

# **A Tool for the Automation of Membership Services and Equipment Management**

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Membership Services and Equipment  
Management**

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We recommend acceptance of this manuscript in partial fulfillment of this candidate's requirements for the degree of Master of Software Engineering in Computer Science. The candidate has completed the oral examination requirement of the capstone project for the degree.

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## **ABSTRACT**

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The Recreational Sport Department at the University of Wisconsin La Crosse wanted a software tool to help manage membership services, track equipment, check in and check out equipment, monitor locker assignment, and finally analyze each equipment’s usage. Currently, the Recreational Sport Department is using a manual process and paper documents to keep track of all the above mentioned activities. This manuscript addresses the development of a software tool to assist the Recreational Sports Department. The tool consists of four major components: (1) Membership registration, (2) Equipment inventory management, (3) Equipment check in and check out processes, and (4) Receipt and report generation. The Membership Registration component consists of addition, modification and deletion of membership; in addition, it also includes locker assignment and cost calculation processes. Equipment inventory management consists of addition, modification and deletion of individual equipment. An added side component of equipment inventory management allows the users to group a list of desired equipment and create a team equipment group to be checked out later. Equipment check out and check in processes shall have an intuitive GUI to make the activities easy to use. A user will be able to print the membership receipt at any time. In addition, users will also be able to generate any report on usage of equipment with a variety of information.

## **ACKNOWLEDGEMENTS**

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## **GLOSSARY**

### **API**

Application Program Interface. The interface through which an application accesses the operating system and other services.

### **CAS**

Campus Administrative System at the University of Wisconsin-La Crosse. A database management system used by the campus for keeping track of all students and faculty information.

### **Crystal Report**

A report generating tool incorporated in Visual Studio .NET for report generation and graphing technology.

### **IEEE**

An acronym for Institute of Electrical and Electronics Engineers, Inc., which is an international organization whose constitution describes their purpose as “scientific and educational, directed toward the advancement of the theory and practice of several engineering fields including computer science.”

### **IEEE 830-1998 Standard**

This is a recommended practice describing approaches for the specification of software requirements. It emphasizes the development of unambiguous and complete requirements specification documents.

**REC**

Recreational Sport Department

**SQL**

Structured Query Language is a popular computer language used to create, modify and query databases.

**SRS**

Software Requirements Specification specifying the requirements of a software system.

**Stored Procedure**

A program that is physically stored within a database that can be run to perform various queries or other database operations.

**UML**

Unified Modified language (UML) is a third generation modeling language that provides a notation for capturing and communicating object structure and behavior.

**Visual Studio .NET**

A Microsoft GUI development environment for building software applications.

**PC**

Personal Computer.

**GUI**

Graphic User Interface.

**C# (pronounced C Sharp)**

C# is an object-oriented programming language developed by Microsoft.

**MSR**

Magnetic Stripe Reader.

**OPOS**

OLE(Original Line Equipment) Point-Of-Sale

# 1 Introduction

The Recreational Sports Department at the University of Wisconsin-La Crosse provides modern facilities, creative programming and quality recreational equipment to students, faculty/staff and sometimes to La Crosse area community members. The department oversees eight separate program areas and uses two facilities, the Recreational Eagle Center and Mitchell Hall. Both these facilities employ over 200 students in a variety of positions.

The department wanted to streamline its membership services and equipment checkout process. The objective is to computerize the current manual process in order to make the registration and equipment checkout processes fast and accurate. The computerization of these processes will simplify paperwork and provide electronic storage of data.

Memberships are sold to students, faculty and staff for 35 different fitness classes. Approximately 900 fitness memberships are sold each semester. In addition, there is a separate management system for different types of membership such as facility memberships to faculty and staff members are also sold each semester. The equipment checkout process is carried out on a daily basis allowing checkout of a variety of equipment every day. This equipment includes basketballs, volleyballs, racquetball racquets, badminton racquets, jump ropes, boxing gloves, etc.

Because of the amount of equipment to be checked out every day, and the number of members involved, the workload for staff members in the department increases every year. The operating cost includes the maintenance cost of the equipment and their inventory. Some of the problems faced by the staff members are listed below:

- Voluminous paper work is one of the major problems during membership registration process. Given unreasonable amount of resource and time, membership service remains a tedious process to deal with for staff members at REC. In addition to membership registration for students, faculty and staff, separate memberships for spouses or partners is required during the registration process.
- Each piece of equipment is individually marked for identification purposes; however, there isn't a method to allow a user to backtrack or check into certain equipment in terms of its usability and for maintenance purposes. This often leaves the user with an uncertainty on how good the equipment is in a given day, and when the next maintenance service is required on a particular equipment. Lack of information on the status and maintenance of equipment leads to bad quality of equipment because of unperformed maintenance. This, in turn, may cause customer dissatisfaction when poorly conditioned equipment is being rented out. In the worst case, this could result in an injury as well due to inadequate maintenance of these equipments.
- Tracking various types of memberships involves additional time thus increasing the cost of membership services.
- Manually completing forms creates another issue due to hand-writing. That is, more than one person will be handling the forms, and each person has a different style of hand-writing. This leads to misunderstanding of the information on the forms, especially when maintenance requests are entered by one staff member and not understood properly by another staff member.
- Forms could be easily misplaced, thus resulting in missing documents. Human error on checking form for completeness could result in incomplete form.
- The equipment check in and check out processes are difficult and involves extensive labor to get the work done right. Currently, a staff member is required to manually check each equipment that is being checked out for the day, and

make sure things are getting checked in correctly. On top of that, the staff member is required to tally up all equipment before closing of the business on that day to make certain that all equipment are in place; otherwise, they may have equipment shortages and may have to reorder.

- One of the constraints currently imposed on the check out process is that a member is allowed to only checkout one piece of equipment at a time. However, this is not being enforced and it is very difficult to track using the manual check out process how many items a particular member has checked out. Conflicts in the equipment check in and check out process remains a headache.

Because of the above problems, the Recreational Sports Department has been actively searching for a software tool to manage their equipment inventory, equipment check out and check in processes, and membership organization. According to REC department, Commercial software tools for this type of management are very expensive, and the features and customization options are limited. Commercial products for this management process cost from \$20,000 to \$50,000. This cost does not include annual maintenance fees for providing service and updates.

The Recreational Sports Department therefore decided to develop an in-house software product with the help from the Computer Science Department. This manuscript addresses the development of a customized software tool that assists the Recreational Sports Department in maintaining their membership services, rental, equipment inventory tracking system, user registration, and item reservation. This tool, called AMEMS (Automation of Membership Services and Equipment Management System) in the rest of this manuscript, is based on a client-server model. The software is design to be used internally within the REC department hence all the equipment checkout and membership services have to be done within the facility in the building. In addition, the client-server model design allows future extensibility to

add features to the existing program or to integrate a web interface for a monitoring purpose that does not interfere with the existing system.

## **2 Principle of Software Engineering Approach**

The software development process utilizes a systematic approach with an emphasis on capturing customer's requirements, creating design document based on requirements gathered and applying this to a systematic development of a correct, consistent and maintainable software product [10]. The inventory management and membership registration process in REC is not new; nonetheless, having to convert from manual operation to electronic form and store crucial information into a database system for future reference is non-existent. This is not a re-engineering process; rather, it is creating a new piece of software to better accommodate the current growing operational needs for REC. The principle of software engineering are applied throughout the process in creating the software tool for REC.

The software engineering approach applied here involved several different stages; these are requirements gathering, requirements review, software design, design review, implementation of software, verification and validation of the software.

### **2.1 Software Requirement Specification**

It is important to ensure all requirements are captured in the SRS [1] before the design process starts because the problems identified in the requirements are easy to correct than to find and correct them later in the development stage. A program by definition is intangible; it is a sequence of algorithms executed within a PC. Most of the time, the process of creating and developing software can only be realized near the end of project. For this reason, it is essential to have a process to manage the development of the software systematically. This will allow for better control, more

accurate output and better overall design. Both developer and client can predict the outcome of a software product, so that the product can be made to satisfy the specific needs of the customer before delivery.

During the requirements gathering process, several meetings were held with the clients to capture the functional requirements of their needs. A walkthrough of the current operation was performed at the very beginning of the software development cycle to better understand the current operation. The same process was performed on the equipment check in and out operation and membership registration. The walkthrough revealed the complexity as well as the method used for keeping records in the current operation. This is a good exercise to execute before even gathering the requirements for the sake of understanding the day to day function in REC.

A brainstorm discussion was carried out to bring out all new and desired requirements. The focus was to create a good user centered design by listening to customer needs and capturing the core functional requirements to satisfy the current operation of the REC. After going through a few iterations of requirements gathering, a software requirements specification was created. A series of reviews to study the software requirements was carried out to check for consistency and correctness. The review committees involved staff members from the REC group as well as examination committee members. Peer review is a very efficient approach to double-check requirements that one may overlook. Earlier detection of any ambiguity in requirements results in accurate requirement gathering and saves time when carried over to the design process.

## **2.2 Software Design Specification**

The Software Design Specification [11] was generated using the requirements captured in the software requirements specification. The design document is supposed

to reference back to the requirements and satisfy each and every requirement. The design document describes the technical details of creating and developing the software, the technology used, methods and functions used in the software requirements specification. This document was reviewed by examination committee members and was revised according to their comments.

Once the requirement and design documents are completed, software development and implementation was carried out. This capstone project is intended to be completed by one student; and hence a parallel process would be impossible. In an ideal scenario, a parallel processing approach is desirable because it can help cut down testing time and better support developers in finding bugs and fixing them before final release. Development and testing efforts were done serially before product demonstration. The Incremental Prototyping model was used across the development cycle to better suite customer needs. Presentation of prototype software was done early in development cycle to get customer feedback.

### **2.3 Prototyping**

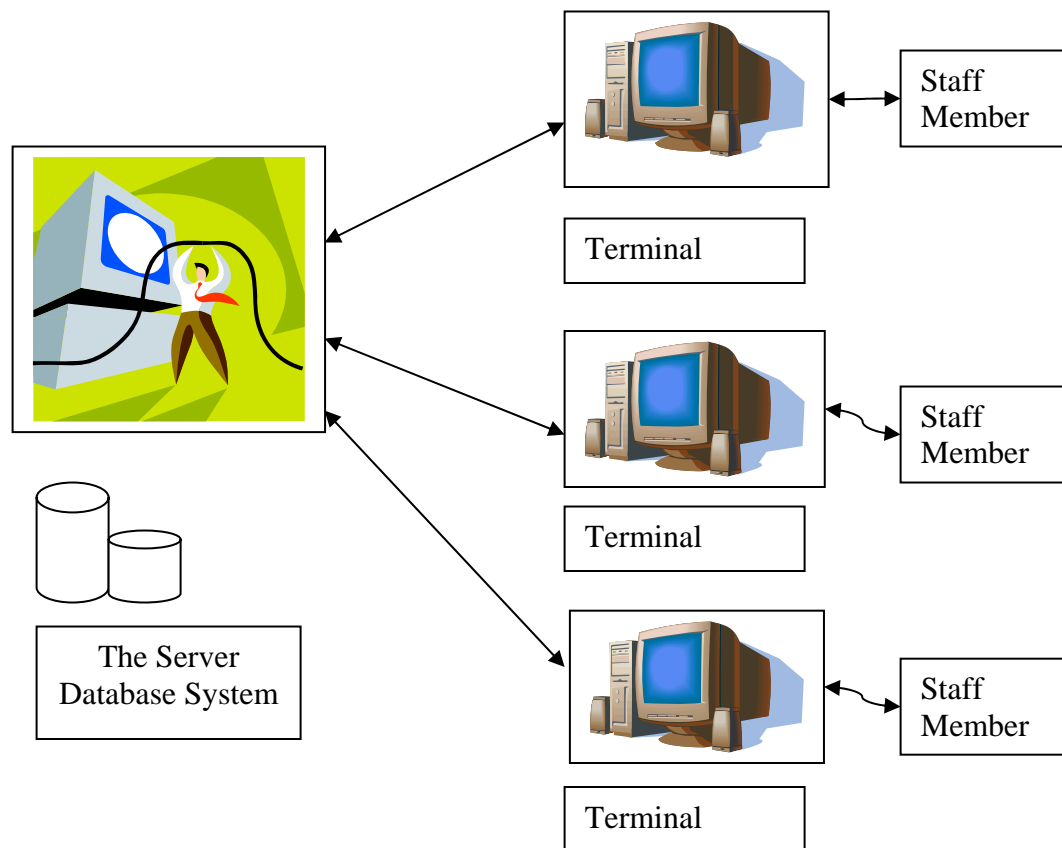
The Incremental Prototyping approach was used in this project because the developer was able to demonstrate the software product to the customer before it reached the final stage. A total of 4 demonstrations were delivered during the development process. This was done to get consensus from the customer as well as to give them a feel of what they will be getting. As for the incremental prototyping approach, during each phase of prototype more features and functions were added to the previous design. Regression testing was done during each phase to ensure product integrity when more features were integrated into the prototype.

## **2.4 Software Verification and Validation**

Software testing is done through a cooperative effort between the client and developer. Integration testing is performed when deployed on the client side for a test run of the software system. All testing done by the developer was verified on the developer's machine where test data was manually generated and executed with the software developed. The database is installed locally on a development machine using a server-client database system to mimic the actual database system that will be used in the final product.

### 3 Software Architecture

The software is based on a client-server relationship system. Software architecture from a high level view consists of two major components. Those two components are the Database system on the server side and client applications residing in the customer's domain. Figure 3.1 gives a brief view of the overall system context diagram.



**Figure 3.1 System Context Diagram**

The software is designed to have a login mechanism in place to track each user's login status. All information of the system is stored in a database system in a

server. The server runs on Window server 2003 with an Oracle database system. Each terminal shall have windows based operating system XP version or Vista with .Net Framework support of version 2.0 or higher The requirement of .Net framework is a must because the software is written in C# which uses the .Net Framework as its base.

The software created in this application uses a 3-tiered design approach. 3-tier design includes (1) a layer of database system strictly designed to deal with all database requests, updates and store procedures, (2) an application layer which includes all the necessary methods and functions per the requirements specification and lastly (3) a GUI layer between the user and the software. The intention is to have a clear separation between the database system, application and GUI. This type of design is popular for its ability to detach each individual layer and further upgrade without interfering with other layers. This is very useful not only for future expansion of the software in term of usability but also opens the door for replacing the database system or changing or updating the GUI without unintentionally breaking the core application. This is also helpful during the testing of the software as each of the 3 applications can be tested separately.

### **3.1 Database System**

The final product resides in a Windows 2003 server running an Oracle database system. This, however, is not the case during the development cycle. The Oracle database system is not available in the local development station; hence the next closest alternative is the MySQL database system [5]. The reason for selecting this database is because the database is also based on a server client relationship. Another good reason for selecting this database system is the fact that MySQL is open source and it's free for the public to use.

The connection to the database uses the SQL connector downloaded from the MySQL website. The connector integrates well with C# thus connecting to a database is a breeze. SQL is a fairly popular scripting language that is well supported across many database systems including Oracle. Given the fact that there will be some minor differences between SQL in Oracle and MySQL, the most common inquiry commands are used in the database code. Common SQL statements used in the software are: SELECT, INSERT, DELETE, UPDATE, WHERE and COUNT [2]. In order to minimize the incompatibility between the two different database systems during testing, other functions are not implemented in the software. This may result in writing a longer SQL statement rather than using a built-in function to complete the same task. However some sacrifices are necessary in order to maintain compatibility between the two database systems. The ultimate goal is to minimize having to rewrite the SQL statements when transferring from the MySQL database system used during test to the Oracle database system during deployment.

The system shall provide a set of encapsulated operations with stored procedures to be performed on the database. Having these procedures provide a clear separation between the database system and main application. The database is not tied closely to the main application; rather, it is standalone. In using a stored procedure to query information, updated or stored data can be re-written or modified without any impact to the core application. The stored procedures are highly optimized database access routines that are used by the application when trying to access into database upon initial execution within the database server. All subsequent calls to the same procedure is a direct fetch from memory because it has been loaded in system memory.

### **3.2 Database Tables Design**

The design of the database is somewhat generic in a sense that it can be represented by any database system of the developer choice.

The database system is represented by three major sections:

- Overall System usage
- Membership Registration usage
- Equipment Check in/out usage

### **3.2.1 Overall System usage**

3.2.1.1 Table name: Staff Member

Column attributes: Staff ID  
Password  
Privilege  
Staff Last Name  
Staff First Name  
Staff Middle Initial

Description:

This table will store all staff members in the system. The privilege shall determine the level of access to AMEMS that is available to the user. All staff members shall have a unique staff ID. This will be used as a login ID along with the password for logging into the system before a user can access the AMEMS functionality.

### **3.2.2 Membership Registration usage**

3.2.2.1 Table name: Membership Members

Column attributes: Member Name  
Address  
City  
State

Zip Code  
Phone number  
Email Address  
Spouse Partner Name  
Membership Start Date  
Membership End Date  
University Name  
Locker ID  
Membership ID  
Membership Fee  
Payment Method  
Membership Type  
Locker Term  
Partner ID

Description:

The table holds all membership information. Unique membership IDs are assigned to members upon registering. The partner ID is given when adding a partner along with membership registration. The Locker ID and term will determine the availability of the locker to the member. Membership fee and payment type are identified for future reference when generating a membership receipt after successfully registering a membership.

3.2.2.2 Table name: Lockers

Column attributes: Locker ID  
Membership ID  
Locker Number  
Locker Type  
Locker Comment

Description:

The Locker ID is unique. Each locker has a locker type and locker number of unlock code. Locker comment is meant for recording maintenance information as needed. The Membership ID associated with the locker serves as an indication of whether the locker has been rented out or not.

3.2.2.3 Table name: Basic Cost Name

Column attributes: Cost Name  
Is Locker

Description:

This table stores the entire cost name that is associated with basic cost. The cost name is unique; deletion of cost name will result in deleting basic cost information related to it. Another attribute within this table represents the parameter to determine whether or not the cost name is meant for locker only.

3.2.2.4 Table name: Basic Cost

Column attributes: Cost Name  
Cost Term  
Cost Price  
Partner price

Description:

This table provides a level of customization to cost information tied directly to membership and locker. This table serves a dual purpose: managing the cost information for both memberships and lockers. Each cost shall have a unique cost

name and cost term. Cost price indicates the membership price information; on the other hand, partner price indicates the additional cost associated with membership when a partner is added. The partner price information however will not be populated when it's selected to store as a locker.

### **3.2.3 Equipment Check in/out usage**

#### 3.2.3.1 Table name: Equipment Type

Column attributes: Equipment Type Name  
Equipment Type Description  
Allow Multi Item Check Out.

Description:

Every equipment consists of a type thus allowing the user to further categorize equipment in inventory and better arrange them. Equipment type is unique to the system. A brief description or comment can be assigned to the equipment type to put information regarding the equipment type for future reference. Furthermore, each equipment type has an attribute to determine if multiple items of the same type are allowed to be checked out multiple times. This will provide customization capability to users to create the equipment type desired.

#### 3.2.3.2 Table name: Equipment Infos

Column attributes: Equipment Type  
Equipment ID  
Equipment Description  
Equipment Availability For Rent  
Equipment Associate Group  
Equipment Name

#### Description:

This table keeps the equipment info related to a specific equipment type. The equipment ID and name are unique to the system. As a rule of thumb, no two equipment can have the same name or ID. This will enhance the equipment search capability. In addition, each piece of equipment has a status for explaining the availability, indication on whether it's associated with team/ group equipment and a brief description to capture information regarding the equipment itself.

#### 3.2.3.3 Table name: Equipment Check In And Out

Column attributes: Membership ID  
Check In Staff ID  
Check Out Staff ID.  
Equipment Type  
Equipment ID  
Equipment Associate Group  
Equipment CheckOut Date and Time  
Equipment CheckIn Date and Time

#### Description:

This table keeps a history of equipment check out and check in information. This information later will be gathered to calculate the number of usages and to generate a statistical report. This table will be shared by the equipment check in and check out process. In each process, the check in or check out date and time are logged into the table for future reference along with staff on duty ID. It's worth mentioning that team equipment is treated as individual equipment during the check in or out process.

#### 3.2.3.4 Table name: Equipment Group Infos

Column attributes: Equipment Group Name  
Equipment Group Description  
Equipment Group Availability for Rent

#### Description:

This table keeps track of all team equipment that was created when grouping 2 or more pieces of equipment together. Each team or group has a name that is unique to the system. Team equipment is treated as individual equipment and shall get checked out as a whole that includes all equipment associated with the team. The status explains whether the team is available to be checked out or not or whether it's out on maintenance.

### **3.3 Main Application**

Figure 3.2 provides the detail of the class diagram of the application. The detail of each class is given in the design document.

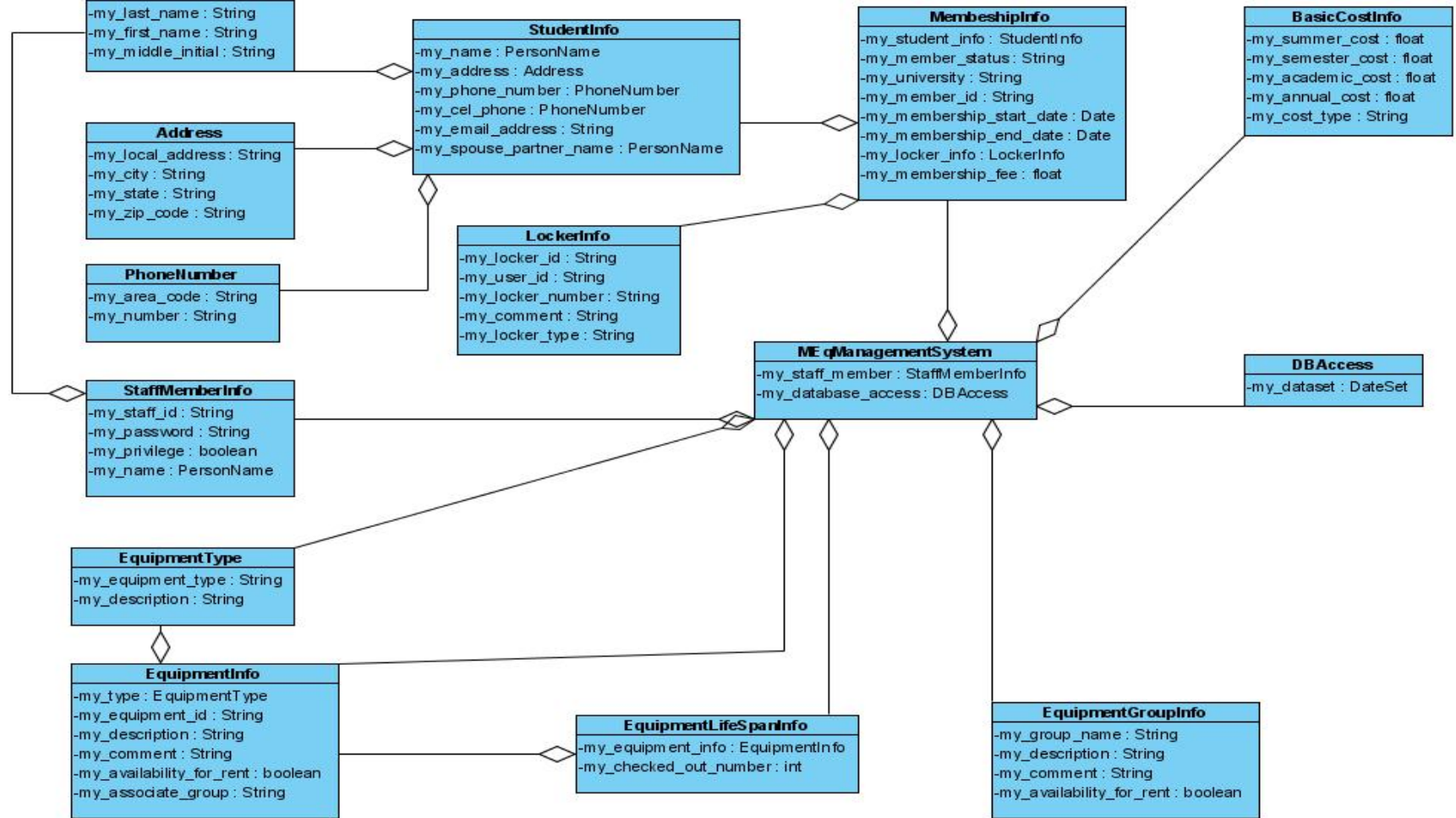


Figure 3.2 UML Class Diagram of AMEMS

The UML diagram [8] given above is created through a free software tool downloaded from the internet via visual paradigm website [7].

The AMEMS application consists of four major components. These components are: equipment inventory management, equipment check in and out, membership management system, and receipt and report generation. In addition to these core components, the application comes with a login mechanism for security purposes, a locker and membership cost customization and equipment team customization. The tables given below describe the functionalities coexisting in each section.

**Table 3.1 Administrative functionalities.**

Module Name	Functionalities
Login	<p>Handle all staff members login. This function will also log the time staff was on duty. The staff information shall display in the membership receipt upon membership registration and equipment check in and out.</p> <p>Upon login, the staff member on duty are displayed on screen to notify the login status and the privilege of the staff member currently held. The privilege level determines the level of access in AMEMS.</p>
LogOut	<p>Logout of the staff member from application. This function logs out the user from AMEMS, returning the user back to the initial screen.</p>
Staff Member Registration	<p>Provide an interface to enable user to register new staff member to the system. Add, modify and delete functions are available through this interface. Staff member privilege level can be assigned via this interface.</p>

	<p>In addition, a brief profile of staff member are made available through a list. User can bring up the list to search through a particular pre-existing staff member in the system.</p>
<p>Basic Cost Info</p>	<p>Allow user to customize basic cost information that is of interest to the user in relation to locker, partner and membership registration. Information regarding cost of registration on a specific term can be customized via this module.</p> <p>Before cost information can be created, user must first create a cost name to associate this cost information.</p> <p>User will be able to go through the list previously created and review pre-existing basic cost information created via the list.</p> <p>Add, delete and modification of the basic cost information are available through this module as well.</p>
<p>Basic Cost Name</p>	<p>The cost name are associated with particular cost information mentioned above. The cost name can be assigned to locker or membership cost.</p> <p>User will be able to go through the list previously created and review pre-existing basic cost name created via the list.</p> <p>Add, delete and modification of the basic cost name are available through this module as well.</p>

Exit Application	This function terminates the program. The staff member who is currently logged in will be logged out as a result of this action; database connectivity terminates at this point.
------------------	--

**Table 3.2 Equipment Management Functionalities**

Module Name	Functionalities
Equipment Type	<p>Allow user to specific the type of equipment in inventory. This will enhance user search ability later on. All equipment type names are unique to ensure that no two equipment of the same type can exist in the system.</p> <p>User can further customize the detail of the equipment type by specifying whether to allow this particular type of equipment to be checkout by one user multiple times.</p> <p>User will be able to go through the list previously created and review pre-existing information created via the list.</p> <p>Add, delete and modification of the information are available through this module as well.</p>
Equipment Info	<p>Before equipment information can be created, user must first create an equipment type to which equipment information can be assigned. Equipment information consists of a type, availability status, equipment ID and name.</p>

	<p>The equipment ID and name shall remain unique. Hence this particular information cannot be modified.</p> <p>User will be able to go through the list previously created and review pre-existing information created via the list.</p> <p>Add, delete and modification of the information are available through this module as well</p>
Equipment Team Info	<p>Equipment Team Info allows user to group several pre-existing equipment information into one team. Each team has a unique name and availability status.</p> <p>The team name is unique, hence cannot be modified. The team can only be formed by combining several equipments that is currently available. Pre-filtering process is performed to filter out equipment that is not available for rent. Once equipment team has been formed, all equipments within the list are reserved for the team and can only be rented out as a team. Thus team equipment cannot be rented out individually.</p> <p>User will be able to go through the list previously created and review pre-existing information created via the list.</p> <p>Add, delete and modification of the information are available through this module as well.</p>

Locker Info	<p>Locker information can be categorized into multiple types by customizing it through basic cost name and cost information. Due to the fact that each locker is tied to a specific rental cost, locker information is closely related to basic cost information as well.</p> <p>Before locker information can be created, the user will need to create a basic cost name and cost information that will be associated with the locker info.</p> <p>Each locker comes with a locker code number for its unlock key. In addition, each locker shall have locker ID which is unique to the system, thus cannot be modified.</p> <p>Locker can be assigned to a particular membership; hence membership ID will be associated with the locker information when it's registered to a member. The membership ID is for reference purposes and thus cannot be modified.</p> <p>User will be able to go through the list previously created and review pre-existing information created via the list.</p> <p>Add, delete and modification of the information are available through this module as well.</p>
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**Table 3.3 Membership Management**

Module Name	Functionalities
Register New Membership	<p>This process handles the membership registration. Membership registration consists of membership term information, locker registration, partner registration and membership cost information.</p> <p>The membership partner and locker information are linked to the membership term and hence the rule of expiration apply to both.</p> <p>A preview of the membership receipt is made available upon completion of membership form. The membership ID will not be assigned at this point and hence receipt preview will not have this information. Print capability is made available at this point.</p> <p>Once the user has registered member into the system, new ID are assigned automatically by the system. Membership receipt will show this information once the member is recorded in the system.</p> <p>Smart filtering system will be available for assigning locker information to a particular membership. Only available lockers will be shown to the user, thus reducing the need to search for available item. Cost calculation will be done automatically because cost information was made available in the system. User reserves the right to change the final cost if desired.</p>

	<p>User will be able to go through the list previously created and review pre-existing information created via the list.</p>
<p>Delete/ modify existing Membership</p>	<p>This will allow user to make modifications and deletions to memberships in the database. The membership ID is unique hence this information cannot be modified.</p> <p>Smart filtering system will be available for assigning locker information to a particular membership. Only available lockers will be shown to the user, thus reducing the need to search for available item. Cost calculation will be done automatically because cost information was made available in existing system. User reserves the right to change the final cost if desired.</p> <p>User will be able to go through the list previously created and review pre-existing information created via the list.</p> <p>Delete and modification of the information are available through this module as well.</p>
<p>View membership receipt.</p>	<p>Once membership has been recorded into the system, user can retrieve the receipt of a particular membership at any given time. A list are generated to the user to select the desired member and view receipt.</p>

	<p>Printing capability is made available at this view. Locker information, partner membership, membership period, term and cost information are displayed on the receipt. User can further save the receipt into an electronic document in PDF format for convenient viewing on other PCs as well.</p> <p>User will be able to go through the list previously created and review pre-existing information created via the list.</p>
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**Table 3.4 Report Generation and Equipment list look up.**

Module Name	Functionalities
Report Generation	<p>Report generation consists of several options as listed below:</p> <ul style="list-style-type: none"> <li>Equipment Type Report Based on Date Range</li> <li>Equipment Type Report Based on Specific Date</li> <li>Equipment Type Life Span Report</li> <li>Individual Equipment Type Life Span</li> <li>Membership List Report on Specific Date</li> <li>List of Equipments Not Check In</li> <li>List of Equipments Checked Out by Student on Specific Date</li> </ul> <p>User will be able to go through the list previously created and review pre-existing information created via the list.</p>

**Table 3.5 Equipment Check in and Check out operations**

Module Name	Functionalities
Student or Member Lookup	<p>This module provides a search capability for user to quickly lookup a student or member in the system. The search criteria will be on the student last name, phone number or ID. The result of the search are displayed in a list for user to select.</p> <p>Only one selection can be made at a time. Student or member information will be displayed on screen once a selection has been made. This will inform the user of the selected person and membership status.</p> <p>Membership status on whether the membership is active or expired will be shown on screen. If the membership has expired, the particular student or member cannot be selected; the system will not allow the student or member to proceed forward to equipment check out.</p>
Equipment Check Out	<p>Equipment check out process involves creating buttons representing all available equipment types to be checked out later by member.</p> <p>User will have the ability to customize the buttons to specific equipment types. The buttons are created during run time and the button size can be manually adjusted according to the window frame size.</p> <p>Smart filtering process is available to filter out</p>

	<p>unavailable equipment. Only available equipment can be checked out.</p> <p>User will be able to go through the list previously created and review pre-existing information created via the list.</p> <p>The check out process also includes team equipment checked out. The team equipment can be customized when creating team equipment in equipment management functionalities mentioned in previous module.</p>
Equipment Check In	<p>Equipment check in process involves creating buttons representing all available equipment types to be checked in later by member.</p> <p>The buttons are created during run time and button size can be manually adjusted according to the window frame size.</p> <p>Smart filtering process is available to filter out unavailable equipment.</p> <p>User will be able to go through the list previously created and review pre-existing information created via the list.</p> <p>The check in process also includes team equipment checked in. The individual equipment or team</p>

	equipment check in process can only be done on equipment previously checked out.
--	--

### **3.4 AMEMS Graphic user Interface**

The graphic user interface for this program is developed using Microsoft Visual Studio 2005 development environment with .NET framework version 2.0 technology. The Visual Studio package comes with full support of several programming languages; however C# is the language of choice here for the whole development [4]. The AMEMS consists of a main window frame followed by a series of panels that can be invoked from within the main window frame. A window frame is the common naming used in C# development for representing window screens just like other programs available in Windows operating system.

Inside the typical window frame, a list of common functionalities such as button presses, menu bar, status panel, list box, etc. can be placed to create user desired functionalities. AMEMS uses all these tools to generate a more user-friendly environment to help enrich user experience when using the program. In general, all components mentioned are referenced as controls in the C# environment. Each control can be configured to have a specific behavior and appearance via the development environment. Controls can be added, deleted or modified using a “toolbox” from within the development environment system [9]. Controls from the “toolbox” can be inserted into the window frame to create a meaningful application. The process of creating the window frame is called design panel. The design panel of C# within the visual studio environment [3] further allows the user to customize all components to specific needs. A series of window frames are created by re-using the controls from “toolbox”.

Another use of the GUI is when generating a report for equipment information or receipt printing. The process of creating these report screens is done through Crystal Report technology. Microsoft Visual Studio has incorporated Crystal Report by Business Object [6] into a package hence enabling a programmer to benefit from using it to create and generate reports that are appealing to the users' eye. AMEMS uses this technology not only in creating various reports but generating receipts for membership and displaying statistical information through its graphing mechanism. The information on equipment usage can further be presented to the user in a bar graph format to enhance user experience and to help user understand and digest the information effectively. The Crystal Report incorporated with the Visual Studio package is based on crystal report version 10 technology. In order to benefit from this, the PC will have to install crystal report viewer. This will enable Crystal Report's report to be viewed in that particular PC.

## 4 Software Walkthrough on AMEMS

The goal is to have AMEMS replace the current labor intensive operation and migrate all information regarding equipment check in or check out and membership registration information into a database system that can be maintained easily and effectively.

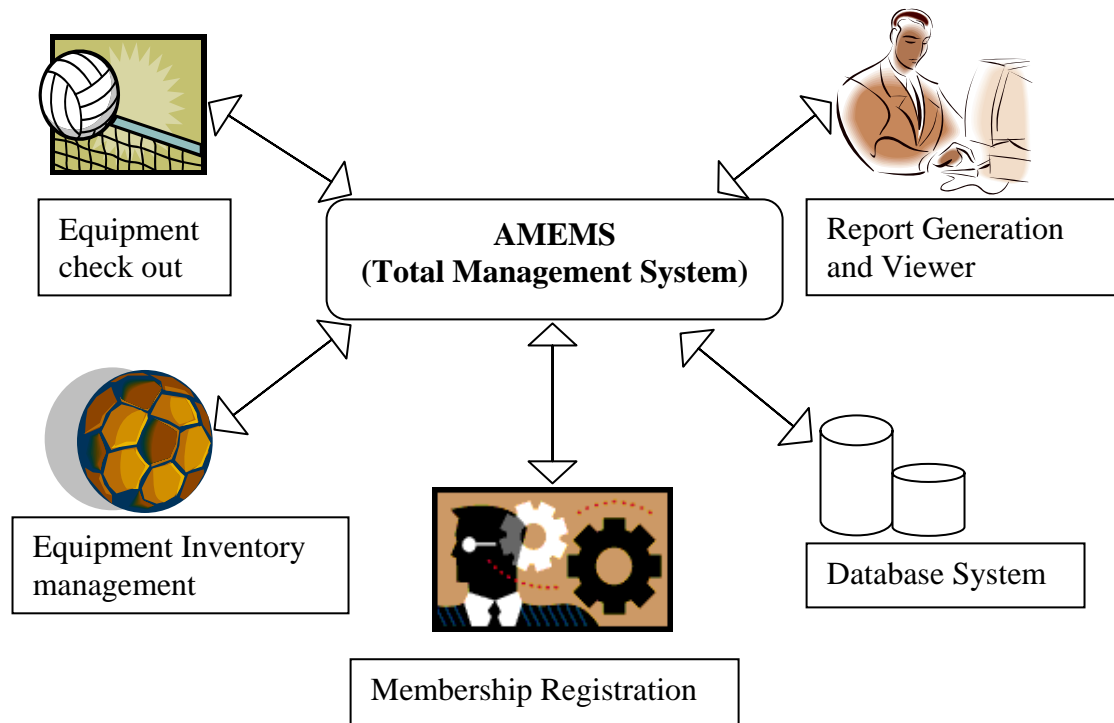


Figure 4.1 AMEMS Core applications for REC

### 4.1 AMEMS Toolset Overview

Overall AMEMS is a management tool designed to satisfy the REC sport department's needs in managing their system. One of the main concerns is customization support capability of the tool.

As the inventory grows, the cost of items will change, equipment inventory will quickly be replaced with new items every year and membership registration will grow as well. As a result, upkeep is very important to ensure the AMEMS can handle the rapid changes of the inventory and be able to scale up. The remedy to this problem is to have a great degree of customization capability built into the system.

#### **4.1.1 Staff Registration and Login**

This tool is used to login to the system before starting to use the software. Addition, deletion and modification to staff member can only be done by a user with supervisor privilege. The staff registration process will require the user to input new id, name and privilege of the new user; user cannot modify the ID once created as this is unique to the system.

#### **4.1.2 Item Cost Customization Tool**

This feature set provides the capability for user to customize a particular item name and cost. The name can be associated with locker or membership and hence gives the user the freedom to make changes to their cost of locker or membership. Each semester or term of school year the cost associates with membership or locker will change and hence there is a need for the cost to be updated accordingly.

### **4.1.3 Inventory Management Tool**

All equipment or items that will be rented out as a service provide by the REC sport department. All sport equipment managed in two separate locations, namely the Recreational Eagle Center and Mitchell Hall. In addition, locker rental is also considered as an asset of rental as well. The equipment and locker can further be broken down into different types of categories to distinctively represent each individual item.

In order to meet the high demand of the customers in the REC sport department, team equipment creation is necessary to satisfy certain events such as tournaments and competitions that are held from time to time. Groups and teams of sports members will ask for sets of equipment of certain sports events and hence there is a need to create team equipment. This tool set will provides the capability to enable a REC staff member to further customize a list of equipment from existing inventory to group together in order to create a team equipment. Team equipment are checked out as a set and checked in as a set.

### **4.1.4 Membership Registration Management Tool**

Registration of membership will be handled separately from the equipment check in and check out process. The process is treated differently from regular equipment check out. As a rule of thumb, all users desire to participate in using the service or equipment in the REC sport department are a member of the department. By default, students registering in UWL are automatically considered as members; membership for the REC sport department is granted automatically. As for faculty, partner of faculty and partner of student are not considered as members and so they are required to register with the REC separately in order to get the membership required to access into the services provide by the REC sport department. The

registration process is straightforward and recorded into the system seamlessly. The term selection and period of membership are recorded in the receipt of the membership upon submitted to the system. In addition to membership registration, locker assignment and partner information added to the membership are included as part of the membership registration as well.

Receipt viewing and printing capability are incorporated into this tool to provide staff members with the ability to back track membership records for future reference and print out a receipt for record keeping of their customer as well as paper document filing for internal usage in the REC sport department file system.

#### **4.1.5 Report Generation Tool**

The report generation tool is important in order to collect the statistics from daily operation. The reports generated inform the user about the usage of the equipment and other information of value to the user. There are a total of seven reports that can be generated by AMEMS, the list is shown below:

- Equipment Type Report Based on Date Range
- Equipment Type Report Based on Specific Date
- Equipment Type Life Span Report
- Individual Equipment Type Life Span
- Membership List Report on Specific Date
- List of Equipments Not Check In
- List of Equipments Checked Out by Student on Specific Date

In general the report is divided into three different categories: equipment type, membership and equipment checkout. Each report can further be customized to specify the date, equipment type or specific equipment.

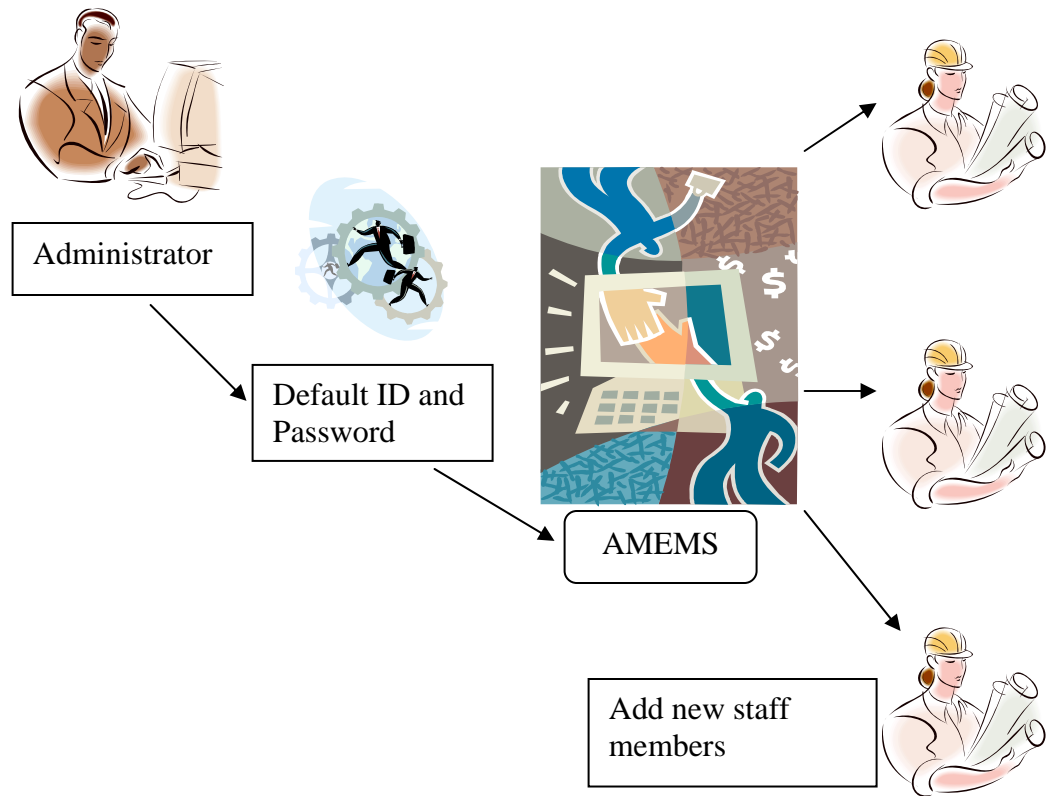
#### **4.1.6 Equipment Check out and Check in management Tool**

The check in and check out process involves several steps and procedures that are in place to ensure rules are enforced during the checkout process and to ensure the integrity of the equipment inventory. This tool will handle the tedious procedure of equipment check out and check in process. In addition, it also enforces rules to make sure each equipment checked out are in place and that no multiple items can be checked out twice to different users and no user can check out an item more than once after checking out an item.

Knowing that rules on different equipment are controlled differently, equipment customization is crucial in determining which equipment can be or not desired to check out multiple times per session. User can further customize each equipment type to specify the attribute to allow multiple users to check out the item for more than once.

## **5 AMEMS Interaction**

The software has a login mechanism to introduce another layer of security to the system. The idea is to make sure and record the user usage of the system and is responsible for monitoring the process during the period on duty. Thus the first step in using the AMEMS is to have user first login to the system. The login process is pretty straightforward, a default login ID and password will be given by the system. It comes with supervisor privilege to allow user to have full access to all features and functionalities. The purpose is to enable a privileged user to take control of the system and create new user name, ID and password later on. The default ID can then be able to be purged by the administrator for the system. It's the responsibility of the user to decide who will get to use the system and assign user privilege accordingly.

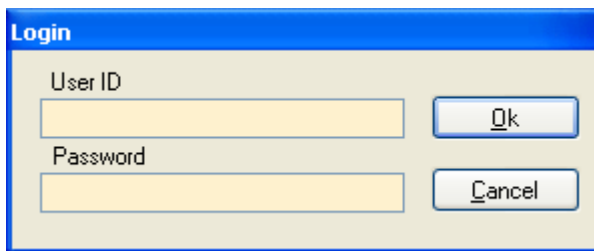


**Figure 5.1 Staff Member Registration**

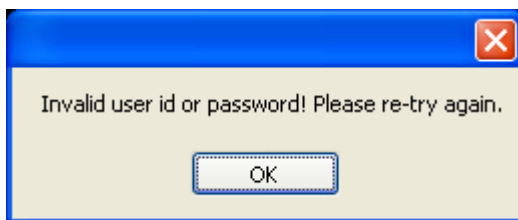
The default password and ID will be given to the administrator during installation. The administrator will be responsible for creating and deleting new or existing staff member plus granting the privilege level to staff member. The default password and ID can be purged later after creating as least one new password or ID for staff members with the privilege level of supervisor.



**Figure 5.2 Entry Screen to AMEMS**

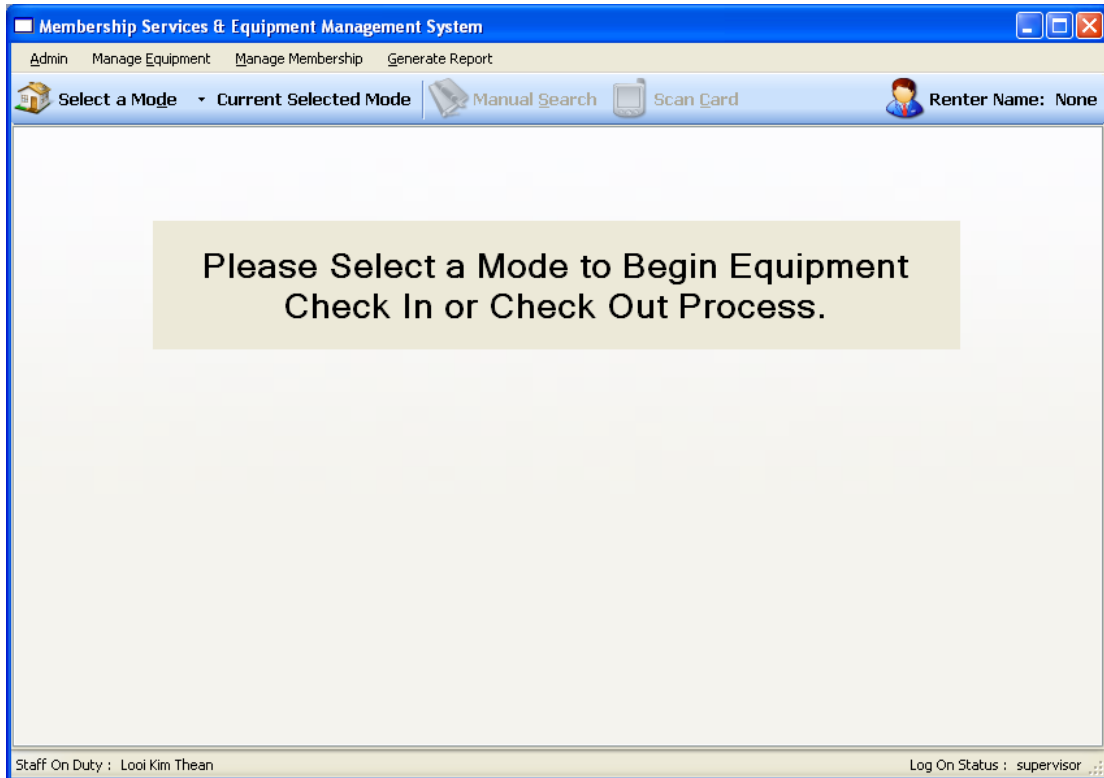


**Figure 5.3 AMEMS Login Screen**

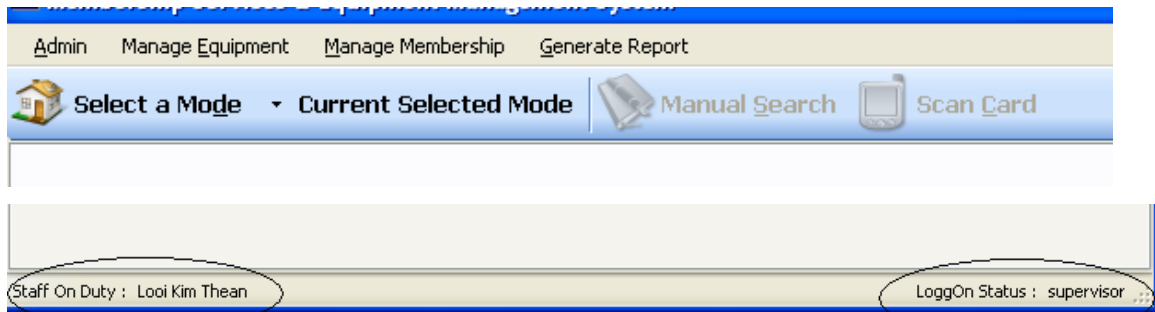


**Figure 5.4 Error Screen Prompt for Retry**

Upon a successful login, the user or staff name will appear on screen to notify the user of login status. All features on menu bar will be enabled based on the privilege level given to the particular staff member. Figure 5.5 shows an example of a successful login screen with the name and log on status.



**Figure 5.5 Successful Login**



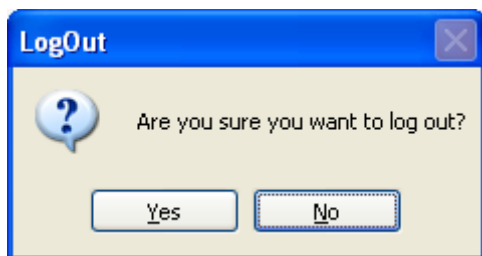
Indicates the staff's name on duty

Indicates the staff's privilege level

**Figure 5.6 Indication of Login Information**

### 5.1.1 Log out

At any given time, user can log out of the system. At this point, the status bar will be updated to default back to initial entry and user are logged out from the system. Before the user is logged out, the user are prompted for confirmation to ensure this process wasn't done unintentionally.

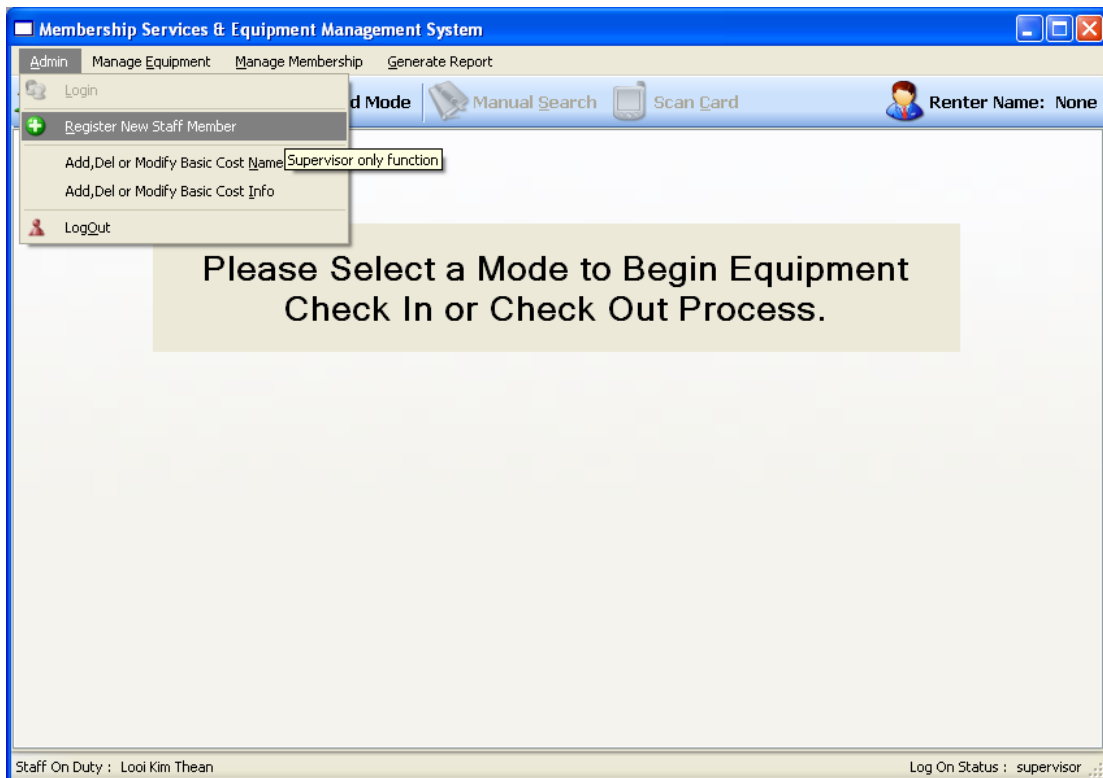


**Figure 5.7 Confirmation screen for logging out**

Upon log out, a user is brought back to initial entry screen. Refer to **Figure 5.2 Entry Screen to AMEMS**.

## 6 Staff Member Registration

Upon successful login to AMEMS using the default ID and password provided, user may go into the staff member registration screen to add, modify or delete an existing staff member. In order to enhance the user's experience in using the staff member registration process, a list of options is given to user to select the desire operation. As mentioned earlier, a privileged user can add new staff member, modify or delete an existing staff member.



**Figure 6.1 Staff Member Registration**

Once this feature is selected, AMEMS will bring up the staff member registration screen. Upon entry, all input fields will be masked and disallow user from new entry until a valid operation is elected.

Staff ID	Staff Name
Jane	Lai Chun Chow
Nato	Nathan Barnhart
thekim	Looi Kim Thean

Please Select an Operation

- Please Select an Operation
- Add New Staff Member
- Modify Staff Member
- Delete Staff Member

First Name:

Middle Intl:

Login Information

User ID:

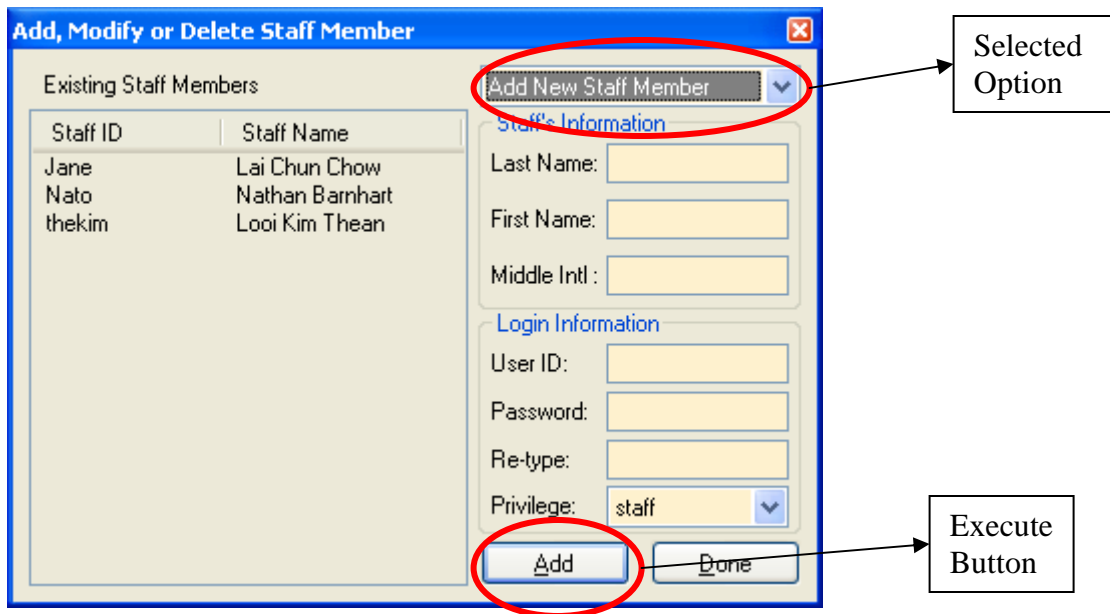
Password:

Re-type:

Privilege:

**Figure 6.2 Addition, Modification and Deletion Screen for Staff Member**

The entry screen is pretty self explanatory; it consists of a list of existing staff ID and name to inform user of current active staff member currently registered with the system. A combo box on the top right displaying all current available options for the operation that can be executed within this screen and input fields associated with the staff member registration process.



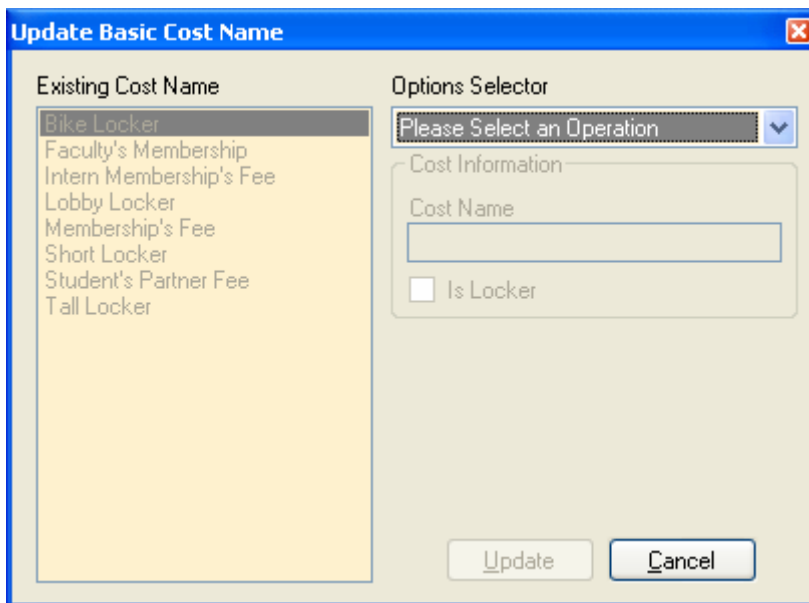
**Figure 6.3 Add New Staff Member**

After filling out all the require fields, a user can execute the operation by pressing the “Add” button. At this point, the new staff member is registered into the AMEMS. The button shown above will change functions according to user selected option. For deletion and modification, the user will have to use the “Delete” and “Update” buttons respectivly. The selected option dictates the behavior of the input fields. Some fields will be enabled or disabled based on the selected options. For instance, the list on the left will be disabled during add new staff member. On the other hand, it will be enabled for member modification and deletion process. This is to allow the user to select the desired staff member from the system to modify or simply purge away.

Having a more interactive screen helps the user in organizing and enhances the user experience towards user friendly user interface. For consistency sake, the same procedures are used across all features and functionalities.

## 7 Customization tool set for basic cost name and Information

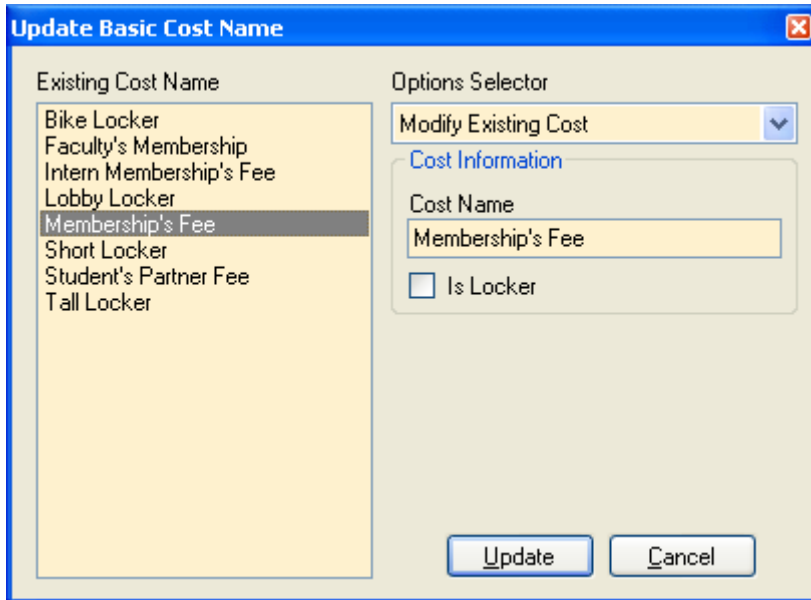
Basic cost name and information are used to provide a certain degree of customization toward locker and membership registration. Cost associated with lockers and memberships gets altered frequently and hence require a tool set to change this information. Given this feature, the user shall be able to specify their membership type or locker type at will and later assign cost value to the newly created type. Additionally, further detail cost information associated with this cost type can be defined separately during the creation of cost information.



**Figure 7.1 Basic Cost Name screen**

In order to create cost information for a specific type, the user must first create a cost name to represent the type of cost. This can be easily done so by going through

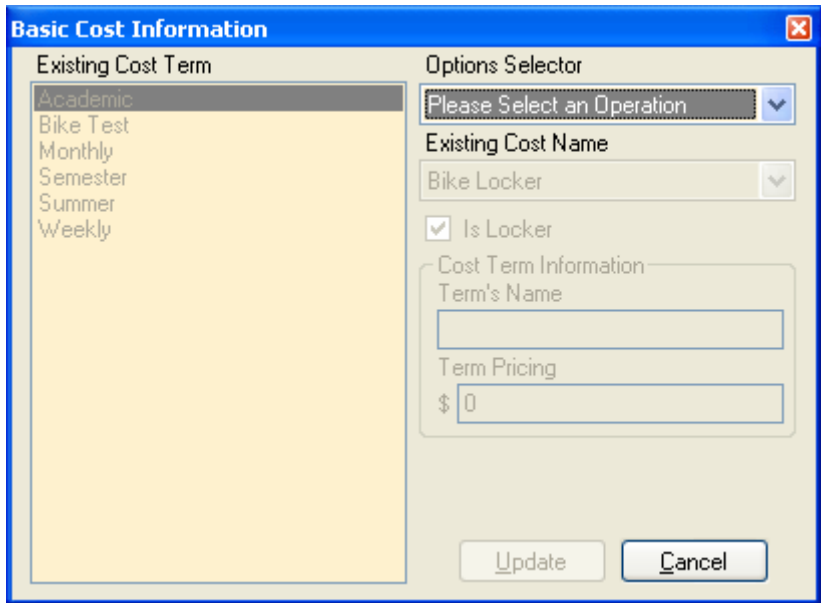
basic cost name screen and creating a new cost name. Furthermore, the user can also modify or delete an existing cost name.



**Figure 7.2 Basic Cost Name Update**

Notice that each cost name has an attribute to specify whether the cost is a locker or not. Cost name can be associated with either a locker or membership. This information will later be used in the membership registration process to determine locker fee or membership fee.

Upon completion of creating new cost name, the user shall proceed to creating new cost information to associate with this newly created cost name. This again can be easily done by bringing up the basic cost information screen.



**Figure 7.3 Basic Cost Information screen**

The cost information shall consist of a term name and term price in addition to the cost name. The cost name appears in the combo box is a copy list of previously created cost name from basic cost name creation screen. When the desired cost name is selected, the screen will also indicate whether the name is associated with locker only or not. If the cost is associated with a locker, the screen behavior is shown as below.

The screenshot shows a dialog box titled "Basic Cost Information" with a close button in the top right corner. It is divided into two main sections: "Existing Cost Term" and "Options Selector".

- Existing Cost Term:** A list box containing "Academic", "Monthly", "Semester", "Short Test", "Summer", and "Weekly". "Academic" is selected.
- Options Selector:**
  - "Add New Cost": A dropdown menu.
  - "Existing Cost Name": A dropdown menu with "Short Locker" selected.
  - "Is Locker": A checked checkbox.
  - Cost Term Information:** A sub-section containing:
    - "Term's Name": An empty text input field.
    - "Term Pricing": A text input field containing "\$ 0".

At the bottom of the dialog are two buttons: "Add" and "Cancel".

**Figure 7.4 Locker Cost Information**

Otherwise if the cost name is associated with membership, the screen behavior is described as below.

The screenshot shows a dialog box titled "Basic Cost Information" with a close button in the top right corner. It is divided into two main sections: "Existing Cost Term" and "Options Selector".

- Existing Cost Term:** A list box containing "Monthly" and "Weekly". "Monthly" is selected.
- Options Selector:**
  - "Add New Cost": A dropdown menu.
  - "Existing Cost Name": A dropdown menu with "Intern Membership's Fee" selected.
  - "Is Locker": An unchecked checkbox.
  - Cost Term Information:** A sub-section containing:
    - "Term's Name": An empty text input field.
    - "Term Pricing": A text input field containing "\$ 0".
  - Partner's Cost Information:** A sub-section containing:
    - "Term Pricing": A text input field containing "\$ 0".

At the bottom of the dialog are two buttons: "Add" and "Cancel".

**Figure 7.5 Membership Cost Information**

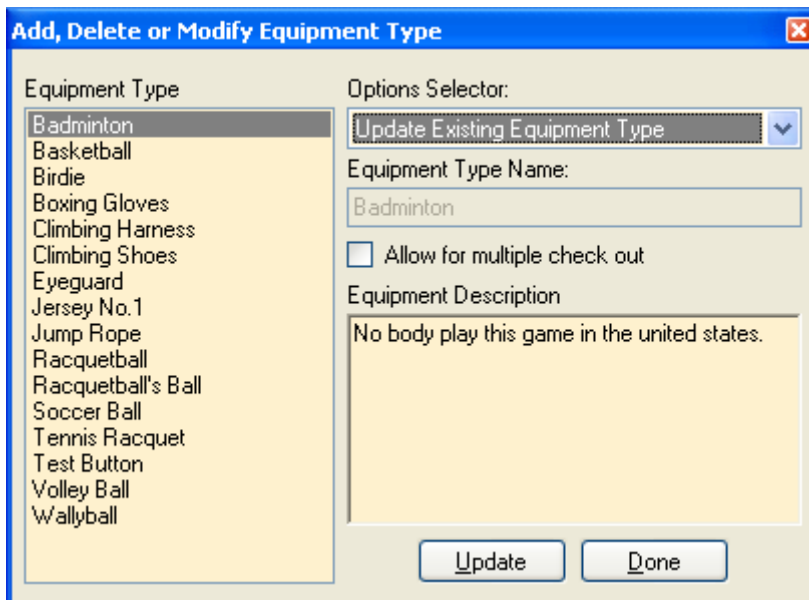
In addition to this the user can choose to modify or delete existing cost information from AMEMS. The membership cost presents additional partner cost information that is not available to locker. This information is used during membership registration process when the user adds a partner to a membership.

## 8 Inventory Management Tool

In order to accommodate all equipment in the inventory, a structural and well organized system needs to be in place.

### 8.1 Add New Equipment Type and Information

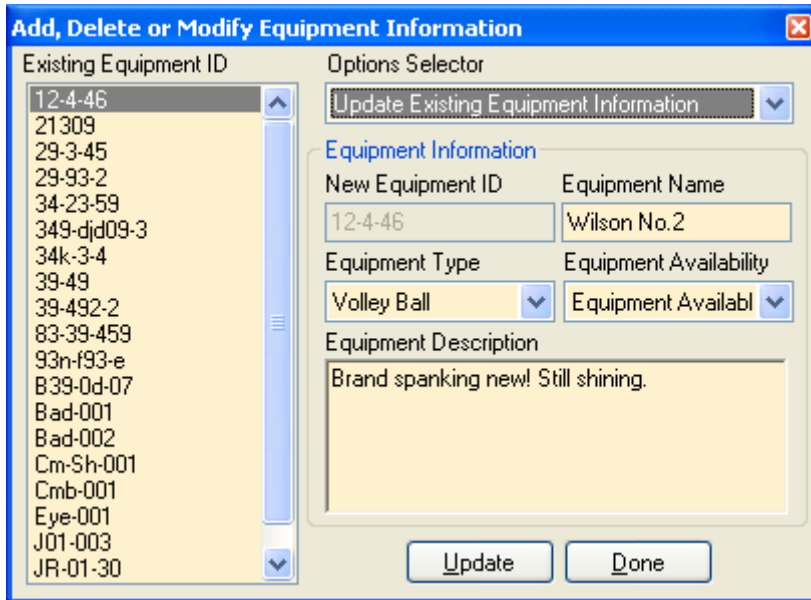
Each equipment has a type that is unique to the system. Furthermore each type shall hold the attribute to define if the specific equipment type can be checked out multiple times. All these are handled in add, delete or modify screen of equipment type.



**Figure 8.1 Add, Delete or modify Equipment Type screen**

New equipment type can be created from this screen. The user will have the ability to delete and update information related to equipment type such as the attribute

and description. Assigning specific equipment information to the relative type is trivial with using add, delete or modify equipment information screen.



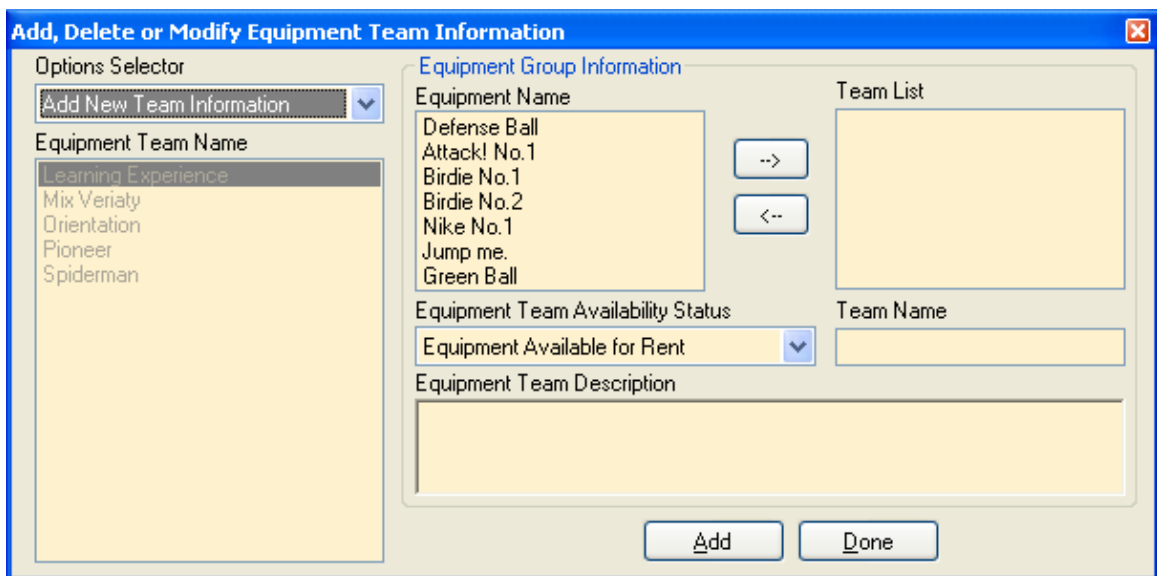
**Figure 8.2 Add, Delete or modify Equipment Information Screen**

Each equipment shall have a unique ID and equipment name to accurately identify the specific equipment in inventory. Equipment type is derived from the equipment type table in the database. This will be the equipment type that user specified earlier in the process. No new equipment information is added if equipment type does not exist. The attribute of equipment availability is to inform the user of the current equipment status. There are three possible states that equipment can be in: Equipment Rented, Equipment Available for Rent and Equipment is being repaired. In order to assist the staff member to better handle the individual equipment, these settings are in place to clearly identify each equipment status.

## **8.2 Team Equipment Customization**

Creating new equipment type and adding new equipment into AMEMS inventory is one thing but organizing team equipment and customizing a group of equipment in team equipment is another. The requirement of creating new team equipment requires that there must be a list of available equipment items existing in the system. As mentioned earlier, the availability status of each equipment will determine if the particular equipment can be associated with team equipment or not.

Assuming we have a group of players from UWL that is going to hold a sports events in the Recreational Eagle Center. The group consists of 50 players and is going to separate in teams of five. In this case we shall have 10 teams playing against each other. Each team of course will be identified by a team name and will have their own jersey and equipment for the sport event. The AMEMS will enable the staff member to create the team equipment ahead of time in order to help organize for the sport event. By naming each team and creating team equipment to associate with the team, the equipment can be reserved for the event without worry about getting check out accidentally by any other member.



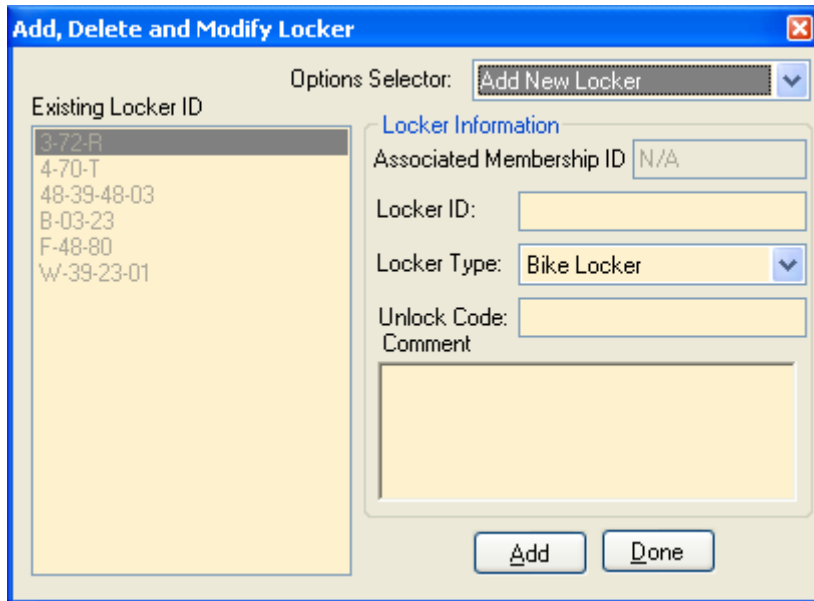
**Figure 8.3 Add, Delete or modify Equipment Team Information Screen**

The add, delete or modify equipment team information screen will enable the staff member to assign equipment to be associated with a team ahead of time to help manage the up coming event systematically. Team equipment information is similar to equipment information, it consists of team name, a brief description for the team and status to inform user of the availability. The team name is unique to help identity the team equipment accurately. Notice that the one thing that differentiates equipment information from team equipment information is the equipment list in the team. Each team shall have a list of equipment that must be greater than two. Otherwise it won't make sense to create team equipment at all. Staff members have the ability to create, mix and match any equipment that is available in the system. Once selected, simply assign a team name and add it to the database.

Needless to say, staff members will have the ability to go in and update or delete existing team information from the system as well.

### **8.3 Adding Locker to Inventory**

Lockers are part of the inventory in AMEMS and can be assigned to existing members during membership registration. Each locker shall have a unique ID, type and unlock code for the locker. It's worth mentioning that each locker can be assigned to a member and hence the member ID can be associated with a locker.



**Figure 8.4 Add, Delete and modify Locker**

The operation of adding a locker is pretty much identical to adding equipment to inventory. Staff members will have the right to modify or remove existing lockers from AMEMS as well.

## **9 Membership Registration Management Tool**

There are three different functionalities that are tied to a membership registration process, membership registration, locker and partner assignment, and receipt printing. Taking into consideration that membership registration process is important because all services provided by the REC are for members only. Hence keeping a good record of membership information in the REC is crucial for overall process. During the membership registration, user can choose to add locker and or partner to their membership. The cost for the addition will automatically be calculated in the system through the information given in basic cost information called out in *Customization tool set for basic cost name and Information.*

The electronic form given In AMEMS will effectively replace the paper form. Notice that the cost information of the membership can further be altered by staff members at will if the default cost assignment does not apply. This occurs during a rental session for a non-profit organization or a special event to help promote the REC.

**Figure 9.1 Membership Registration Form**

The locker information is retrieved from the data given earlier during locker addition session in **Adding Locker to Inventory**. The same applies for membership type and term information which is given during the process of adding basic cost name and basic cost information in *Customization tool set for basic cost name and Information*.


Furthermore the tool provides the flexibility for staff members to preview the membership receipt before registering any membership. Note that this is done by not assigning a membership number until it's officially registered to the system. For a preview of receipt, the membership ID will be 0. This indicates that the user has not been registered to the system yet. Once the user has registered a member to the

system, the receipt will show the newly assigned membership ID. This ID will be used to identify the particular member during any equipment check out process.

**Receipt Window**

Main Report

**Recreation Membership Receipt** Sunday, November 18, 2007



**REC SPORTS**

**University of Wisconsin-La Crosse**  
**Recreational Eagle Center**

**Phone Number: 608-785-5222**  
**Web Address: www.uwlax.edu/recsports**

**Membership's Information**

Membership's ID: 3	
Member's Full Name: Mo McAlp	
Spouse/Partner's Full Name: baba Ali	Spouse/Partner's ID: 34-59-395-54
Address: 130 rack	
City: Lacross	State: WI Zip Code: 54601
Phone Number: 9298883838	Email Address: dsafdsaf@yahoo.com

**Membership & Locker Information**

Membership's Type: Faculty's Membership	Membership's Term: Semester
Membership's Start Date: Tuesday, October 30, 2007	
Membership's End Date: Monday, December 31, 2007	
Locker Type: Bike Locker	Locker Term: Semester
Locker ID: B-03-23	Locker Code #: 23-45-46-3
Locker Description: Sixth locker.	

**Waiver - Read and Sign**

I understand that all individuals participating in recreational activities at the Recreational Eagle Center or Mitchell Hall do so at their own risk. The university of Wisconsin-La Crosse and the Board of Regents are not responsible for injuries that may occur to the individual participating in any recreational activity. Participation in any recreational activity is on purely voluntary basis. Individuals are encouraged to have a physical examination, adequate health, and insurance prior to participating in all recreational activities. In addition, I will comply with all policies and procedures of the Recreational Eagle Center and Mitchell Hall.

Member's Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Spouse/Partner's Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Payment Method: Payroll Deduction

Membership's Fee: \$ 150.89

Current Page No.: 1      Total Page No.: 1      Zoom Factor: Whole Page

**Figure 9.2 Membership Receipt**

In addition to registering a new member, staff members can back track to existing member to review their information or make modifications such as adding a partner to the membership or assign a locker later on.

Update or Delete Existing Membership's Information

Membership ID

1
2
3
4

Options Selector: Update Membership's Information

**Member Information**

Last Name: McAlp First Name: Mo MI: [blank]  
Address: 130 rack City: Lacross State: WI  
Zip Code: 54601 Phone No. 929 -- 8883838  
Email Add: dsafdsaf@yahoo.com  Add Partner to membership

**Partner Information**

Last Name: Ali First Name: baba MI: [blank]  
Assign ID: 34-59-395-54

**Membership Type and Period**

Membership Type: Faculty's Membership Start Date: 10/30/2007  
Membership Term: Semester End Date: 12/31/2007  
 Add Locker to membership

**Locker Information**

Locker Type: Bike Locker  
Locker Term: Semester  
Locker ID: B-03-23

**Payment Information**

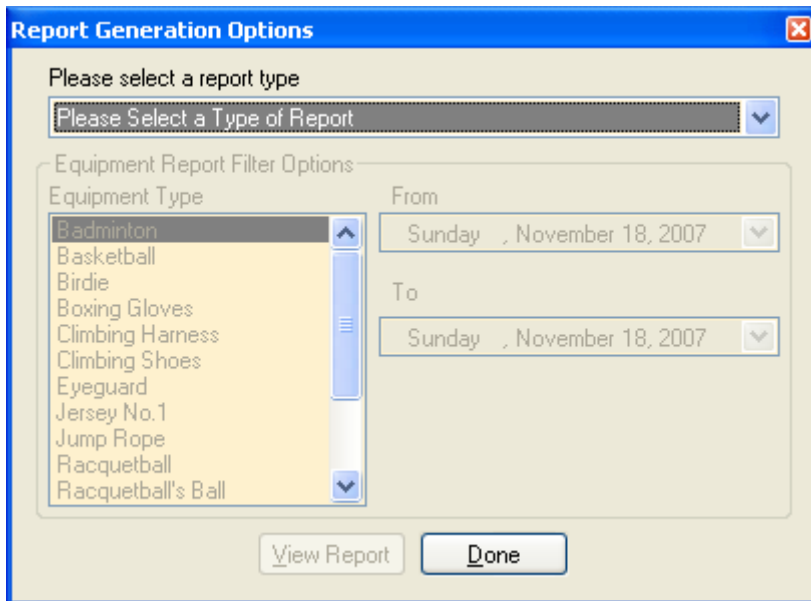
Payment Method: Payroll Deduction  
Membership Fee: 150.89

Update View Receipt Done

**Figure 9.3 update or Delete Existing Membership's Information**

## 10 Report Generation

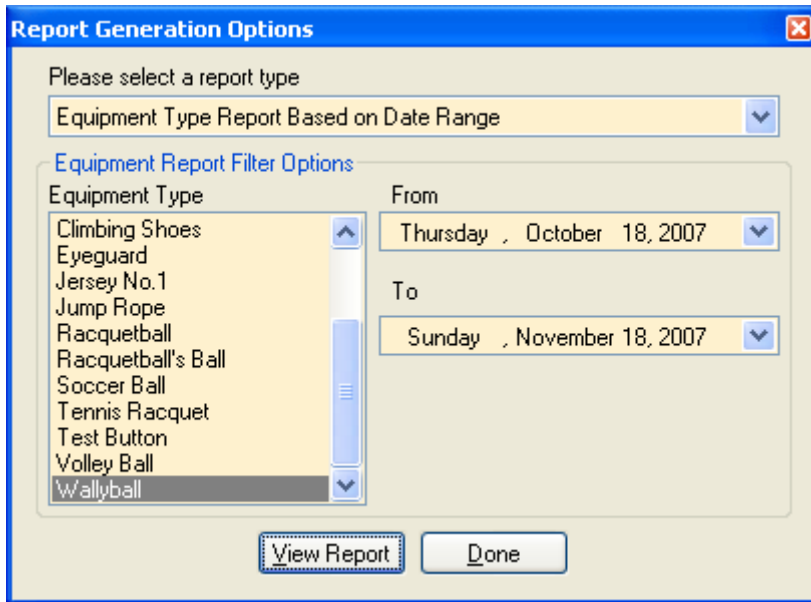
The capability to generate various types of report is beneficial to staff members. This will allow them to further analyze their need in equipment and better manage their inventory. AMEMS provides various report types that are required by the REC sport department. One of the important requirements is to be able to generate statistical reports on equipment type. This information will help the staff member to determine when and what equipment need to be repaired or maintain to ensure longevity usage of the product. This not only saves money in the long term but also ensure safe operation of the equipment to be used by members.



**Figure 10.1 Report Generation Screen**

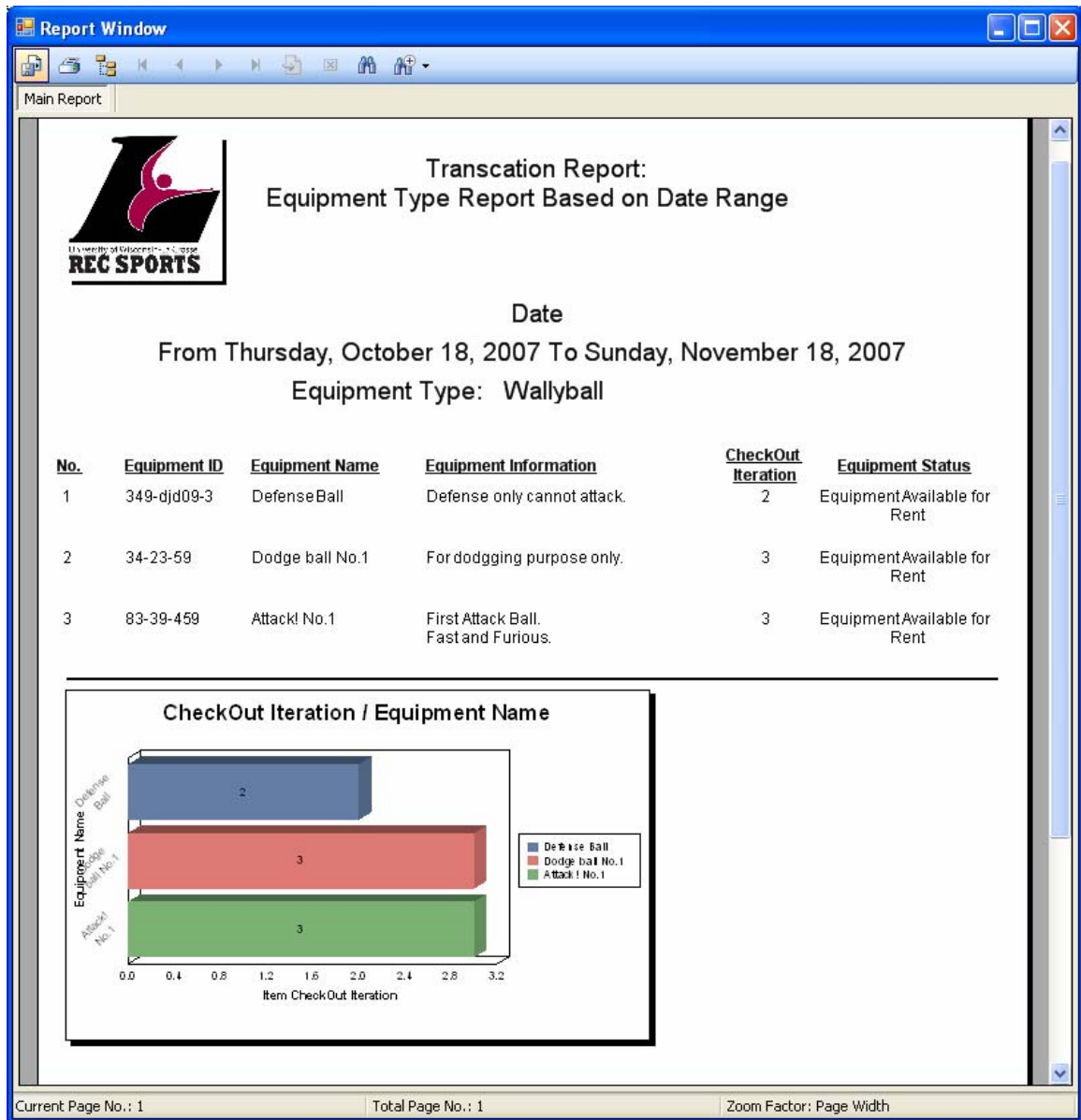
There are a total of seven different types of reports. For simplicity sake, we will go through one of the examples here to given an idea of what the report is going to be like. Please refer to Appendix for all report capabilities.

For simplicity sake, equipment type report based on a specific date range to show the report generated by AMEMS is shown in Figure 10.2. This report will show the list of equipment of the particular selected type on the report plus a graph to show statistics of the usage during this period.



**Figure 10.2 Equipment Type Report with Statistical Graph**

The staff member shall select the desired equipment type from the list given. The list represents the previously created equipment type via **Add New Equipment Type and Information** screen. After specifying the data range information in the screen, the user will then press the view report button to view the report. AMEMS will gather all information required from the database to be factored into the report to be viewed. The result is shown Figure 10.3.



**Figure 10.3 Report Result of Equipment Type**

Note that the graph within the report represents the statistical information for each individual equipment with regard to the amount of time this particular equipment has been checked out during the period specified.

## 11 Equipment Check In and Check Out Process

For illustration purpose, assume that a student walks in to check out a basketball and a pair of safety glasses. The student gives the student ID to the staff member to begin the check out process, this is critical because as pointed out before REC services are meant for members only and a student is automatically considered as a member. The student ID is input to AMEMS in order to bring up student information on screen and verify member status. AMEMS is capable of informing the staff member of the membership status. This is helpful to identify whether a membership is active or not. AMEMS can also check into CAS to verify student existence to ensure membership is valid.

**Student Or Member Lookup**

Search By  
Student/Member ID:  Last Name:   
Phone No.  --

Search Result  
3

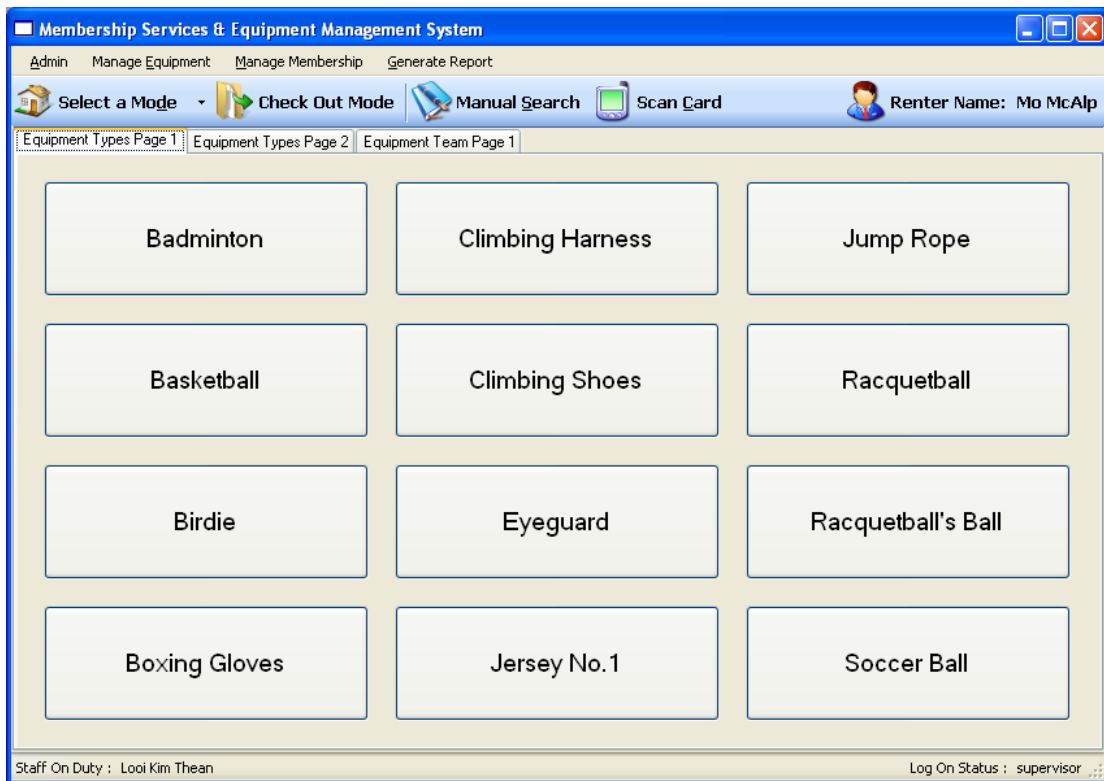
Member Information  
First Name:  MI:   
Address:   
Zip Code:   
City:   
State:   
**Membership's Status: Active**

**Figure 11.1 Membership Look Up Before Equipment Check Out**

Once AMEMS successfully recognizes a particular member exists in the database, it proceeds to the check out process. The AMEMS generates a selection of

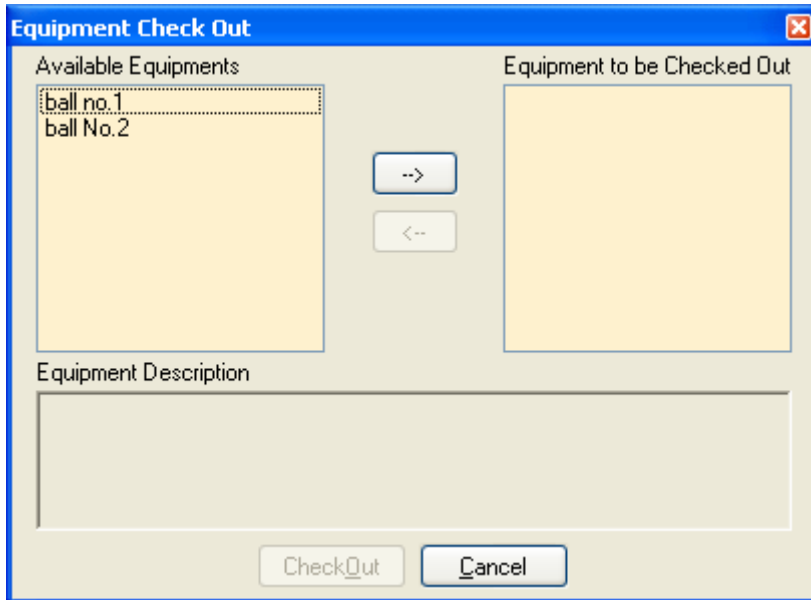
equipment types on screen to enable the staff member to effectively select the equipment type that needs to be checked out. In this scenario, it will be the basketball. It's worth mentioning that one of the requirements is to have an interactive user interface to allow staff member to easily make a selection on equipment type. The tricky part is that AMEMS needs to be able to generate the selection during runtime to show all available equipment type. Note that these equipment types can be customized accordingly to user desire hence leaving some freedom for user to create their own equipment type to be displayed on screen selection.

In order to make the selection process easy as well as easy to pick out, big sized buttons are desired at this point. The same holds true of the individual and team equipment check out process.



**Figure 11.2 Equipment Check Out Screen**

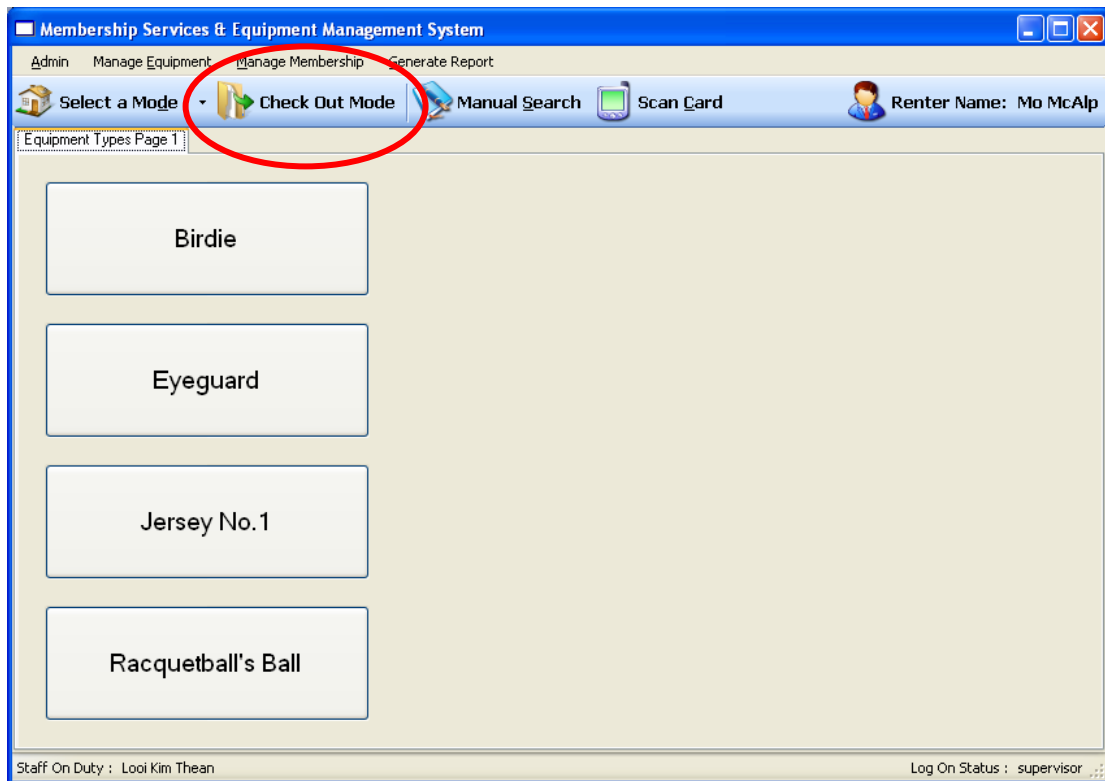
Check out process requires that a staff member to select the equipment type desired on screen and click on the button. This will bring up the check out screen. The check out screen will confirm the actual item selection of the equipment type and check out the item from there.



**Figure 11.3 Check Out Screen**

Note that only one item can be checked out at a time. Hence after moving an item from available list to check out list, one cannot move to another item. Check out can only be executed if you have one item on the checkout list.

Upon finishing checking out an item, user will be prompted to continue on to check out of another item. Check out process can be ended by simply cancelling on continuation of checking out, nonetheless we are going to check out another item, the safety glass as indicated above. Thus we shall continue on to check out.



**Figure 11.4 Second Check Out Screen**

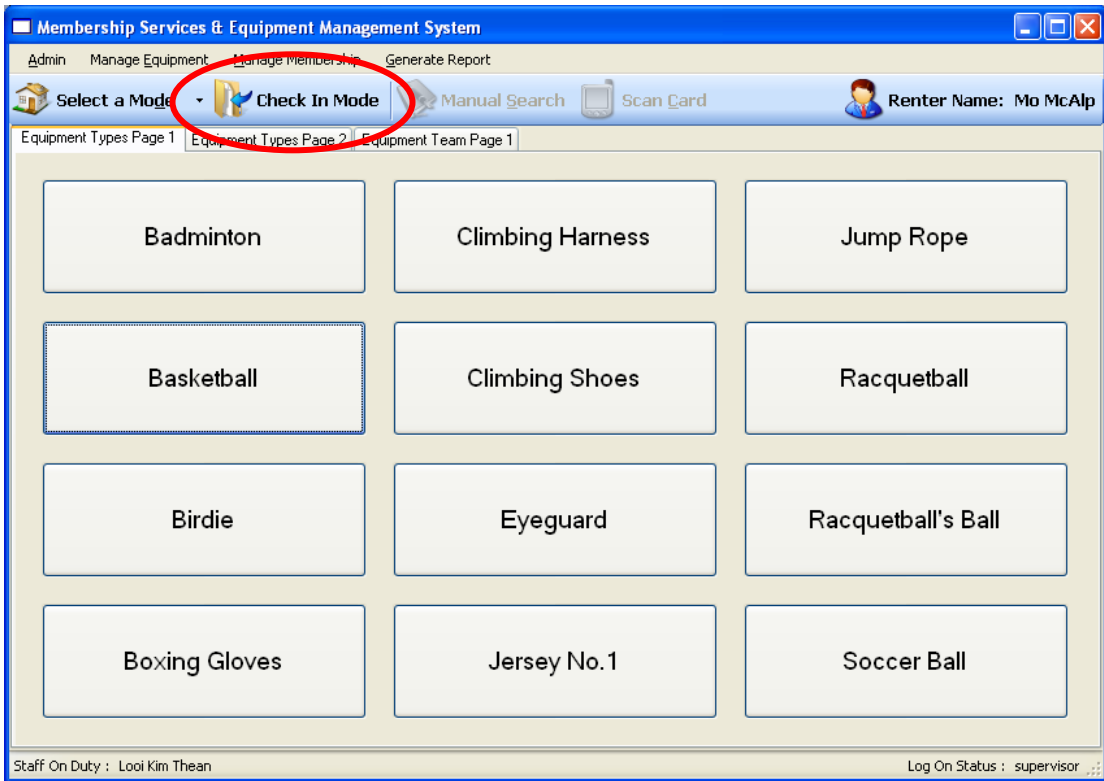
One will notice the difference: most of the equipment type existed from before are no longer present in here. This is a desired feature, the student is not suppose to check out more than one item at a time with one exception, that is if the particular equipment type is allowing the user to check out the item multiple times. Let's look back to adding equipment type scenario. Remember that each equipment type has an attribute explaining whether the particular equipment type is allowed to be checked out multiple times; this attribute is used here to help distinguish regular equipment from multiple check out items. Again this is one of many customization features made available in AMEMS.

The same process applies to team equipment check out as well. The same rule applies in both places where if the student has checked out an item, checking out the

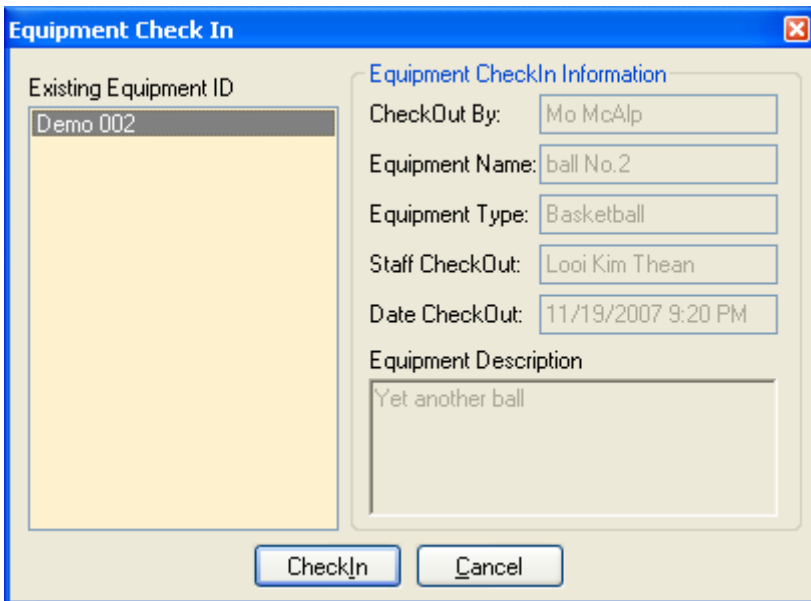
second item is not allowed unless it's of special case where the equipment type allows multiple item check outs.

## **11.1 Equipment Check In**

Equipment check in works the opposite of equipment check out in terms of putting the particular checked out item back into inventory. The equipment check in process is only valid for items that have been checked out earlier. AMEMS will filter out all items and only show items that have been checked out. The check in process is similar to check out; the user is presented with big buttons for all equipment types available. In the example given above, when the student is finished playing with the basketball, the student will hand the particular equipment to the staff member. The staff member is responsible for checking for any defects and checks the item back into AMEMS to allow the item to be checked out another time.



**Figure 11.5 Equipment Check In screen**



**Figure 11.6 Check In Screen**

In order to check in a particular equipment, a user simply selects the equipment type of the item to be checked in. AMEMS will pull out the information on the item ready for the staff member to select. Staff member will have to make a selection that matches the item checked out then check in the item from there. In the scenario given above, student has checked out a basketball and safety glass before. Hence, the screen above indicates the item ID of which equipment has been checked out before. Given a scenario with multiple items of the same type, the staff member can easily browse through the equipment ID list to view the check out information in determining the exact item to be checked in.

Once finished with item check in, the staff member will be brought back to the check in screen.

## **12 Challenges and Resolutions**

Throughout the process of software development, several challenges were encountered. Some of the challenges were resolved by incorporating new tools into the software; others required intense design and review process to come up with new ideas and methods to overcome the difficulty.

### **12.1 User Interaction**

One of the problems encountered during the design phase is the ambiguity of designing the user interface. The system depends heavily on the usability of the staff members at REC. Hence, ease of use of the software remained the focus in the design. In order to enhance the usability of the system, several new user interaction ideas were being introduced in the design phase. Touch screen display and card scanner recognition were to integrate into the software product to help improve usability of the system and greatly enhance user experience.

The design of graphic user interface is based on touch screen display approach where screens, button and changes are made larger and easy to access by user. Nonetheless this is only true when accessing daily activities of inventory check in and check out of equipments. The data entry and administrative functionalities are using a more data centric approach where user will be presented with information from database of the inventory to enable easy viewing access to administrative staff members.

On the other hand, the card scanner utilizes external hardware for magnetic card recognition and later redirects the card's information to the software product. The

communication layer between the hardware magnetic card scanner and software application are implemented using an event handler mechanism provided by the hardware driver. Thus, integration effort between hardware and software application is needed in order to ensure successful recognition of the card's information. For this capstone project, the MSR used is integrated with the keyboard bought from Cherry, and hence the driver used is proprietary to Cherry. The software is using the hardware driver (OPOS) provided by Cherry keyboard, and it's only compatible with use of Cherry keyboard with MSR.

## **12.2 Self Adaptive Equipment Check In and Out Component**

Another important role of the software is future extensibility support. The software shall automatically detects the equipment type previously existed in the database and self generate the check in and check out button accordingly for user to make easy selection. As time progress, the equipment type in will grow and be modified from time to time as inventory changes, thus having to design the software to self adjust according to inventory change will greatly benefit future extensibility of the system. The initialization of the check in and check out screen shall be generated dynamically during run time. The screen is shown in Figure 11.2 Equipment Check Out Screen. Additionally users have the ability to customize its own equipment type into team equipment which then can be check out as one item. The detail of customization feature will be described in Section 12.3 *Customization of Equipments*

## **12.3 Customization of Equipments**

The commercialized products for this application are expensive and they do not allow much room for customization. This always presented an issue for the user because the user wanted to customize the equipments inventory. A lot of effort has been put into this area to improve the product life time for future use. The result of this is to go through several design phases and reviews with customer to come out with customization features that is well suited for future use. Several demonstrations and reviews have been held during the development cycle to get feedback from stakeholder to get consensus from

everybody to ensure the product meet customer expectations. These customization features allow the users to assign individual equipment detail information with regard to pricing, maintenance information and the ability to group multiple items to be considered as single item to be checked out by other user. In addition, locker assignment and pricing information can also be assigned at any given time. These features will enhance the life time of the software usage as the inventory will get change from time to time and may require some update on individual item.

## **12.4 System Integration**

The whole integration process consists of software components, hardware component and database system. The software components consist of crystal report viewer support and license issue that tie to a particular installed system. The software was being developed using MS visual 2005 that came with crystal report support. Thus in order to license out the crystal report viewer to another computer, a distribution package was needed to be initiated from MS visual 2005 in the development PC. This was done via deployment process using .NET framework 2.0 merge module with the crystal report redistribution package which can be download from the crystal report website.

The hardware integration consists of MSR which comes with the Cherry keyboard. The final product is using the Cherry keyboard that support MSR, thus will be using the driver supported by the keyboard. This will require software integration with the driver in order to respond to the event handler upon finish reading from the card. The driver component is given in the installation disk that comes with the Cherry keyboard; this component will need to be referenced into the software development of the capstone project.

For testing purposes, MySql database system was being used in the project. This required the use of the correct connector in order to connect to MySql database system. The MS Visual 2005 comes with connector that is compatible with SQL server but not MySql, and hence new connector for MySql was downloaded from MySql website and installed in development machine before one can connect with MySql database system. The final deployment of the project will be using the Oracle database system. The Oracle

database system is based on a client server relationship thus is similar with MySQL. Migration from MySQL to Oracle shouldn't be an issue here other than having to change from using MySQL connector to access into the database; the software shall use Oracle connector instead.

## **12.5 Other challenges not yet resolved**

### **12.5.1 Software Merge with Outdoor Connection Application**

The Outdoor connection department within the REC is running its own PC software to keep track of the inventory system and equipments rental on daily basis. In order to integrate the activities of REC into one standard process, merging of the two software system is desired to centralize REC inventory and usage information. In order to accomplish this task, some information on existing software usage is required to better learn the advantage and short coming of existing software. This will help better improve the future product in its design phase. Database migration will remain another issue to be solved here when merging the two software products. The current Outdoor Connection department is storing the rental and contract information locally in Access database. Thus work need to be done migrating database information from Access to Oracle and update database connection of the new system.

### **12.5.2 Migration from MySQL to Oracle database**

The final deployment of the project shall be using Oracle database for storing all inventory information. The initial deployment of the project shall be running in PC locally control by REC staff member using MySQL database system. This is done so in order to get staff member familiar with the new software system as well as using this as beta test. As the software mature and ready to migrate into Oracle database system, there are 2 tasks that need to be addressed to ensure successful deployment. (1) Importing existing data from MySQL into Oracle. This can be done using SQL command to export database information from MySQL and later import it into Oracle. (2) Updating the

software to use Oracle connector instead of MySQL connector for database connection. This step will involve some software changes which deem to be minor. The .NET framework comes ready with oracle connector support hence the software update shall remain relatively small.

## 13 Conclusion

This thesis describes the design and implementation of Automation of Membership and Equipment Management System (AMEMS). The operation of AMEMS evolved so that it can help the REC sport department in offsetting some of its daily activities and in return shift more time into more productive activities and manage their inventory system more effectively. With AMEMS it makes a smooth transition from using a labor intensive method to electronic form which can then be stored in a more secure database that is backed up constantly.

AMEMS further simplifies the REC sport department inventory management system by introducing a more structural and well organized method of managing their equipment inventory. This will not only save time but reduce the work load of having to manually search for a particular item for maintenance purposes or repair. All the grunt work can be properly handled through AMEMS by altering the status of the equipment. The staff members can also check the statistical information of a particular type or equipment to better help in determining the maintenance time frame.

The typical usage on AMEMS will be on membership registration and equipment check in and check out process. Built in with customization capability, AMEMS allows staff members to create team equipment and decide the pricing on memberships to support the ever changing events in UWL. Apart from this, staff members can now print out receipts and store the receipt for each membership for record keeping in digital format. In a nut shell, AMEMS offers a vast management system with an intuitive user friendly GUI.

In addition to regular equipment check out activity, AMEMS enforces certain rules directly in the system by only having staff members to only allow items to be checked out to one user at a time. Granted that this may be difficult at some time due to a variety of equipment type and item that can be introduced to the system in future, AMEMS is designed to be forward compatible. It allows the flexibility for staff members to specify equipment types that may or may not be checked out multiple times, thus providing staff members to customize equipment in the future.

All the features and tool sets provided are meant to give the REC sport department a new way to manage all activities and their inventory..

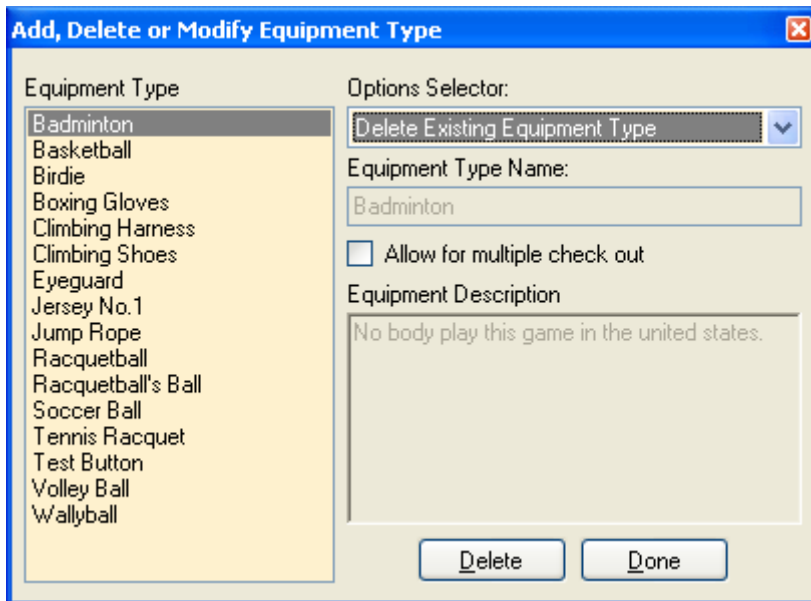
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- [2] Ben Forta, MySQL Crash Course, Sams Publishing 2006.
  
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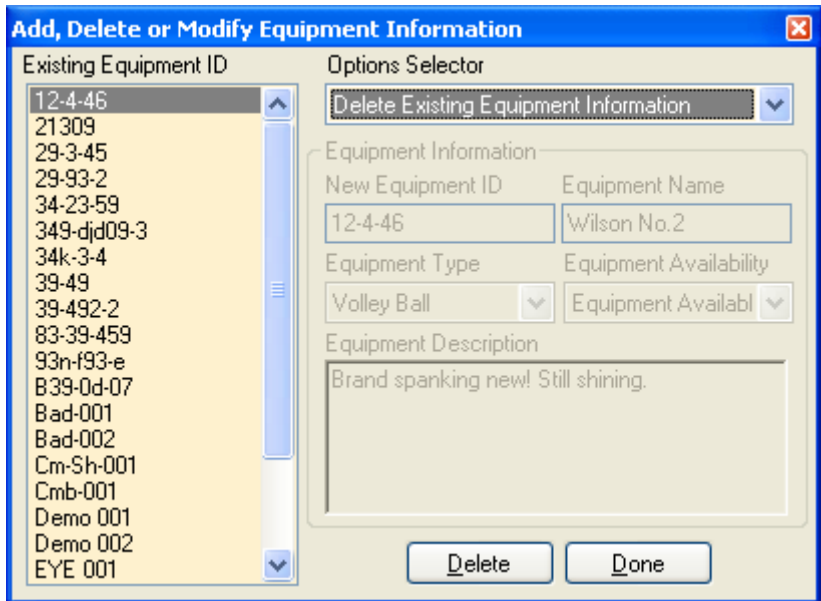
[11] IEEE Recommended Practice for Software Design Descriptions, IEEE Std 1016-1998, 1998.

## 15 Appendix

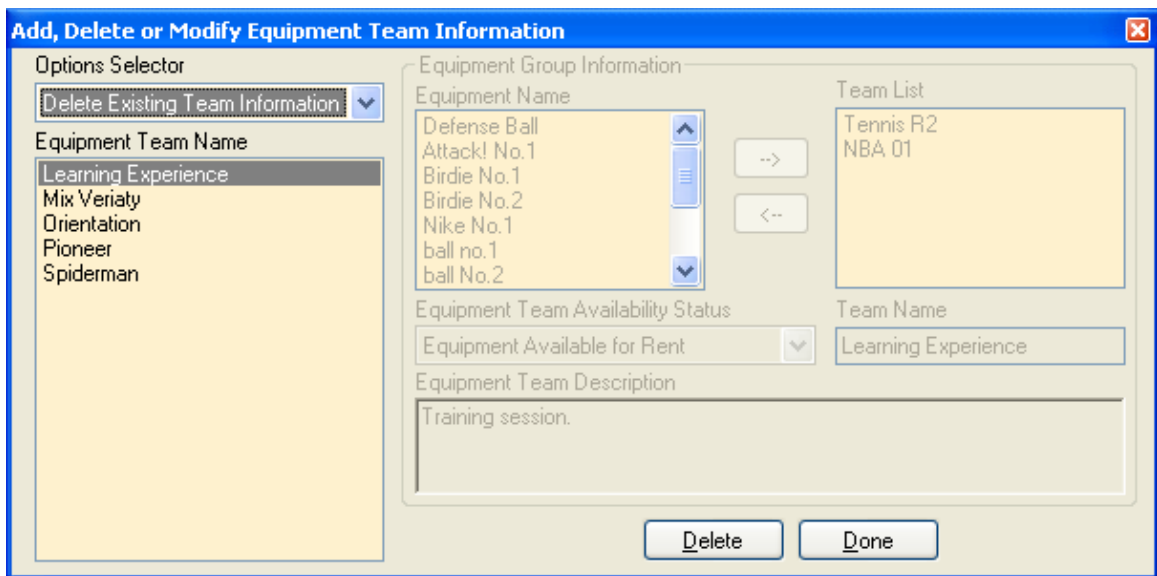
### 15.1 Selective Screen Captures on AMEMS



Delete operation for equipment type.



Delete operation for equipment information.



Delete operation for equipment team information.

**Add, Delete and Modify Locker**

Options Selector: **Delete Existing Locker**

Existing Locker ID

- 3-72-R
- 4-70-T
- 48-39-48-03
- B-03-23
- F-48-80
- W-39-23-01

Locker Information

Associated Membership ID: 2

Locker ID: 3-72-R

Locker Type: Short Locker

Unlock Code: 34-85-24

Comment

First Locker

**Delete** **Done**

Delete operation for locker.

**Update or Delete Existing Membership's Information**

Options Selector: **Delete Existing Membership**

Membership ID

- 1
- 2
- 3
- 4

Member Information

Last Name: Forta First Name: Ben MI: Micheal

Address: 800 East 96th Street City: Indianapolis State: ID

Zip Code: 46240 Phone No. 394 -- 8383932

Email Add: BenForta@sams.com  Add Partner to membership

Partner Information

Last Name: First Name: MI:

Assign ID:

Membership Type and Period

Membership Type: Faculty's Membership Start Date: 10/26/2007

Membership Term: Test Term End Date: 12/14/2007

Add Locker to membership

Locker Information

Locker Type: Short Locker

Locker Term: Weekly

Locker ID: 3-72-R

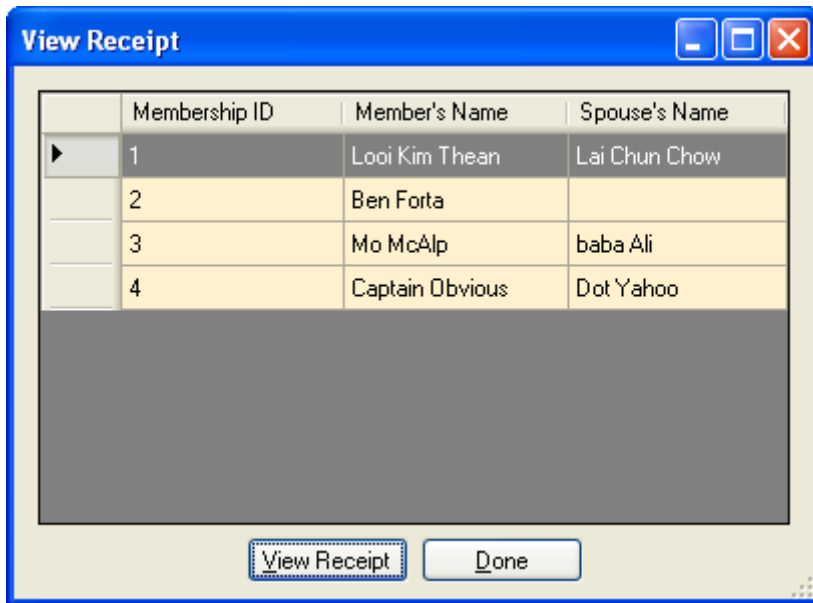
Payment Information

Payment Method: Check

Membership Fee: 59.99

**Delete** **View Receipt** **Done**

Membership delete screen.



Existing membership viewing window.

## 16 Appendix B: Report Screens.

Report Generation Options

Please select a report type

Equipment Type Report Based on Date Range

Equipment Report Filter Options

Equipment Type

- Badminton
- Basketball
- Birdie
- Boxing Gloves
- Climbing Harness
- Climbing Shoes
- Eyeguard
- Jersey No.1
- Jump Rope
- Racquetball
- Racquetball's Ball

From

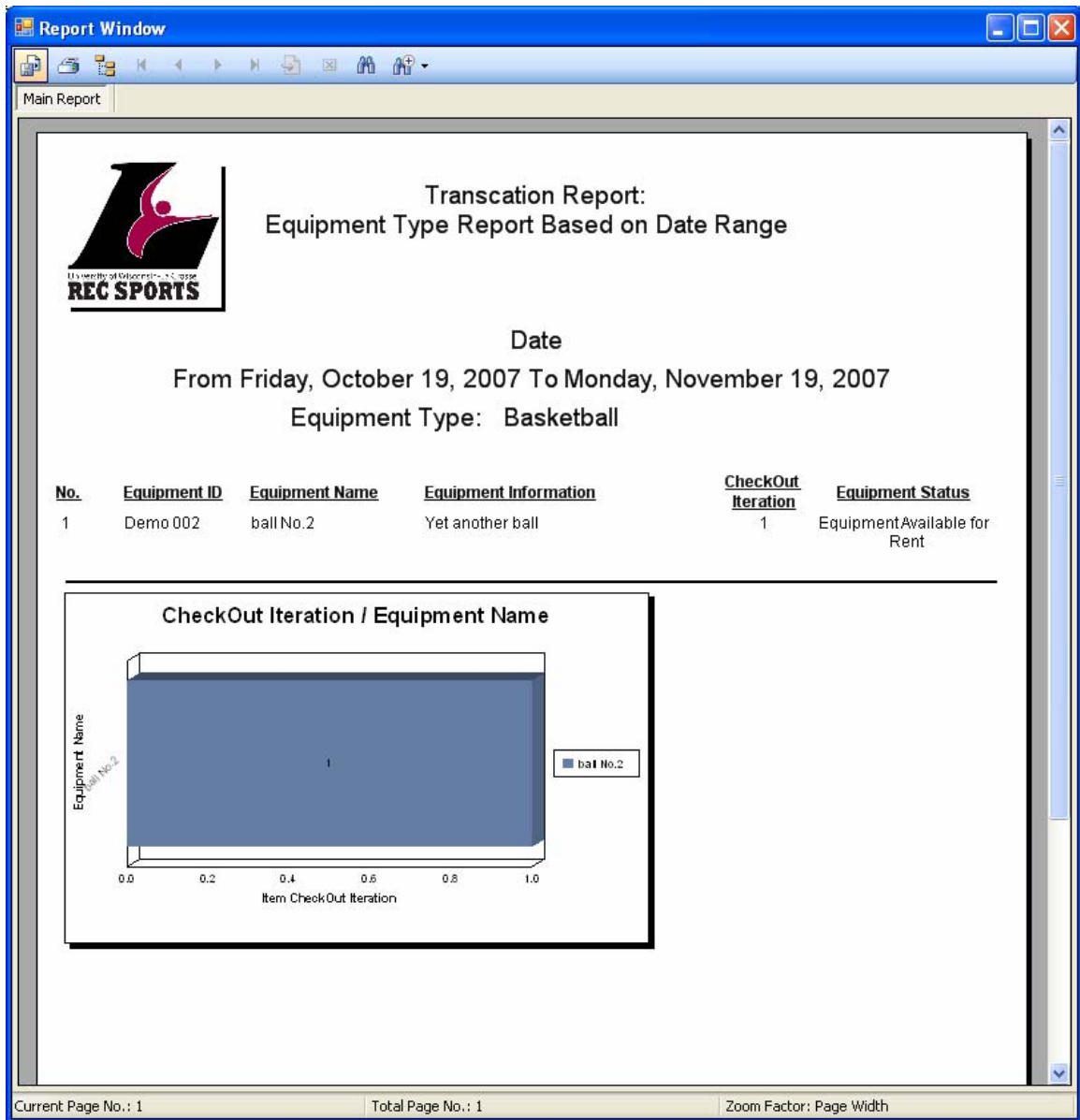
Monday, November 19, 2007

To

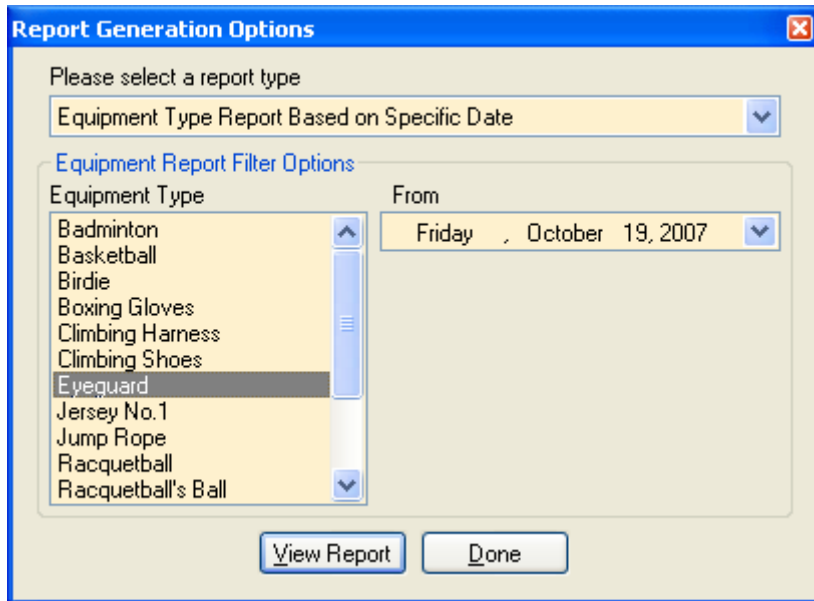
Monday, November 19, 2007

View Report Done

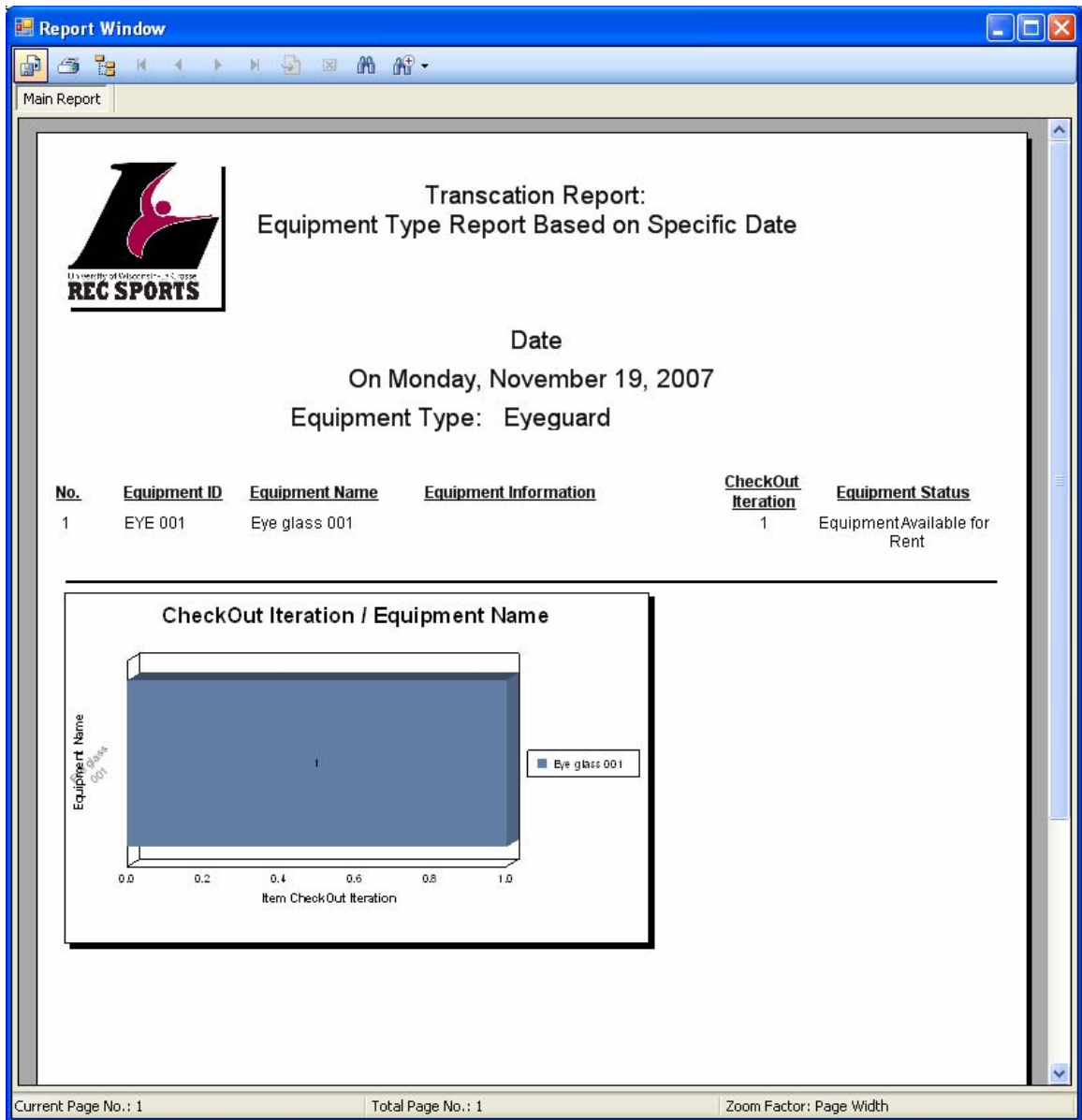
Report option on equipment type based on given date range.



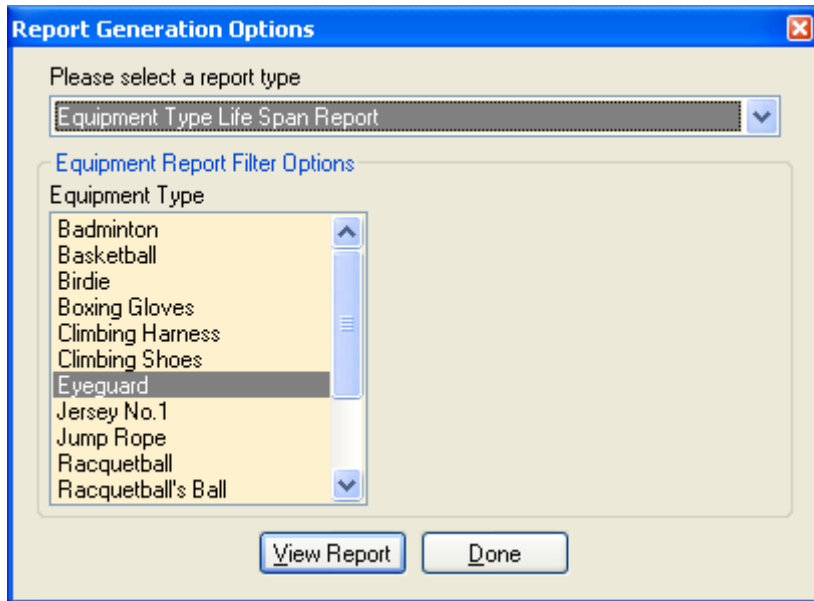
Report generated.



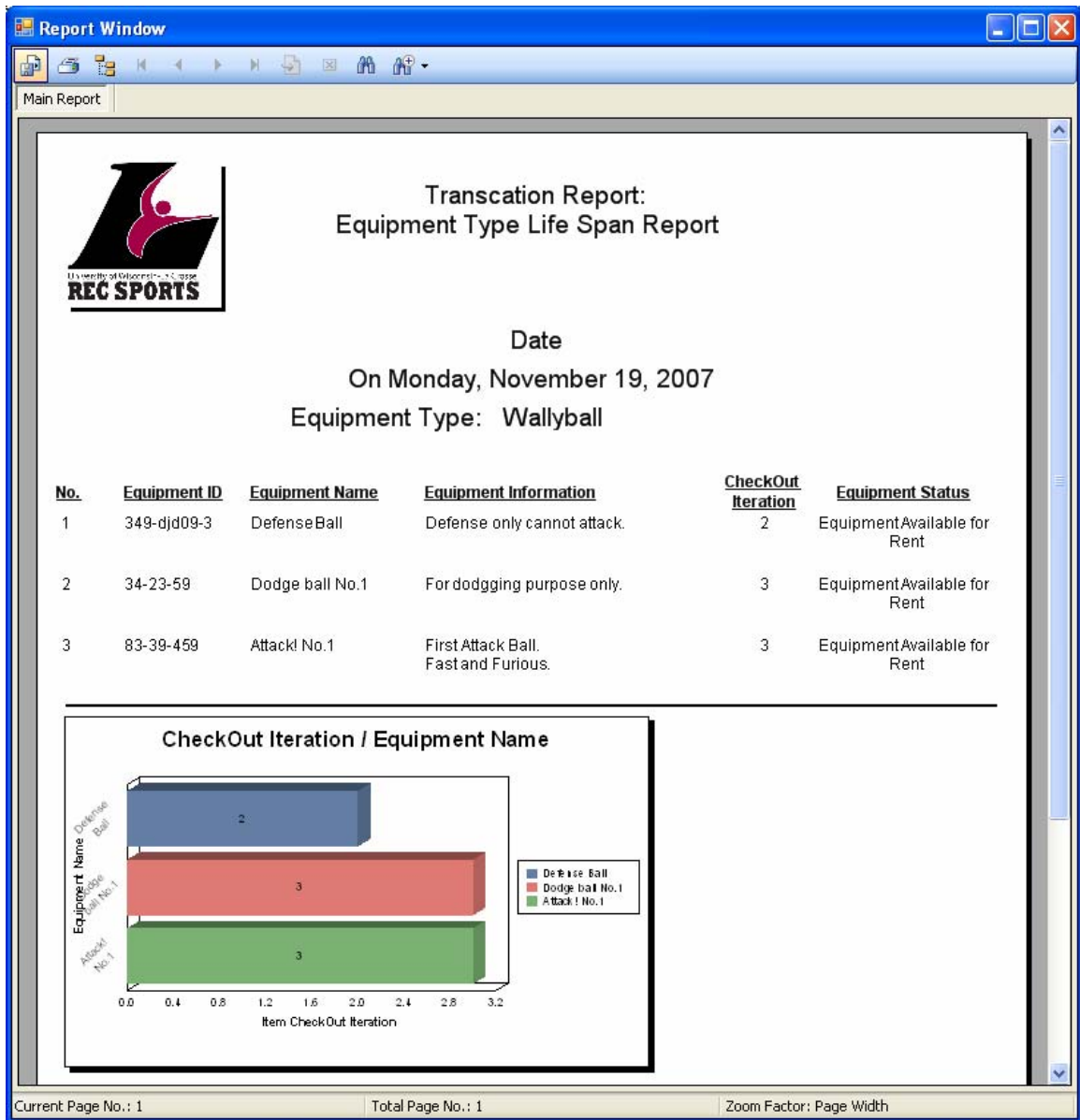
Report option on equipment type based on specific date input.



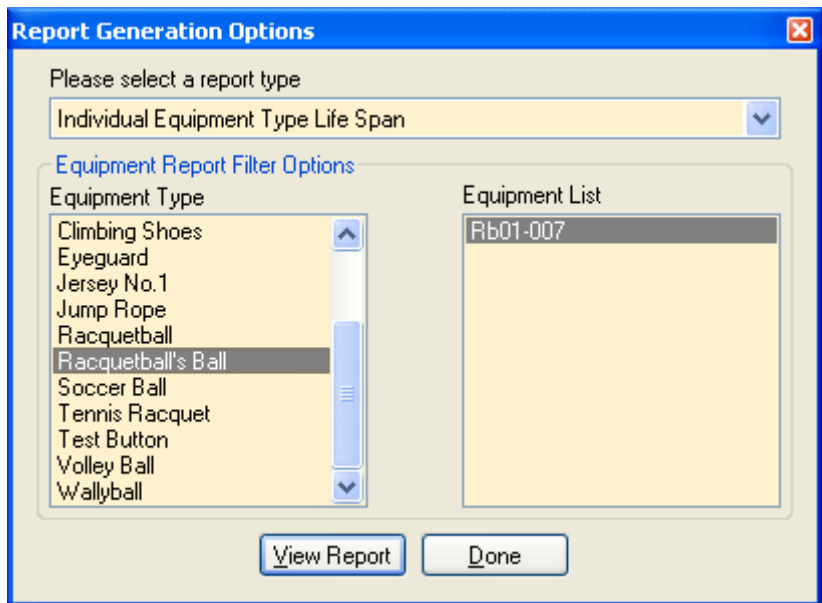
Report result.



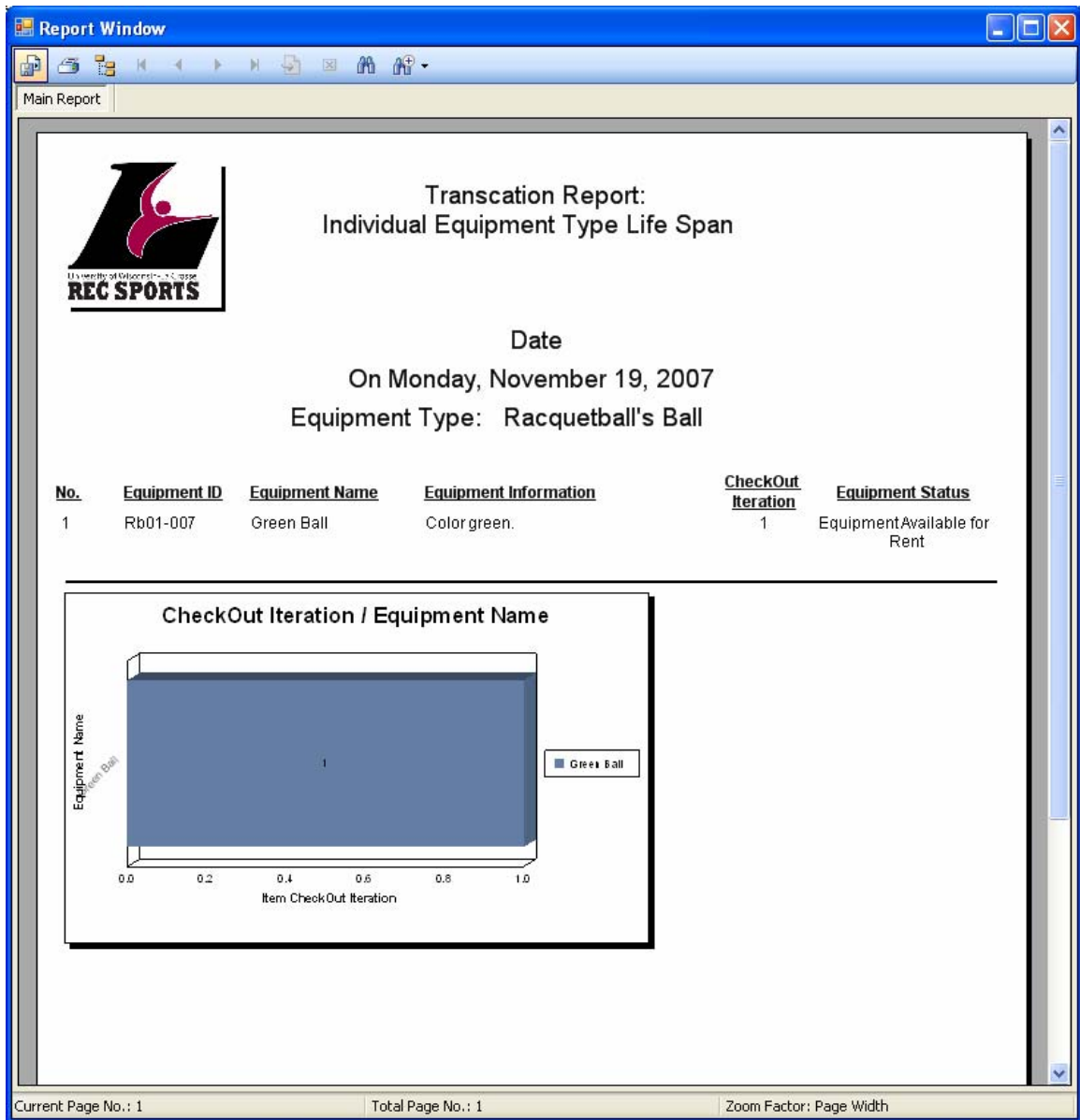
Equipment life span on specific equipment type.



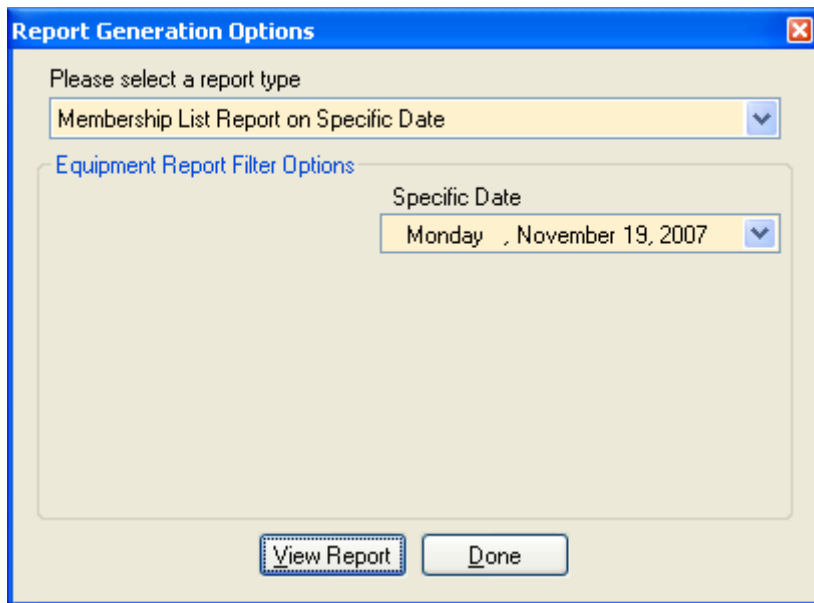
Report result.



Report option on individual life span of specific equipment type




Report result.



Report option on membership list.

MembershipListReportWindow

Main Report



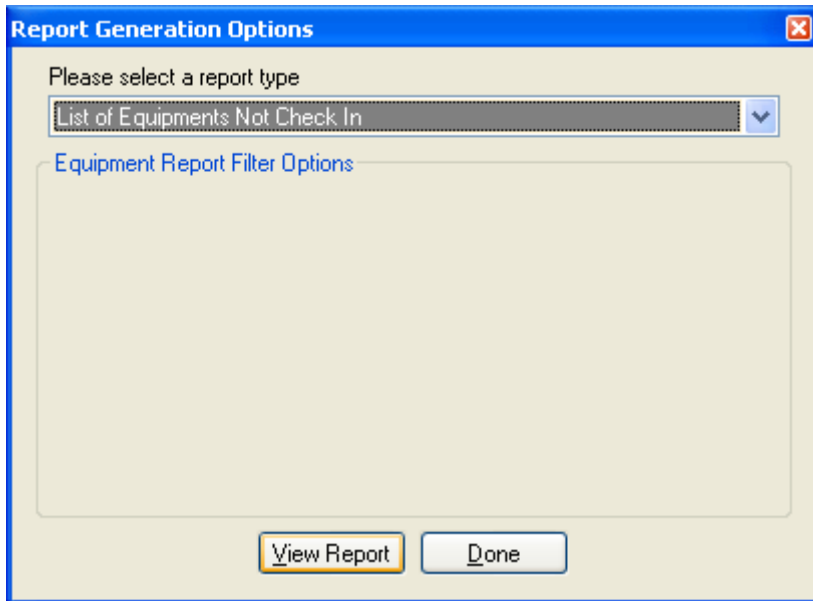
Transaction Report:  
Membership List Report

Date: On Monday, November 19, 2007

<u>No</u>	<u>Membership's ID</u>	<u>Membership Information</u>	<u>Membership Term</u>	<u>Locker Status</u>
1	1	Member's Name: Looi Kim Thean Partner's Name: Lai Chun Chow	Fall Semester	ShortLocker
2	2	Member's Name: Ben Forta Partner's Name: None	Test Term	ShortLocker
3	3	Member's Name: Mo McAlp Partner's Name: baba Ali	Semester	Bike Locker
4	4	Member's Name: Captain Obvious Partner's Name: Dot Yahoo	Fall Semester	None

Current Page No.: 1 | Total Page No.: 1 | Zoom Factor: Page Width


Report result.



List of equipment not check in report.

List of Equipment Not Check In Report

Main Report



11/19/2007

### Transcation Report of Equipment Item/s not checked In

No.	ID	Equipment Name	Equipment Type	Associated Group Name	Checked Out By	Checked Out Date/Time
1	83-39-459	Attack! No.1	Wallyball		Looi Kim Thean	11/19/2007 11:42:53 PM
2	Rb01-007	Green Ball	Racquetball's Ball		Looi Kim Thean	11/19/2007 11:43:03 PM
3	Bad-002	Birdie No.2	Birdie		Looi Kim Thean	11/19/2007 11:43:08 PM
4	Eye-001	Mask me	Eyeguard		Looi Kim Thean	11/19/2007 11:43:15 PM

Current Page No.: 1 | Total Page No.: 1 | Zoom Factor: Page Width

Report result.

**Report Generation Options**

Please select a report type

List of Equipments Checked Out by Student on Specific Date

Equipment Report Filter Options

Student Information

Student/Member ID: 3      Search

Last Name: McAlp

First Name: Mo      Middle Initial:

Address: 130 rack

City: Lacross      State: WI      Zip Code: 54601

Specific Date


Monday , November 19, 2007

View Report      Done

Equipment list report on a student on specific date.

List of Equipment Checked Out By Student

Main Report



11/19/2007

Transaction Report of Equipment Item/s Checked Out by:  
 Mo McAlp  
 On Monday, November 19, 2007

No.	ID	Equipment Name	Equipment Type	Associated Group Name	Checked out Time	Checked In Time
1	Demo 002	ball No.2	Basketball		9:20:08 PM	9:55:02 PM
2	EYE 001	Eye glass 001	Eyeguard		9:43:29 PM	9:55:31 PM

Current Page No.: 1 | Total Page No.: 1 | Zoom Factor: Page Width

Report Result.