Table of Contents

1. Executive Summary ........................................................................................................................................ 2

2. System Components ...................................................................................................................................... 3
   2.1 User Interface ........................................................................................................................................... 3
   2.2 System Requirements .............................................................................................................................. 11

3. System Environment ...................................................................................................................................... 14
   3.1 Architecture ............................................................................................................................................ 14
   2.1 Hardware ................................................................................................................................................ 16
   2.2 System Software ..................................................................................................................................... 21

4. Implementation Requirements ..................................................................................................................... 24
   3.1 Capacity ............................................................................................................................................... Error! Bookmark not defined.
   3.2 User Training Requirements .................................................................................................................... 25
   3.3 Test Plans ............................................................................................................................................. 26
     3.3.1 Types of Testing ............................................................................................................................... 26
     3.3.2 Roles and Responsibilities ............................................................................................................. 29
     3.3.3 Assumptions for Test Execution ..................................................................................................... 30
     3.3.4 Constraints for Test Execution ...................................................................................................... 31

5. Cost Estimates .............................................................................................................................................. 31

6. INDEX.......................................................................................................................................................... 34
1. Executive Summary

This document proposal will provide detailed information on the systems design specifications, assessment and recommendation for SCR – TIMS. SCR Associations will be launching a new training information system design entitled Training Information Management System (TIMS). TIMS will launch early next year which will provide training courses to clients and to the public.

The core values of SCR-TIMS are ethically treating all customers as a very important person (VIP), identifying businesses as well as individual student training and technical expertise needs and successfully making sure the clients are absolutely satisfied upon course completion. TIMS is committed to the idea that training and continuous education are critical aspects for quality performance or an organization.

Upon implementation, TIMS will be a web-based online educational training system. This innovative information system will systematically capture requirements for software updates seamlessly and the configuration of TIMS will permit interactive training without installing any software on the client side. TIMS will be browser-based accessible allowing clients to be mobile and flexible which only requires a workstation and internet access (see Figure 1).
2. System Components

This portion will list the system components interacting to achieve a cost-effective training solution for TIMS’s customers. Source documents, reports, screen layouts, diagrams such as data flow diagrams and network specifications are all included in the system components. A decision tree will be constructed to make sure that TIMS has consider all logical processes to make sure no possible combination of conditions are overlooked (e.g. accounting discounts).

2.1 User Interface

One of the first stages in the systems design phase is implementing the output, the user interface and data flow diagrams. The output will focus on the user needs for print out forms and web-based forms. TIMS’s user interface focal point will be a comprehensive design which allows effective interactions between the user, their workstations and input design.

As we plan the systems design specifications, the basic user interface principles of TIMS are to:

- Observe the functions that TIMS must support
- Maximization of graphic features in the interface design while profiling the typical TIMS user
- A comprehensive interface that will include all required tasks, communications and commands that fits user’s needs
The menu tool bar design will have menus leading to students, instructors, courses, course schedules, and course rosters.

A user must register for course via mail-in form (see Figure 2). Online course registration will be available to all our clients in the future (see Figure 3). Once registration forms and payments have been received:

- Students / Corporate clients must initially register their TIMS ids, same as login id, before entering the login page confirming receipt of id
  - IDs maybe sent hardcopy via mail
  - IDs maybe sent softcopy by email
- Clients may access the login page (see Figure 5)
- TIMSpages, consisting of user profile, will be the next interface (see Figure 6)
- Course Homepage is accessible by links on the TIMSpages. Course Homepage will include:
  - Menu Toolbar
    - Home Menu
    - TIMSpages (students and instructors directory are inclusive in drop down menu),
- Courses (course schedules, and course rosters are inclusive in drop down menu)
- TIMS info including important information on upgrades, events and special announcements
  - Certifications Earned, Certifications In-progress, Current Courses and Special Announcements (see Figure 7).

No restrictions will be placed on completing a course allowing our clients to logout and return to any previous course. A quiz will be given at the end of each course (see Figure 8). TIMS Administrator will automatically receive course completion and grades for clients. If the client passes the course, the system will generate a certificate.

TIMS will reduce input errors through data validation checks such as:
- Sequence checks verifying chronological order sequence such as registration process
• Existence checks verifying mandatory data such as social security number for course registration
• Data type checks verifying data input such as only alpha characters are allowed in name fields
• Range checks verifying input range such as only ten numerical digits are permitted for U.S. clients telephone numbers
• Reasonableness checks verifying uncertain inputs such as questionable payment amounts (e.g. $0.01)
• Validity checks verifying values such as clients course number input matches the registered course number for the client
• Combination checks verifying two or more fields such as the password field and the confirm password field during id registration

Several diagrams will reiterate the scope of TIMS. In Figure 9, the context diagram illustrates an entire overview of TIMS including the entities (instructors, students, corporate clients, course listings, training administrator and accounting) which will collect and maintain data. Figure 10, diagram 0, has a continuous break down of the context diagram detailing the system’s data flow, data storage and four main internal processes which are establishing registration, assigning classes, creating class roster, and producing reports. The entity-relationship diagram (ERD), Figure 11, will show the relationship between the entities in the system which a breakdown of the ERD is demonstrated in Figure 12 also known as a cardinality notation. Finally, in Figure 13, a diagram will display a lower-level decomposition of the business functions and processes.
Notice the TRAINING SYSTEM process is at the center of the diagram and the six entities surrounding the process. The TRAINING ADMINISTRATOR has one incoming data flow – REGISTER STUDENTS and one outgoing data flow – MANAGE COURSE SCHEDULING (the training system will manage course scheduling which the schedule will be sent to the training administrator. The ACCOUNTING SYSTEM and INSTRUCTOR entity can be explain in the same manner. The STUDENTS, MASTER COURSE LISTING and CORPORATE CLIENTS are a little different. CORPORATE CLIENTS and STUDENT entity both send an outgoing data flow - SUBMITTED REQUEST FOR REGISTRATION into TIMS. In return, TIMS sends an outgoing data flow - PROVIDE COURSE LISTING which is an incoming data flow for – MASTER COURSE LISTING which this entity sends an outgoing data flow – PROVIDE LISTING FOR NEXT 90 DAYS – into CORPORATE CLIENTS and an outgoing data flow – PROVIDE LISTING TO STUDENTS into STUDENTS entity. The STUDENT entity also receives an incoming flow of a CREATED CERTIFICATE FOR COMPLETED COURSES.
Figure 10. A breakdown of the context diagram is illustrated below in the diagram 0 for TIMS.

Notice this diagram is very similar to the previous diagram but it is an expansion of the internal process of TIMS with additional processes, additional data flows and also one additional data storage. For instance, remember the context diagram from Figure 9? For Figure 10, there are similarities. The TRAINING SYSTEM is still at the heart of all the entities and processes but notice the numbers on the processes which means there is a sequence order—ESTABLISH REGISTRATION is 1, ASSIGN FINAL CLASS is 2, PRODUCE STUDENTS REPORTS is 3 and the new data storage CREATE CLASS ROSTER is D2.

In this diagram we see the TRAINING ADMINISTRATOR who sends an outgoing data flow REGISTERS STUDENTS to an internal process that ESTABLISH REGISTRATION that sends STUDENTS REGISTRATION STATUS into TIMS. TIMS then sends out ORGANIZE RECORD to the internal process ASSIGN FINAL CLASS that sends an outgoing data flow — MANAGE COURSE SCHEDULING to TRAINING ADMINISTRATOR AND TIMS. Finally, TIMS outgoing data PROVIDE STUDENTS DETAIL INFORMATION to the internal process PRODUCE STUDENTS REPORTS the sends STUDENTS REPORTS to the INSTRUCTOR entity. The INSTRUCTOR sends an outgoing data flow — PROVIDE COURSE INFORMATION into the ACCOUNTING SYSTEM who produces PAYMENT & DISCOUNT STATUS back into the ESTABLISH REGISTRATION and etc.

Notice there is another process going on in data storage two (D2). TIMS sends DETAILS FOR POPULAR CLASSES to the MASTER COURSE LISTING which this entity then PROVIDE COURSE LISTING to the data storage CREATE CLASS ROSTER. CREATE CLASS ROSTER data storage sends an outgoing data flow to CORPORATE CLIENTS and STUDENTS with PROVIDE LISTING. Then, the STUDENT and CORPORATE CLIENTS interacts with the data storage CREATE CLASS ROSTER by sending an outgoing data flow SUBMITTED REQUEST FOR REGISTRATION. Notice that the second data storage is linked to the heart of the training system due to MASTER COURSE LISTING.
Figure 11. The entity-relationship diagram shows the relationship between the entities in the system. Here in this example, the accounting system bills the student who assigns to an instructor that reports the roster to the training administrator. The training administrator manages the course listing that goes to the corporate clients.

Figure 12. The entity-relationship diagram breakdown is shown in this cardinality notation.

**CARDINALITY NOTATION**

One and only one ACCOUNTING SYSTEM can bill anywhere from one to many of the STUDENT entity.

One STUDENT or many students, or none, can be assigned to one INSTRUCTOR or many instructors or none.

One INSTRUCTOR or none can report a roster list to one and only one TRAINING ADMINISTRATOR.

One and only one TRAINING ADMINISTRATOR manages one and only one master COURSE LISTING.

One and only one master COURSE LISTING goes out to one CORPORATE CLIENT or many corporate clients.
Figure 13. A structured chart illustration, lower-level decomposition of the business functions and processes

EXPLANATION OF FIGURE 13: The training system is the controlling module with four task modules of Manage Course Scheduling, Register Students, Maintain Training Records and Produce Reports modules. The arrow with an empty circle means that data follows from one module to another. For instance, the MAINTAIN TRAINING RECORDS task module exchanges PROVIDE RECORDS data flow with the control module TRAINING SYSTEM. An arrow with a circle filled in represents a control couple (also known as a flag) used to signal a specific action. An example: The PRODUCE REPORTS sends a flag PROVIDE COURSE INFORMATION up to the TRAINING SYSTEM (this is not an exchange data for the two modules).

A line with a diamond on the end represents a condition meaning it has subordinate modules that follows. The condition is, the subordinate modules can be invoked by its control module depending on the specific condition. In this case, MANAGE COURSE SCHEDULE can do one of the following - VERIFY COURSE SCHEDULE, REJECT COURSE SCHEDULE or ASSIGN COURSE SCHEDULE. Therefore if REJECT COURSE SCHEDULE sends a request for a rejection notice to MANAGE COURSE SCHEDULE, MANAGE COURSE SCHEDULE will send a REJECTION NOTICE to REJECT COURSE SCHEDULE while invoking the other two subordinate modules, VERIFY COURSE SCHEDULE and ASSIGN COURSE SCHEDULE. The conditions are, if a course is rejected then you cannot logically assign and verify that same course which was previously rejected.
2.2 System Requirements

- **Outputs:**
  - TIMS must provide a master list of courses, students, and instructors
  - TIMS should produce transcripts and verify records for former students
  - TIMS could produce a class roster providing background information about students
  - TIMS should generate registration and class roster printouts
  - Produce schedule printouts of all courses available for the next 90 days
  - Generate report on courses conducted and a listing of instructor assignments
  - Report for SCR's corporate clients on their students
  - Generate signature ready certificates with new logo for successfully completing a course

- **Inputs**
  - TIMS must have future online form for students to input registration information
  - Input screen should resemble systems used by other schools
  - Input schedule report for future reference to see which classes are most popular
  - Input links to SCR Services: Systems Support Group, Network/Web Group, Business Solutions Group, and Project Management Group

- **Processes**
  - TIMS must interact with the accounting system of SCR Associates
  - TIMS must have well organized Records
  - Send questionnaire to former and prospective students
  - System need to identify popular course offerings to estimate the number of expected students
  - Accounting system should reconcile student accounts and bill corporate clients for balances
  - Consolidate all SCR training in the new training group

- **Performances**
  - TIMS must be operational within six months
  - TIMS must support future online registration
TIMS must track registration up to the day course is in session
TIMS must keep track of courses, instructors, scheduling, registration, students, and grades
TIMS must track up-to-date industry certification requirements
TIMS should track credits earned toward IT industry certification requirements

**Controls:**
- Students must have pre-registered for course before joining a training session
- The system must have security for login screen
- TIMS must have a minimum and maximum number of students for courses open to the public
- Grades should not be altered by students
- Different levels of security should be provided to system administrators than the students

*Figure 14. A Sample Module of Report Generator*
**Figure 15. A Sample Detailed Report Output listing course name in alphabetical order**

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<thead>
<tr>
<th>Date</th>
<th>Course Name</th>
<th>Instructor</th>
<th>Number of Students</th>
<th>Student Name</th>
<th>Company</th>
<th>Telephone</th>
<th>SSN#</th>
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<td>GroupWise User</td>
<td>MCH</td>
<td>8</td>
<td>Bishop, Janay</td>
<td>Jamison Electronics</td>
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<td>Bishop, Ruby</td>
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<td>561-333-5650</td>
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</table>

**August Student Count**: 19

**Figure 16. Example of TIM report tracking scheduling, registration and records.**

**TIMs**

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<th>Inputs</th>
<th>Outputs</th>
<th>Process</th>
<th>Control</th>
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<td><img src="#" alt="Registration" /></td>
<td><img src="#" alt="Records" /></td>
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</tr>
</tbody>
</table>
3. System Environment

Scalability, Security, and Batch processing are requirements for system architecture of TIMS providing the flexibility of an interactive system giving longevity to sustain future training from SCR-TIMS.

A suggestion for SCR-TIMS is to have the Analysis team design the hardware and software to accommodate scalability allowing flexibility within the system to expand, modify, or downsized easily to meet the evolving business and technology. This allows advancement for SCR-TIMS future growth and expansion perceptively for accommodations with potential development opportunities in the areas of classes, staffing, and students. Our primary focal point of growth is increasing student base by developing class opportunities to increased revenue.

3.1 Architecture

A proposal for TIMS would be to implement client-server architecture to implement a fast and flexible system. Flexibility allowing IT professionals to share and configure the system and data distribution will be closer to the user are advantages of implementing client-server architecture.

A very flexible, multivendor model can be used for hardware and software integration. To allow Internet communication between the server and the clients, a web server should be used for the system. A wide area network (WAN) should be used to connect to local area networks (LAN), user accessibility to data on a LAN or WAN allows visibility of data as if it were stored on their computer due to the network transparency. Distributed systems have great capabilities because they can connect more than one LAN or WAN.

A file sharing architecture is recommended for TIMS which will allow clients to interact with the user interface, send data request to servers and send data files back to the server, receive data
files from the server and run application programs locally to process data. TIMS’s can handle data requests received from the client, sending data files to the client, storing data files, managing multiuser access, generating / controlling LAN traffic and managing data backup.

Recommendations for a thin client design have the following advantages:

- Lower network traffic - interactions between code and data takes place at the server level
- Faster performance - less network traffic is required
- Lower initial cost - workstation hardware requirements are not as stringent
- Maintenance cost is lower - most program code resides on the central server

A disadvantage of a thin client design is the development difficulties (must optimize the division of processing logic).

A three tier design is recommended for the client-server to allow user interface on the client and data can be stored on the server which can enhance overall performance by reducing the data server workload.
3.2 Hardware

Connecting to an existing router attached to the legacy system will allow network hardware of TIMS to integrate with the IT infrastructure easily *(See Figure 17)*

*Figure 17. Network Infrastructure*

The new SCR-TIMS hardware should be a Star Wired Network with a centralized network server combined with a wireless router access point connected to a Web server. *(See Figure 18)* This design was chosen for many reasons. The primary reason for this network control configuration was the ability to use multiple data storage locations and the unrestricted data flow during batch processing of the classroom data stores to the TIMS dB. The classroom servers are robust enough to handle multiple classrooms but for the sake of simplicity the diagram represents one per class.
Figure 18. Integrated IT Star Network Structure

The Wireless router and the Web server fit well with the need to be scalable in a volatile market. Their purpose is to create an environment for mobility. The wireless allows easy access from anywhere on the facilities premises and the web server provides flexibility for remote access. Both of these features are required to be competitive in today’s educational market.

Batch processing is data collected in a location processed and transferred in groups to another location. In the TIMS case the data is stored on a class room dB until it is time to transfer the data. The course data storage process is to minimize data transfer during peak hours of the day. This is what was referred to in the prior paragraph as TIMS Batch processing. The
course/student information is saved on a local database during the day. The transfer is directed by the classroom server at a set point in time when network traffic is minimal through the network server to the primary TIMS database. *(See Figure 19)* There is a level of control that will be implemented during batch processing. To promote data accuracy and quality during this process a log file will be produced to capture all elements that have been transferred to TIMS. This also reduces direct access to TIMS eliminating security exposures.

**TIMS Batch Processing Flow**

*Figure 19. Batch Processing Flowchart*

SCR-TIMS IT security management is universally an issue that will be addressed in hardware, software, and procedural controls to safeguard and protect this system and its data from internal and external threats. All of the growth requirements have been carefully planned with security measures present. Our design will provide measures to detect intrusions and provide stringent rules for passwords and user identification. The TIMS system will be integrated with the legacy security features of the existing system.
- **Hardware Physical Security Management:** This function entails the physical security of assets protecting them from being stolen or tampered with.

  All the servers will be housed in Computer rooms with secure card reader with personal identification access points. Emergency access will be alarmed to maintain the integrity of each computer room.

  The Network Backbone infrastructure will be secured with physical separation in IT closet located in each server’s computer room.

  The desktop computers will be physically secured to each classroom desk to prohibit the units being stolen.

  Notebook computers will primarily be used by staff and this is our most vulnerable asset to manage. While being used on site staff will be responsible to cable lock each unit to a secure point in their office or cubical.

- **Network Security Management:** This is the fundamental premise for the SCR-TIMWS system. Devices connected together transmitting and receiving data between each other.

  Network security issues stem from the need to protect personal information from deviant individuals. Information transmitted without the proper protection remains vulnerable to unwarranted attacks.

  SCR’s reasoning for Encrypting network traffic is to reduce the exposure for intercepted transmissions. An intercepted transmission if encryption is implemented causes the contents to be masked versus plain text which can be easily read and stolen.
We have potential for sensitive personal information being transmitted including passwords.

We will be using Public key encryption on our wired network which will provide the masked protection required if someone has the luck to infiltrate our system network. This is a bit more secure than our wireless network because it resides behind the systems firewalls.

TIMS wireless network will be using the highest level of Wi-Fi Protected Access (WPA2) available. This Temporal Key Integrity Protocol (TKIP) uses a stronger encryption. This is done by creating a new encryption key for each session creating variability the standard. This minimizes anyone being able to crack the encryption methodology being used.

SCR will not incorporate a private network due to the cost associated with the hardware contingency of a private network line. We will be tunneling by use of a virtual private network using the encryption techniques available.

SCR will have a unique port assigned to connect its services. This port will be undetectable with SCR’s use of routers in series to the external network providing a hardware firewall. The routers provide network protection by using network address translation (NAT) this works in conjunction with the Ethernet protocol TCP/IP. The transmissions originating from the SCR-TIMS system’s TCP/IP address will be translated by the router into requests from its single IP address on the WAN or Internet side of the router. (See Figure 20)
3.3 System Software

Software Application Security Management: These will be handled by the user group access levels.

Application security will be handled by the system analyst related to configuration and functions. Understanding these services will help identify security concerns. Services are a necessary part of network communication. These can be breached if not monitored and controlled. This will be handled by user rights associated with their account access level.

Input validation will be handled at the user interface designed in to the database system. These data controls will be done to promote and ensure integrity of the data as it is input into the system. This is to accommodate fast changing processes, personnel turnover and new incoming students. This will also reduce security exposures. Therefore system managers have to take ownership of making the system 'Idiot-resistant', if not 'Idiot-proof'. Patches and updates to each work station will be downloaded and require user intervention to install and activate.
Database File Security Management:

There will be Backup and recovery policies and procedures to protect data stored in TIMS protect this information from damage or loss. If by remote chance something happens and the integrity has been compromised we will have the ability to restore and recover lost or damaged data.

File Security is defined by personal or sensitive data that is stored in files on the server or database. It is a vital part of every data storage system. SCR will handle this for the TIMS project by defining user groups and assigning permissions. This is a requirement of the system because the clients/staff will be using/sharing applications and files.

The User groups will be defined and consist of system administrators, managers, and clients. Basically three levels of access. These levels will allow certain privileges and be controlled by the rank in group permissions.

Permissions will stem between read, write, and execute broken down into access and ability to perform file/application manipulation. The categories are as follows.

- Read a file – read file contents only
- Write a file – store files change file contents
- Execute a file – run available programs
- Read a directory – view contents of directories
- Write a directory – add/remove contents of directories
User Access Security Management: User security issues will be handled with procedural controls managed by the site system administrators with respect to user facility access levels based on their requirements. Site Identity management will be handled by displaying ID cards on each person from students and staff. A color coded stripe will be located on each ID designating the hierarchy for ease of identification.

Password protection will be maintained at various levels. All systems from servers, classroom PC to notebooks will be required to maintain hard drive or bios level password protection and system user password protection all being monitored and reported daily by SCR’s work station security tools. These passwords will require 8 digits, 8 rotational password changes, and not repeatable character password changes. This process minimizes the ability for deviant to breach access to the system.

Social engineering is a deviant attempt gain system access. These attempts would be through various means of social interaction friendship and misrepresentation of their affiliation. This will be handling by SCR as an introductory administrative educational package that all clients and staff will have to take prior to any level of system access. The staff will be on a yearly review process to eliminate exposures due to complacency.

The executive level at SCR may provide the highest level of user resistance adhering to security guidelines related to system passwords and various other security measures. In order to be connected all system users will be required to use the Workstation security application. As stated before this tool will monitor and report any violations to the system administrator.
4. Implementation Requirements

Whenever you develop a new program or system, one of the most important things to consider is future growth. If your application can only support 30 users at a time, what will happen when your user base is 120? While it cannot completely eliminate future capacity issues, capacity planning is a vital element in the systems development process.

Capacity planning is simply estimating the amount of technology resources, whether hardware, software, or infrastructure, that will be needed over a certain period of time. This information is vital as it can help a company plan for future technology purchases in their budgets. The key to good capacity planning is to have new resources available for use as soon as they are needed, as opposed to sitting idle for long periods of time.

There are certainly benefits and drawbacks to doing capacity planning. The benefits are that you plan ahead for future growth and rarely are caught off guard and have to make rush purchases for new equipment. It also allows you to plot out upgrades, again to avoid rushes that cause system outages during heavy volume hours. The downside is that if the growth is not there, purchased resources lay idle wasting money and space.

As it relates to the TIMS project, I think capacity planning is absolutely vital to the ongoing success of this system. I would certainly recommend using an open source planning tool, such as Hyperic HQ, to accomplish this task. I would also recommend that the systems analyst spearhead this effort, with input from those who played a significant role in the development of TIMS.
**User Training**

A combined helpdesk support for the SCR-TIMS system is recommended. This option will provide more flexibility, no maintenance, operational or upgrade expenses and total mobility access for internal staff, corporate clients and students. Perdesk ability provides maintenance for hardware and software through a remote host is an extra bonus for the training system. This permits a quick maintenance resolution for all users not requiring a telephone call.

Combining the help desk center with a vendor will give TIMS access to more skilled IT specialists that might not be available internally due to Perdesk currently has a multifaceted customer base. Perdesk also has more experience with help desk solutions to problems which will require less research time for SCR-TIMS increasing our productivity. Outsourcing some of the functions of TIMS such as tracking management will also improve daily operations of our information center. The disadvantage is sharing sensitive information with Perdesk risking data leakage outside of SCR-TIMS help desk to another organization.

TIMS’s helpdesk should offer:

- a toll free number providing support to students and corporate clients
- an internal number, consist of using the last four digits, providing support for onsite SCR employees, instructors, training administrators and accountants
- regular office hours support for everyone
- after hours support for internal staff members
- bi-lingual support (English and Spanish)
- operational support as well as user training support
- onsite support, web support, email support as well as phone support
The helpdesk should empower the users of SCR-TIMS by providing continuous support. It
should also make data easily accessible that is needed by instructors and staffs to do their jobs
and students helping their training experiences easy and productive. I will later give suggestion
on the location of the helpdesk, internal support, external support and combined support.

Test Plans

Your new system will be thoroughly tested. For the majority of testing, there will be a small test
bed consisting of 7 machines. Of these 7 machines, there will be one machine to represent the
Executive, Systems, Project Management, Business Solutions, Network/Web, Business
Solutions, and Administrative groups. There will also be one machine that will reflect those of
the Training center. Each machine is connected to the server and have the settings, permissions
and programs specific to that group and is tested for compatibility. Prior to testing, a test plan is
created and all test cases are documented. Documentation for users, managers and IT are created
before testing and edited during testing.

(Exforsys 2009)

Types of Testing

There are 4 major testing methods that will be used.

Unit Testing:

Unit testing is a software development process in which the smallest testable parts of an
application or network, called units, are individually and independently examined for correct
function. The purpose of the Unit Test is to recognize and eliminate execution that could have
been missed during desk checking. For this section of testing, we will use test data that will
include correct data and erroneous data. Testing with the correct data is called positive testing
and testing with the negative data is called negative testing. Both methods are equally as important to make sure that the program functions properly when it is used correctly and incorrectly.

Here each part of the network will be tested separately. First we will test the server. The operating system and all of the individual software pieces will be checked to make sure that they are compatible. This will be done by verifying all of the functionality of the services, the operating system and any other program that is housed on the server. The disk array and router will then be checked for functionality.

We will then set up each of the 7 computers for the test bed. Each of these computers will be tested to verify that the software on the machine works while the machine is used as a standalone machine. The server, the printer, the hardware of tier 2 and tier 3 are tested separately to make sure that all parts work. It’s then demonstrated that all the legacy data can be imported into the new programs and that those programs work effectively.

*Integration Testing:*

“Testing two or more programs that depend on each other is called integration testing.”

(Rosenblatt 2008). In Integration Testing components of the system are combined and tested in different ways. When you have programs and components of the network that depend on each other to perform a function then it is imperative to make sure that they work together correctly. Again in this phase of testing we will use both positive testing that simulates your actual conditions and negative testing that simulates incorrect conditions. There are 2 types of integration testing methods: bottom-up and top-down. Bottom-up begins with the simplest parts
of the network and then moves up to the server. Top down testing is just the opposite. We are using a top down method since we are starting with the server.

During the integration testing phase we will verify that all of the hardware functions together. This is the time that computers will be connected to network. We will verify that there isn’t any issue sending updates between the server and the client machines. We will verify that the client machines can connect to the server. It is also verified during this time that the permissions for each of the user groups are functioning as they should. It is verified that all computers can print to the printers on the network and the other devices on the network such as scanners communicate with the computers on the network and vice versa.

During the integration testing phase we will ensure that programs that work together without issue. We will verify that things like your anti-virus and firewall aren’t causing conflict with any of the programs on the client machine.

System Testing:

System testing is where the entire system will be tested for functionality. This is a final testing of all programs and the network. In this final testing we will make sure that they system can handle the predicted volumes of data quickly and efficiently. We will make sure at this time all of your IT staff is trained on the new system and prepared for your Go-Live. All documentation for the users, managers and IT staff is finalized to include changes found during testing, and dispersed this time. Since we have been working with a test bed up until this point, we will now get a small group of 7 beta users set up on the new network. The beta group will be 1 person from each of the 7 groups. They will be given the machines used in the testing phase. They will
use the system as they normally would in their daily roles. This way we can get actual daily activity on the system to test everything. It is in this phase that any scenarios that weren’t caught in the earlier phases testing will be caught and we can ensure that any possible problems are corrected prior to your go-live. The beta team will perform the acceptance test.

**Acceptance Testing:**

Acceptance Testing is the final phase of testing. Acceptance testing completes the formal testing process and is the only test that is the responsibility of the customer. (TechRepublic 2009) In this step a group representing a cross section of end users tests the application. In your case it would be the beta group that we established during system testing. The user acceptance testing is done using real world scenarios and perceptions relevant to the end users. Acceptance testing is where users test the system before “accepting” it. The user will execute the test cases that they have prepared and use the system in their day to day routine.

Upon successful completion of the User Acceptance Testing and resolution of the issues the team generally indicates the acceptance of the system. If it isn’t accepted, we will work with the users to get the system to their liking so that everything is happy and a sign-off can occur. After the system has been accepted, it will be rolled out to all of the other users.

**Roles and Responsibilities**

The following elements are required to support the overall testing effort at all levels within the TIMs project:

**TIMs System Group**

A SCR staff member will participate in the software or solution development activities. Responsibilities:

- Develop the system/application
- Develop cases and requirements in collaboration with TIMs Adopters
- Conduct Unit, System, and Integration testing
- Support user acceptance testing

**TIMs Adopter**

This will include an SCR project manager and a member of the TIMs System Group to forego formal adoption, testing, validation, and application of products or solutions developed by Workspace Developers. Responsibilities:

- Contribute to Use case, requirement development through review
- Contribute to develop and execution of the development test scripts through review
- Conduct Full User Acceptance, regression, and end-to-end testing; this will include identifying testing scenarios, building the test scripts, executing scripts and reporting test results

**TIMs Testing Process Management Team**

This group will include SCR Leads that are allocated to the TIMs system. The Group responsible to manage the entire testing process, workflow and quality management with activities and responsibilities to: Monitor and manage testing integrity, Support testing activities and Coordinate activities.

**Assumptions for Test Execution**

- For User Acceptance testing, the TIMs System Group has completed unit, system and integration testing and met all the Requirement’s (including quality requirements) based on Requirement Traceability Matrix.
• User Acceptance testing will be conducted by End-users

• Test results will be reported on daily. Failed scripts and defect list will be sent directly to developers.

Constraints for Test Execution

• TIMs Adopters should clearly understand test procedures and record a defect or enhancement. Testing Process Team will schedule a meeting with TIM System Group and TIMs Adopters to address any testing related issues.

• TIMs System Group will receive a list of request for the test environment set up, user accounts set up, data set, and defects list.

• TIMs System Group will support ongoing testing activities based on priorities

Enhancement can be added as new requirement after the appropriate Change Management process.

5. Cost Estimates

There is a time constraint on the development of TIMS. It must be operational within six months which the start date will be discussed after the sign-off / approval date. Developing a list of key features for the system is important. The information for this list is usually found during the fact-finding of the system development phase.

Cost management/benefit for developmental and operational costs for the first year is forecasted at $201,600. Several sheets will follow to demonstrate a three year overview of developmental costs, revenues, and other operational costs (see Figures below).
Information Needed and Additional Calculations
Forecast for the new training center:

<table>
<thead>
<tr>
<th></th>
<th>YEAR 0</th>
<th>YEAR 1</th>
<th>YEAR 2</th>
<th>YEAR 3</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salaries</td>
<td>$75,000</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td></td>
</tr>
<tr>
<td>Hardware &amp; Software</td>
<td>$70,000</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>$7,500</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$31,107</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>add two add months of operational costs to cover expenses: 186,640 /12 = 15553.333 monthly rate * 2 months = 31106.666 for year 0</td>
</tr>
<tr>
<td>Totals</td>
<td>$183,607</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$183,607</td>
</tr>
<tr>
<td>Operational Costs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Administration</td>
<td>$0</td>
<td>$13,000</td>
<td>$14,300</td>
<td>$15,730</td>
<td>10% increase after year 1, (13000 \times 10% = 1300, 1300 + 13000 = 14300) yr 1, (14300 \times 10% = 1430, 1430 + 14300 = 15730) yr 2</td>
</tr>
<tr>
<td>Technical support</td>
<td>$0</td>
<td>$35,000</td>
<td>$28,000</td>
<td>$28,000</td>
<td>decrease 20% 2nd year, then remain constant: (35000 \times 20% = 7000, 35000 - 7000 = 28000) yr 2</td>
</tr>
<tr>
<td>Training salaries</td>
<td>$0</td>
<td>$80,000</td>
<td>$120,000</td>
<td>$160,000</td>
<td>will increase to $120,000 in second year, $160,000 in third year</td>
</tr>
<tr>
<td>Supplies</td>
<td>$0</td>
<td>$8,640</td>
<td>$14,400</td>
<td>$21,600</td>
<td>((15 \times 6 \text{ students}) \times 12 = $8640) yr 1, ((15 \times 8 \text{ students}) \times 10 \text{ classes} \times 12 = $14400) yr 2, ((15 \times 10 \text{ students}) \times 12 \text{ classes} \times 12 = $21600) yr 3</td>
</tr>
<tr>
<td>Facilities</td>
<td>$0</td>
<td>$50,000</td>
<td>$55,000</td>
<td>$60,500</td>
<td>after first year, will increase 10% per year: (50000 \times 10% =5000, 50000 + 5000 = 55000) yr 1, (55000 \times 10% = 5500, 55000 + 5500 =60500) yr 2</td>
</tr>
<tr>
<td>Totals</td>
<td>$0</td>
<td>$186,640</td>
<td>$231,700</td>
<td>$285,830</td>
<td>$704,170</td>
</tr>
</tbody>
</table>
Figure 22. Three-year Payback Analysis illustrated to determine the amount of time required to repay the sum of the original investment.

<table>
<thead>
<tr>
<th>Year</th>
<th>Costs</th>
<th>Cumulative Costs</th>
<th>Benefits</th>
<th>Cumulative Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>$183,607</td>
<td>$183,607</td>
<td>$117,000</td>
<td>$117,000</td>
</tr>
<tr>
<td>1</td>
<td>$186,640</td>
<td>$370,247</td>
<td>$201,600</td>
<td>$318,600</td>
</tr>
<tr>
<td>2</td>
<td>$231,700</td>
<td>$601,947</td>
<td>$384,000</td>
<td>$702,600</td>
</tr>
<tr>
<td>3</td>
<td>$285,830</td>
<td>$887,777</td>
<td>$612,000</td>
<td>$1,314,600</td>
</tr>
</tbody>
</table>

Figure 23. Return on Investment (ROI) illustrated below to show the profitability percentage rate.

<table>
<thead>
<tr>
<th>Year</th>
<th>Costs</th>
<th>Cumulative Costs</th>
<th>Benefits</th>
<th>Cumulative Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>$183,607</td>
<td>$183,607</td>
<td>$117,000</td>
<td>$117,000</td>
</tr>
<tr>
<td>1</td>
<td>$186,640</td>
<td>$370,247</td>
<td>$201,600</td>
<td>$318,600</td>
</tr>
<tr>
<td>2</td>
<td>$231,700</td>
<td>$601,947</td>
<td>$384,000</td>
<td>$702,600</td>
</tr>
<tr>
<td>3</td>
<td>$285,830</td>
<td>$887,777</td>
<td>$612,000</td>
<td>$1,314,600</td>
</tr>
</tbody>
</table>

ROI: 48.1%

Figure 24. Net Present Value for TIMS Project

<table>
<thead>
<tr>
<th>Year</th>
<th>Year</th>
<th>Year</th>
<th>Year</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benefits</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>117,000</td>
<td>201,600</td>
<td>384,000</td>
<td>612,000</td>
<td></td>
</tr>
</tbody>
</table>

| Factor | 1.000 | 0.909 | 0.826 | 0.751 |
| Factor of Benefits | 117,000 | 183,254 | 317,184 | 459,612 |

| Costs | 183,607 | 186,640 | 231,700 | 285,830 |
| Factor | 1.000 | 0.909 | 0.826 | 0.751 |

| PV of Costs | 183,607 | 169,656 | 191,384 | 214,658 |

Net Present Value: 317,745
### 6. INDEX

<table>
<thead>
<tr>
<th>Terms</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bugs</strong></td>
<td>Any error or defect that causes the software, application or hardware to malfunction.</td>
</tr>
<tr>
<td><strong>Combination Check</strong></td>
<td>A type of data validation check used to verify combined fields of two or more</td>
</tr>
<tr>
<td><strong>Data Type Check</strong></td>
<td>A type of data validation check used to verify the required type of data input (e.g. numeric or alpha input only in a field on a form)</td>
</tr>
<tr>
<td><strong>Existence Check</strong></td>
<td>A type of data validation check used for mandatory data input</td>
</tr>
<tr>
<td><strong>Range Check</strong></td>
<td>A type of data validation check that measures the number of characters input against the minimum and or maximum length required</td>
</tr>
<tr>
<td><strong>Reasonableness Check</strong></td>
<td>A type of data validation check that confirm data input that is questionable (e.g. a flag will appear for a payment input of $20,000,000 for a course)</td>
</tr>
<tr>
<td><strong>Sequence Check</strong></td>
<td>A type of data validation check used to verify a fixed sequence(s)</td>
</tr>
<tr>
<td><strong>Validity Check</strong></td>
<td>A type of data validation check verifying the input value against the value in the system (e.g. course number and name input matches the course number and name on the roster)</td>
</tr>
</tbody>
</table>