1.4.2.   Item - Item code

            2.1.4.3.   Vendor - Vendor code

            2.1.4.4.   Store - Store code

            2.1.4.5.   Department - Department number

2.1.5.**Reporting** - The system shall provide a way to view historical data, like view purchase order history, transfer stock history, usage by item, vendor expense by month, expense by store etc.

2.2.   View Reorder Level Requirements

2.2.1.The system shall provide a way to display the items that are needed most.

2.2.2.The corporate office would maintain the reorder level of any item in any store.

2.2.3.   Only the reorder level for the store the user logged in should be displayed.

2.2.4.The reorder level screen would also display quantity of any pending open orders so that user would be aware of any order that has already been placed.

2.3.   Purchase Order Creation Requirements

2.3.1.The system should provide a way to create Purchase Orders. The system should accept buyer information, supplier information and product information to create purchase orders.

2.3.2.The system should provide a way to show that the order has been placed for the item and the expected date of arrival.

2.3.3.   The system shall provide a way to see all the purchase orders made till date.

2.4.   Inventory Usage Recording Requirements

The current inventory level information should be provided by the Point of Sale system.

2.5.   Receiving Shipment Requirements

2.5.1.   The system should provide a way to record the receipt of inventory.

2.5.2.If the inventory received is not correct according to the purchase order, the store manager should have the ability to either change the order or return the order.

2.6.   Transferring Stock Requirements

2.6.1.   The system should provide a way to transfer stock from one store to another.

2.6.2.   Only the sending store can initiate the transfer stock option from one store to another.

2.6.3.   The system should maintain the on hands of the sending store.

2.6.4. The on hands quantity for the receiving store should be updated once the item enters the receiving store.

2.6.5.   The system shall provide a way to see all the stock transfers made till date.

2.7.   Item Maintenance Requirements

2.7.1.   The system should provide a way to add items to the inventory by the corporate users.

2.7.2. System should provide a means to change the details of the items available to the stores (corporate only).

2.7.3.   The item list should be a view only screen for general users.

2.8.   Vendor Maintenance Requirements

2.8.1.   The system should provide a way to add vendors by the corporate users.

2.8.2. System should provide a means to change the details of the vendors available to the stores (corporate only).

2.8.3.   The item list should be a view only screen for general users.

2.9.   User Maintenance Requirements

2.9.1.   The system should provide a way to add users to the system.

2.9.2.   System should provide a means to change the details of the users (corporate only).

2.9.3.   The user should be able to change password in the system.

2.9.4.   The user list should be a view only screen to select users in the system.

2.10. Department Maintenance Requirements

2.10.1. The system should provide a way to add departments to the system.

2.10.2. System should provide a means to change or delete the department information (corporate only).

2.10.3. The users should be able to view department details in the system.

2.11. Store Maintenance Requirements

2.11.1. The system should provide a way to add stores to the system.

2.11.2. System should provide a means to change or delete the store information (corporate only).

2.11.3. The users should be able to view store details in the system.

9.2 Appendix B: Functional Requirements

2.12. Login Page Requirements

    2.12.1.   Login page would have three input fields - user name, password and store number. All are required fields.

    2.12.2. Login page would have two buttons - Login and Reset Form

    2.12.3.   If no data is entered in the login page and the user clicks Login button, OIMS should display the following message:

    "Please enter user id"

    2.12.4.   If only user id is entered in the login page and the user clicks Login button, OIMS should display the following message:

    "Please enter user id, password and store number"

    2.12.5.   If the user name, password and store number is entered and the user clicks the Login button, OIMS should validate the data against the Personnel table. If OIMS determines that the input data cannot be matched to the system, OIMS would return back the login page and display the following error message: "User authentication failed…"

    2.12.6.   If the user name, password and store number is entered and the user clicks the Login button, OIMS should validate the data against the Personnel table. If appropriate entry is found, the system should login the user to OIMS. The "LoggedOn" flag of Personnel table should be set to on at this time and the "LastLogin" time of Personnel table is updated with the login timestamp. The system should also create a session variable and store the user name and store number.

2.13. View Reorder Level Requirements

2.13.1.   When the user clicks the 'View Reorder Level' link, the current level of reorder list for the store would be displayed.

2.13.2.   The reorder level would be determined by the difference of the current inventory and the reorder level.

2.13.3.   The screen would display the items by ascending order of the re-order level of inventory.

2.13.4. The reorder level would be displayed for the store number the user logged in.

2.13.5.   The reorder level screen would also display quantity of any pending open orders so that user would be aware of any order that has already been placed.

2.13.6.   In the re-order level view screen, user would be able to click on the item description to go to create purchase order screen

2.14.   Purchase Order Creation Requirements

2.14.1.   The Create Purchase Order screen would have data input fields for the buyer information, supplier information and the product information.

2.14.2.   There should be drop down lists for all the three items mentioned above so that the data can be easily entered in the screen.

2.14.3. The Create Purchase Order screen would be accessible from the main menu.

2.14.4.   The user should be able to update the following buyer information: Shipping address, billing address, telephone, fax, email.

2.14.5. The store number should be populated based on the login store of the user.

2.14.6.   The user should be able to change the following supplier information: Supplier name, address, Supplier manager name, phone number, fax and email.

2.14.7. Following product information would be displayed:

- Description

- Company

- Catalog Reference

- Unit

- Order Quantity

- Unit Price

2.14.8.   The user should click on the 'Create Purchase Order' button in order to create the purchase order.

2.14.9.   New purchase order would be in open status.

2.14.10.   New purchase order would have a unique purchase order number that is a combination of store number and a sequential number and a random check digit.

2.14.11.   One purchase order can have multiple items.

2.14.12.   Each item in the purchase order should be a stored as a separate record in the purchase order table so that the items can be received at different times.

2.14.13.   The Create Purchase Order screen would be also accessible from the Reorder view of inventory screen.

2.14.14.   The inventory ordered should be flagged in such a way that the ordered items would show the order quantity and the expected date of arrival in the reorder screen.

2.14.15.   The purchased items would be recorded in the Purchase Order table.

2.14.16.   The purchase order would be changed to closed status once the items have been received.

2.14.17.   The purchase order would be in returned status if the store manager returns the shipment.

2.15.   Inventory Usage Recording Requirements

The Point of Sale System is responsible for communicating inventory usage information to OIMS. A batch process is run on the point of sale daily after the store is closed. The batch process would send to OIMS a list of items consumed per store. The items consumed would be subtracted from the quantity field of

Item table so that the correct on hands inventory can be maintained. This functionality is out of scope of the current development effort.

2.16. Receive Shipment Requirements

2.16.1.   When a shipment is received, the receiving clerk would open the purchase order to verify the items received against the order. The receiving clerk would verify the item code, quantity ordered, price and vendor information.

2.16.2.   If the item received doesn't match the purchase order, the receiving clerk would contact the store manager. If the store manager decides to receive the orders, the store manager would click the 'Change Order' link to update the purchase order. The system would first prompt the manager to login.

2.16.3.   If the store manager decides to return the order, the store manager can either change the order or return the order. The store manager can change the status of the order and the system records the date of change or return of the order and the status of the order in the purchase order table.

2.16.4.   Once the items received matches the items in the purchase order in the system, the receiving clerk would click the 'Receive Item' link and confirm that the items has been received. At this time, the system would change the status of the order from Open to Closed and update the date delivered field to the received date.

2.16.5.   When the order is received, the system would add the item received to the quantity field of the Item table and the purchase order history table.

2.17. Transfer Stock Requirements

2.17.1.   In order to transfer inventory from one store to another, the Sending clerk would click the Transfer Stock link on the main menu.

2.17.2. The current stock level would be displayed. The screen would be similar to reorder level screen.

2.17.3.　　　User would click an item to transfer it to another store. At this time the Transfer Stock screen would be displayed. The item name and source location fields would be already filled.

2.17.4.　　　The user would enter the destination store number and quantity to be transferred and click the 'Transfer Now' link.

2.17.5.　Item quantity transferred cannot be greater than the on hands item quantity.

2.17.6.　　　The system would remove the item quantity from the sending store's Item table and put the item on the receiving store's purchase order table.

2.17.7.　　　When the item is received by the receiving store, the receiving store goes through the normal purchase order receiving process.

2.17.8.　A transfer order cannot be returned or canceled.

2.18.　Item Maintenance Requirements

2.18.1.　　　When the user clicks the Item Maintenance' link, the current items for the store will be displayed.

2.18.2.　　　The user can click an item description to change the item details.

2.18.3.　　　The item screen would have an item selection drop down.

2.18.4.　　　If the user belongs to the corporate office, this screen would show a link to create new item in the system.

2.19.　Vendor List Maintenance Requirements

2.19.1.　When the user clicks the 'Vendor List Maintenance' link, the list of vendors would be displayed.

2.19.2.　User should be able to select a particular vendor from the Vendor name selection list.

2.19.3.　　　A corporate user should be able to update vendor related information like name, address, phone number, fax, email etc.

2.20. Purchase Order History Requirements

    2.20.1.   When the user clicks the 'View Purchase Order History' link, the purchase order history screen would be displayed.

    2.20.2.   The purchase order history would have drop down list for the following fields: Purchase Order Number, Vendor, Manufacturer and Date Purchased. User should be able to select one of the above options to sort / search the purchase order history information.

2.21. Transfer History Requirements

    2.21.1.   When the user clicks the 'View Transfer History' link, the transfer history screen would be displayed.

    2.21.2.   The transfer history would have drop down list for the following fields: Item, Store Transferred from, Store Transferred to and Date Transferred.

2.22. Report of Vendor Expenses by month

2.23. Report of usage by item

    2.23.1. The user should be able to clicks the 'View Usage Report' link to view the usage by the following:

        2.23.1.1.   Vendor expenses by month

        2.23.1.2.   Usage By Item

        2.23.1.3.   Expenses by store on a monthly basis

2.24. Report of expenses by store by month

3. Web site design requirements:

   3.1.   The home page should show the following information:

        3.1.1.   Title: Login to Inventory Management System.

3.1.2.   Page heading: Welcome to Online Inventory Management System.

3.1.3. Frame to the right: User name, password and store number fields and login button. Shows main menu on successful login.

3.1.4.   About us link: Information about Inventory Management System.

3.1.5.   Contact us link: Shows phone number and address information.

3.2.   The Main Menu should show the following information:

3.2.1.   The Store number, user name should show at the top.

3.2.2.   A logout link should show on the top.

3.2.3.   The main menu would have the following links:

3.2.3.1.   View Reorder level

3.2.3.2.   Create Purchase Order

3.2.3.3.   Receive Shipment

3.2.3.4.   View Purchase Order History

3.2.3.5.   Transfer Stock

3.2.3.6.   View Transfer History

3.2.3.7.   Item Maintenance

3.2.3.8.   User Maintenance

3.2.3.9.   Vendor Maintenance

3.2.3.10.   Department Maintenance

3.2.3.11.   Store Maintenance

3.2.3.12.   View Usage by Item Report

3.2.3.13.   View Vendor expenses by store

3.2.3.14.   View Vendor expenses by month

9.3 Appendix C: Use Case to User Matrix

Use Case	Manager	Ordering Clerk	Receiving Clerk	Corporate
Create Purchase Order	X	X		
Receive Shipment	X		X	
Transfer Stock	X	X		
Item Maintenance	X			X
User Maintenance	X			X
Vendor Maintenance	X			X
Department Maintenance	X			X
Store Maintenance	X			X
View Reorder level	X	X		
View Purchase Order History	X	X	X	X
View Transfer History	X	X	X	X
View Usage by Item Report	X			X
View Vendor expenses by month	X			X
View Vendor expenses by store	X			X

9.4 Appendix D: Physical Database Design
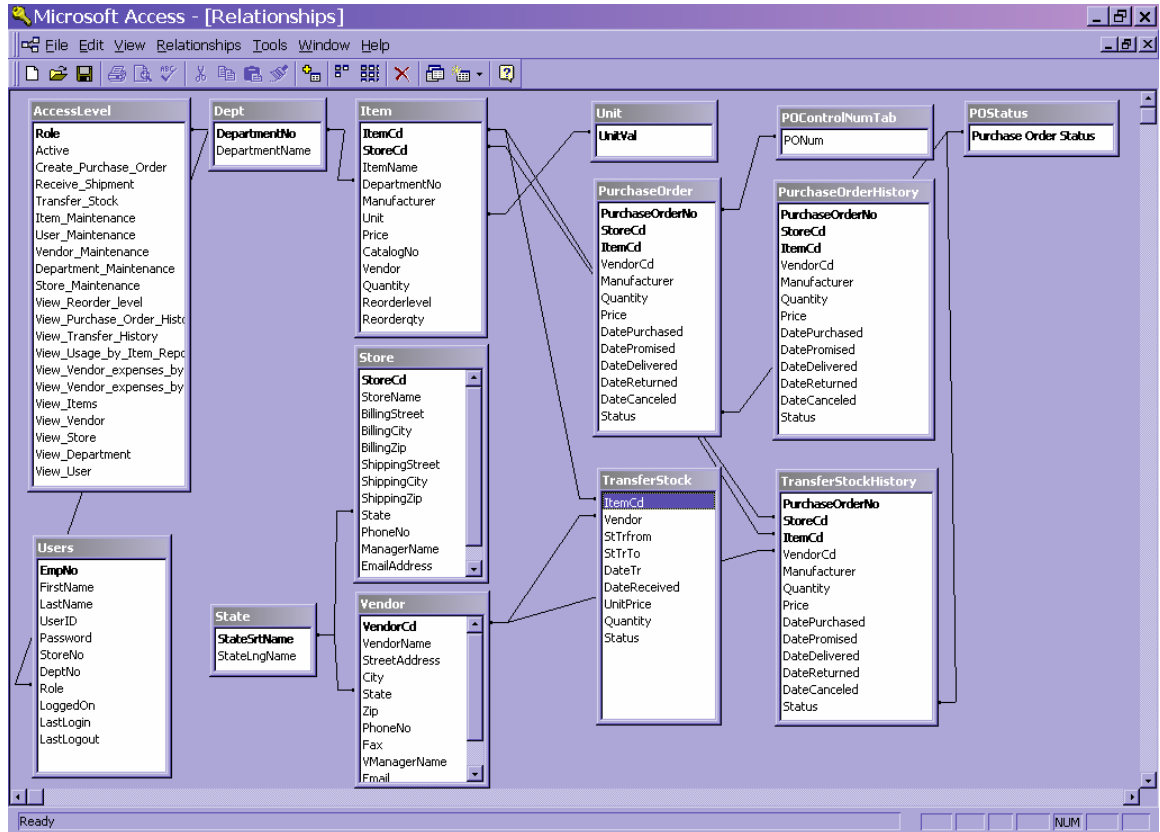
Table Relationships

9.5 Appendix E: CRUD Matrix

	AccessLevel	Dept	Item	Purchase Order	Purchase Order History	Store	Transfer Stock	Transfer Stock History	Users	Vendor
Logon	R								R U	
View Reorder Level			R							
Create Purchase Order			R	C		R				R
Receive Shipment				RUD	C			C		
View Purchase Order History					R					
Transfer Stock							C			
View Transfer History								R		
Item Report					R					
Expense Report					R					
Vendor Report					R					
Item Maintenance			R							
Add Item			C							
Change Item			UD							
User Maintenance									R	
Add User									C	
Change User									U D	
Vendor Maintenance										R
Add Vendor										C
Change Vendor										U D
Department Maintenance		R								
Add Department		C								
Change Department		UD								
Store Maintenance						R				
Add Store						C				
Change Store						U D				

Legend:

R = Read
C = Create
U = Update
D = Delete

9.6 Appendix F: Report Layouts and Designs

9.6.1 *Sample Report - Item Report*

Report ID	RPT001
Description	Item report
Report Type	A web based report that can be viewed or printed from a web browser.
Estimated No. of Pages	2-5.
Which Roles will Use the Report?	Corporate User (view all stores), Store Manager (view only the data for the store the user is assigned to)
What is the Frequency for Viewing the Report?	On Demand.

	Column Element	Sort Sequence	Searchable? (Y/N)	Sub Total (Y/N)
1	Item	1	Y	N
2	Store	2	Y	N
3	Month	3	Y	N
4	Total Expenses	None	N	N

Report Label Source Table.Field ID	Report Label	Field Size	Calculation
PurchaseOrderHistory. ItemCd	Item	50 characters	None
PurchaseOrderHistory. StoreCd	Store	50 characters	None
PurchaseOrderHistory. DateDelivered	Month	50 characters	None
PurchaseOrderHistory. Quantity PurchaseOrderHistory. Price	Total Expenses	50 characters	Sum(Quantity * Price)

9.7 Appendix G: Project Timeline

Task Name	Mar 2005	April 2005	May 2005	June 2005	July 2005	Aug 2005	Sept 2005	Oct 2005
Phase I Analysis Phase	◆▬▬▬◆							
Phase II Design Phase		◆▬▬▬◆						
Phase III Construction Phase			◆▬▬▬▬▬▬◆					
Phase IV Testing Phase					◆▬▬▬◆			
Phase V Implementation Phase						◆▬◆		
Phase VI Maintenance Phase							◆▬▬▬▬◆	