Designing and Implementation of UI Portal Using Oracle in Financial Industry

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Designing and Implementation of UI Portal Using Oracle in Financial Industry

by

Sumeeth Devanaboina

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Submitted to the Graduate Faculty of
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Abstract

Data Quality refers to the processes which help in analyzing or validating the data based on different business rules. As a leading financial providers with a growing customer it is very difficult to maintain their detailed and secured data. An adjustment in the customer data was done very frequently (everyday) and it was done manually. Monitoring huge chunks of present and historical data is a complex task. The client will not take any risk even in losing any one of its secured financial data. The client’s current system has lot of limitations such as monitoring, adjusting, and validating employee data. The data that was in crude form was processed in order to satisfy the need of the end user for this kind of analysis. The user data and roles from different sources, legacy systems, interfaces need to be kept in track for audit and to overcome these limitations, the client implemented Certification Application, which not only allowed supervisors to certify their subordinates from various source systems but also used for auditing purpose on a fiscal year basis by which data integrity is maximized and data redundancy is minimized, as the single centralized place of all data also implies that a given set of data only has one primary record which helps maintaining of data accurate and consistent to enhances data reliability. Easier for use by the end-user due to the simplicity of having a single database design. This helped the business to have an auditing of the secured data which in turn assisted appropriate financial decisions to the stake holders.
Acknowledgement

I am really thankful to my advisor Dr. Hiral Shah for the guidance she provided me throughout the course of this project. She is always being a source who guided me in the right path of success, and shared her knowledge. She took her valuable time to read this paper and was most patient and understanding till the end of the project. Dr. Shah’s insightful suggestions and recommendations were very helpful to present this project effectively.

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Chapter I: Introduction

Introduction

There are many financial providers in the market. It is very difficult to choose one company with one best policy. Due to its growing customers, it is very difficult to maintain their detailed data. The client will not take any risk even in losing any one of its customers. An adjustment in the customer data is done very frequently (everyday) and it is done manually. Monitoring huge chunks of present and historical data is a complex task. To reduce the complexity in monitoring the huge amounts of data, the client plans to implement an UACS Application.

Among the present major applications in the market Oracle Applications is one of the more popular Enterprise applications. It is very important for any company to develop reports to analyze the performance of the company and make decisions. In today’s world reports and dashboards are usually made on maintenance and planned or budgeted data of the company. The process of developing reports usually involves an Oracle application framework that has a tool or a suite of tools that help to visualize the data in the desired formats needed for decision making.

In addition to the Application framework, there is also a heavy involvement of effective data mining and data warehousing techniques through which store process and maintain data for the reports or dashboards. To fulfill this requirement, the companies today have more than one dependable oracle framework available in the market that uses Oracle ADF BC (Application Developer Framework Business Components) is the new Oracle term for BC4J (Business Components for Java), a component of Oracle Fusion Middleware, is
Oracle's long-established technology to design and build enterprise applications quickly and efficiently. Oracle remains committed to the development of this technology, and to the ongoing release as a component of the Oracle platform. This continuing commitment to application technology enables to leverage the existing investment by easily upgrading and integrating existing Oracle UI applications to take advantage of web technologies and service oriented architectures.

**Problem Statement**

The client’s current system had lot of limitations such as monitoring, adjusting, and validating employee data. The data that was in crude form was processed in order to satisfy the need of the end user for this kind of analysis. The user data and roles from different sources, legacy systems, interfaces needed to be kept in track for audit and to overcome these limitations, the client was planning to implement Certification Application, which not only allows supervisors to certify their subordinates from various source systems but can also used for auditing purpose on a fiscal year basis.

**Nature and Significance of the Problem**

For any financial industry it is important to make decisions that are critical in no time. The data was used to make decisions, to reduce invalid transactions, etc. The users and their roles data was integrated from various external system and legacy system databases. The CERT application improves the performance and security of the user roles information and visualization of any abnormalities in the data. The company application provided the flexibility to obtain the data against various levels of business hierarchy and over a selected range of users on a quarterly basis.
Objective of the Project

The Certification application for financial management is required to conduct a quarterly review of the user community in such a way that an Agency supervisor once per year certifies every financial app user and their roles. The application presents the application design for the User Access Web Portal that make the data available for the end user to analyze, better visualization to meet the demands and also for auditing the data.

Project Questions

- What type of data mapping integrations implemented for external systems?
- What kind of certifications are done by financial supervisors using CERT?
- What type of data is being Audited?
- What are the security implementations on data?
- What are the benefits to client for implementation of the project?

Limitations of the Project

1) I-Web roles are managed at the district level. Since user-role-orgs within the Certification application will only be certified at the Regional level, certification of a user-role-org at the Regional level will imply that a user-role-org is certified at any district below the level certified.

2) The EmpowHR or other HR authority will provide the Certification application with a list of Agency employees/contractors and their immediate Supervisors via the Certification interface. This is necessary in order to facilitate searching by employee Supervisor Last Name on the Certifier search page. Without an official list of who is a supervisor for whom, we cannot implement this type of search.
3) It appears that the same exact name can be used in different locations so Home Org must be part of that unique key. There are only a handful of true duplicates—there duplicates should be handled manually, as changing the data model and user mapping algorithm will result in a much larger manual data mapping process.

4) Possible data quality of list of Supervisors from HR may be incorrect. This will require manual update of the list of Supervisors because that list is used to determine who is assigned the Certifier role within the Certification application.

**Definition of Terms**

**DW (Data Warehouse):** Stores the data at historical levels for Hierarchy.

Data Warehouse: Data warehouse is a data base which handles data from the central servers and arranges them in from of a particular schema (Extended Star Schema in case of CERT) which can be used for reporting purposes.

**ETL:** ETL stands for Extract-Transform-Load. As the name says, an ETL system is used to extract the data from the Data warehouse and transform it into required format using transformations and then load into info providers to use for reporting.

**SQL (Structured Query Language):** It is the language that database understands for the retrieval of required data with the conditions and level of aggregation necessary.

**PLSQL:** (Procedural Language/Structured Query Language) is Oracle Corporation's procedural extension for SQL and the Oracle relational database.

**GUI (Graphical user Interface):** It is graphical interface that helps to convert the data into a graphical format.
API: API, an abbreviation of application program interface, is a set of routines, protocols, and tools for building software applications. The API specifies how software components should interact and APIs are used when programming graphical user interface (GUI) components.

UACS: User Access Certification System.

Web Application: In computing, a web application or web app is a client-server software application in which the client (or user interface) runs in a web browser.

End user: End user refers to the high level managers.

Summary

In this chapter problem faced by the Financial companies, nature and significance of the problem, objective of the project and limitations of the project implemented were discussed. Background related to the problem, literature related to the problem and methodology used for implementing the project will be discussed in the next chapter.
Chapter II: Background and Review of Literature

Introduction

This chapter clearly describes about the problem statement in detail and also provides the literature related to the problem so that this literature can be used for further analysis in future to gain more knowledge over the problem. This chapter also explains about the literature related to the methodology of the problem.

Background Related to the Problem

The client for this project is one of the leading American multinational banking and financial services holding company, which is headquartered in San Francisco, California, with hub quarters throughout the country. It is the fourth largest bank in the U.S. by assets and the largest bank by market capitalization. Wells Fargo is the second largest bank in deposits, home mortgage servicing, and debit cards. Wells Fargo became the world's biggest bank by market capitalization worth $285 billion. Wells Fargo offers a range of financial services in over 80 different business lines. Wells Fargo delineates three different business segments when reporting results Community Banking, Wholesale Banking, and Wealth, Brokerage and Retirement. The client revenue by 2014 is $84.3 billion with almost 266,000 employees.

The client’s current system has lot of limitations such as monitoring, adjusting, and validating employee data. The data that was in crude form was processed in order to satisfy the need of the end user for this kind of analysis. The user data and roles from different sources, legacy systems, interfaces need to be kept in track for audit and to overcome these limitations, the client is planning to implement Certification Application, which not only
allows supervisors to certify their subordinates from various source systems but also used for auditing purpose on a fiscal year basis.

The project was all about getting the data from various sources and loading into a table in form of a cube which had the data available at all levels of business hierarchy and gave the option of slicing and dicing the data as per user selected options using UI application through various API’s. The data was to be loaded daily from the trade feeds that were sent from various geographical regions. The company needed to reduce their time in generating these reports manually. Creating these reports needed end user involvement in requirements gathering and the knowledge required for gathering the data.

**Literature Related to the Problem**

Anne Marie Smith (2005) stated that in many organizations, the control of data resources has been centralized due to the origin of data management within the mainframe environment. However, with the emergence of client-server technology and the blending of data and process in the object-oriented method, many organizations considering the combination of data management and application development cite the need for swifter implementation of databases and more rapid enhancements to existing databases. Sensitivity to deadline pressures in a constant throughout all development projects. Decentralizing data management (logical and/or physical) appears to offer some slight advantages in faster application development. However, the actual exposure to poorly defined data and poorly structured databases, incorrect enhancement procedures and un-sharable data far outweigh the small saving in time resulting from application developers performing data management functions.
Industry studies have consistently shown high costs for redesign and re-enhancement when the logical and physical data management functions are not performed by data management specialists. Effective project management practices suggest the division of labor into discrete tasks and each of those tasks to be performed by a specialist in that area. Employing this management practice in the area of data management in a system-development or enhancement project will enable an organization to adequately maintain the costs of that project.

Simply stated, faster application development is not the objective. The correct objective is the development and enhancement of high quality and high integrity applications as efficiently as possible. Data is rapidly growing in stature as a recognized corporate resource. A centralized approach to logical and physical data management will promote the development and use of integrated, sharable data throughout applications, preserve the quality of that data and serve the needs of the business more effectively.

**Literature Related to the Methodology**

Fillip Szymanski (2011) stated Building applications that meet the needs of the business is becoming increasingly challenging, with more-complex business processes and ever-increasing amounts of data to manage. On top of that, customers today expect instant results, which creates additional time pressure and leaves no room in the application development schedule for rework.

Building applications right the first time is more important than ever. These applications not only need to meet the needs of the business, but they have to overcome extremely complex processes. To add to the challenge, customers are accustomed to accessing
information when they want it, meaning the applications need to always be available, in an instant.

In order to overcome these complexities, organizations should leverage these practices to properly define application requirements. This will allow application teams to execute more efficiently, lower costs, and eliminate rework—all while meeting the needs of the business and providing instant results to customers. There is much to learn about improving the usability and value of requirements from agile development methods, where user stories (really just another term for requirements) are at the heart of the process.

Which is easier to understand?

2. Customer enters ID and password.
3. System checks ID:
   a) If ID doesn’t exist, display error message and return to step 2.
   b) If ID does exist, continue to step 4.
4. Check password:
   a) If password doesn’t match ID, display error message and return to step 2.
   b) If password matches ID, continue to step 5.
5. Authenticate user and display next screen.

Figure 1: EAuth Process

The Level of Access logic E- Authorization from Figure 1 is implemented in UACS application. The Certification application will aggregate the user accounts, role and org
assignments from all Wells Fargo mixed financial systems into a central repository, which will be administered by Financial Management. On a quarterly basis, this user access information will be staged in the Certification application in its entirety. An algorithm will be used to select 25% of the user community for certification. There will be three application roles: Reporter, Certifier, and Administrator. The Certification application will then be used by Supervisors to certify user accounts and roles. Results of the Certification Period will be aggregated and exported for each mixed financial system for action by the external systems.

External interfaces will be built to move data between Certification and the mixed financial systems (system-specific user-role-org information), Human Resources (user-supervisor information), Onboarding (new Agency employee information), Separations (termination events, retirement events, etc.). This information will all be moved through staging tables in the Certification application.

Summary

In this chapter background related to the problem, literature related to the problem and literature related to the methodology used for designing and implementation oracle API’s for Oracle Application. Design of the study, data collection process, techniques used to analyze the data, and timeline of the project will be discussed in the next chapter.
Chapter III: Methodology

Introduction

This chapter gives a detailed idea of the design of the project and the methodology used to implement the project. The data collection method and timeline of the project are also discussed in this chapter.

Design of the Study

The Certification application API’s are being developed using PL/SQL, the Oracle procedural extension of SQL high-performance transaction-processing language and the Application is developed in Oracle JDeveloper 11 using Oracle ADF Business Components for the data model, and JSF for the presentation layer. ADF BC (Application Developer Framework Business Components) is the new Oracle term for BC4J (Business Components for Java). The two terms will be used interchangeably.

The Certification application will aggregate the user accounts, role and org assignments from all Wells Fargo mixed financial systems into a central repository, which will be administered by Financial Management. On a quarterly basis, this user access information will be staged in the Certification application in its entirety.

An algorithm will be used to select 25% of the user community for certification. There will be three application roles: Reporter, Certifier and Administrator. The Certification application will then be used by Supervisors to certify user accounts and roles. Results of the Certification Period will be aggregated and exported for each mixed financial system for action by the external systems.
The Certification Period Cycle

Figure 2: Certification Period Cycle

Figure 2 shows the certification period cycle in which external interfaces will be built to move data between Certification and the mixed financial systems (system-specific user-role-org information), Human Resources (user-supervisor information), Onboarding (new
Agency employee information), Separations (termination events, retirement events, etc.). This information will all be moved through staging tables in the Certification application.

The Certification application will run on the I-Web servers at WFDC but will not be branded with the I-Web logo. End users will be required to authenticate with WFC EAuthentication in order to use the application. The Certification application will have an interface with the I-Web UMA data in order to facilitate quarterly transfer of users and credentials since I-Web is one of the Agency mixed-financial systems. There will not be a Certification dependency on UMA. End users will be given a separate URL in order to access the application outside the I-Web login process.

**Note:** During Phase 1, interfaces with external systems will be performed manually. Phase 2 will implement live interfaces to automate integration with the external systems. External systems will be responsible for implementing outbound and inbound interfaces on their respective systems, and for acting upon the Certification decisions subsequent to closing of each Certification Period. External systems will likely implement this as a manual process during Phase 1.
Figure 3: Certifier Use Case

Figure 3 shows the certifier use case during certification period for every quarter. The user will be first authenticated from E-Auth Server for Level of access. Once the access has been cleared the search for users home org can be done which allows the certifier to certify and review the certifications. All these certified changes are committed during the cycle and are removed from future search results.
The UACS-UMA Synchronization Process

Figure 4, UACS-UMA Synchronization process, initiates once the certifier certifies all the users during cycle period. Once it is updated it validates in UMA if the user is active or...
not and based on the result set user would be archived. The process also validates the user org for the role and update the DB accordingly.

**Data Collection**

Before the application started to build following were few important data collected by the team members, management (users).

- Type and version of the DB and Application servers to be used depending on the load to be handled and cost involved in purchasing the licenses and maintaining them.
- The number of client systems needed based on the number of developers.
- Documents and information related to the applications which are to be integrated.
- Number of data-tables in the database required depending on the data collection and the department.
- Design of the database schema to be followed throughout the project.
- User selective fields that were mandatory so as to reduce the data for analysis and increased the performance.
- Tracking system to be used for version controlling and check-in the code.
- Number of web pages required and relationship/links between them. Should also take care of the flow of data from page to page.
- The fields which required scripting for additional functionality. Like data binding/retrieving. If so what would be the kind of script (Procedures, triggers) and what events, methods are required.
- The required fields to be used in generating the reports.
• Workflows required for automation of business process like sending the invoices to client.
• Application Integration needed for exchanging data between database and the application.

Data Analysis

Considering all the requirements and analyzing the project, the application satisfies the business needs which help the users to audit the secured data and certifies the user roles this is a mix of quantitative and qualitative approach which can be more useful. The company followed qualitative approach for analyzing the results by different testing methods like functional, stress, Integration, User Acceptance Testing (UAT) and also performance test.

Budget

The Budget allocated for the project is around $8 million. The Budget includes server costs, equipment costs, database cost, database maintenance cost, software costs, software licenses, maintenance costs and the salaries.

Timeline

The Timeline for the project is 1 year. Below are the milestones achieved for the project.
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<th>Milestone Description</th>
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<td>Update GUI Design to reflect implementation, Document JDeveloper BC4J/ADF. Design Update ORACLE database design and Phase I enhancements</td>
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<tr>
<td>1.2</td>
<td>April 2015</td>
<td>Update ORACLE database design and Phase II enhancements</td>
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<tr>
<td>1.3</td>
<td>June 2015</td>
<td>Update design to include web Methods interactions and Operations Manual. Update Code to reflect Email process extraction from web Methods</td>
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<td>1.4</td>
<td>July 2015</td>
<td>Add steps to operations manual to notify management when BASE ticket needed</td>
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<tr>
<td>1.5</td>
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<td>Transition updates, Testing</td>
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<td>1.7</td>
<td>Oct 2015</td>
<td>Final Defense</td>
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**Summary**

In this chapter the study for the process, documents, data collection and the process of collection, flow diagrams, budget, and timeline of the project was discussed. The actual analysis of data will be discussed in the next chapter.
Chapter IV: Data Presentation and Analysis

Introduction

This chapter focuses on explaining the client’s new application development process which occurs in two phases in which developing Oracle Database API’s using PLSQL Code, building GUI using Java Developer and API’s for Jasper reports. The chapter explains how data that was in crude form was processed in order to satisfy the need of the end user for this kind of analysis and reporting. It also specifies user data and roles from different sources, legacy systems, interfaces need to be kept in track for audit purpose on a fiscal year basis.

Data Design Presentation and Analysis

As part of the project implementation, the development approach is explained in data design, application design and reports.

2.1 Database objects. Figure 5 shows the Certification application is located in the new CERT database schema within the I-Web database. The application will be self-contained within that schema, having no foreign key dependencies on other I-Web tables, and has the following proposed data structure:
Figure 5: Data Model for IWEB Cert Schema
2.2 Database Processes.

2.2.1 I-Web Interface. Each external system requires an inbound interface needed to stage user and credential information. Each external system also requires an outbound interface needed to stage user and credential certification action items for consumption by each external system. A standard format for this information from all external systems will be based on the CERT_INTERFACE_USERS and CERT_INTERFACE_CREDENTIALS tables. Some external systems may require some unique data elements; these data elements will be added to the interface tables so that the same set of tables can be used by all external systems.

The following process describes a typical inbound interface from an external system such as I-Web. The external system will perform the following steps:

- Create interface record in CERT_INTERFACE—this will be a standard record to be inserted with the appropriate values for an inbound interface.

- Stage all user records in CERT_INTERFACE_USERS—this will require a custom process to aggregate user records having active mixed-financial roles assigned within the system.

- Stage all user credential records in CERT_INTERFACE_CREDENTIALS—this will require a custom process to aggregate user-role-org records for mixed-financial roles by Wells Fargo.

- At this point, the Certification data merge processes will be invoked which will process the staged interface data and aggregate with the existing Certification data for the currently open Certification Period. These data merge processes
will be a generic process within the Certification application; they are described within this document (CERT_INTERFACE_PKG).

Note:

1. All system roles and their descriptions are present in CERT_SYSTEM_ROLES. If an unknown role appears on the interface, a record will automatically be created in CERT_SYSTEM_ROLES.

2. All users from external systems are mapped in CERT_SYSTEM_USER_MAP. Based on the user information in CERT_INTERFACE_USERS a record will automatically be created to facilitate future mapping so that user records from a particular system can be identified using the original external identifier upon export.

3. Package CERT_INTERFACE_PKG handles all interface processing of straightforward external systems as NITC, IAS, FTRS, FFIS, NFC, FDW, ASR Interfaces.

4. This interface data is staged by a script running on the Certification database. This interface can also be run multiple times. After loading large numbers of new users into the Certification base tables, this interface should be run to update the supervisor and other missing eAuth fields.

### 2.2.2 Employee Onboarding Interface

CERT_INTERFACE_PKG. This interface was based on the ONBOARDING interface data from HR. Whenever a user is activated in the Wells Fargo, a record will be provided to the Certification application and loaded into the CERT_INTERFACE/CERT_
INTERFACE_USERS table. This is an HR interface of type ONBOARDING. Onboarding a user in this way will either activate an INACTIVE user pre-existing in CERT_USERS, or provision a new user in CERT_USERS designating status ACTIVE.

**2.2.3 Employee Separations Interface.**

CERT_INTERFACE_PKG. Inbound interface needed to stage a list of users separated from service with the Agency. This list of users will be deactivated in the list of Agency users recorded in the Certification application. When action is taken in the Certification application based on this interface, a subsequent outbound interface will be generated for all External Systems also directing them to disable the accounts in question. CERT_USERS status after SEPARATION will be SEPARATED.

**2.2.4 Data Merge Process for Interfaced Users.**

CERT_INTERFACE_PKG. Users interfaced from external systems are matched to existing Certification users using the mapping process / algorithm described in a section below. As part of this mapping process, the user record may be updated depending on what fields the external system records. Primarily, the First, Middle, Last names will be used as a key for each user record. So, for instance:

- EmpowHR: If the interface is from HR and specifies that a particular user is a Supervisor, then the user roles will be updated in the Certification application (System: HR, Type: SUPERVISORS).
- EmpowHR: If the interface is from HR and specifies a different home organization, phone number or supervisor name, then the user record will be updated (System: HR, Type: UPDATE).
Employee Onboarding: If the interface is from the onboarding authority and indicates that a new user should be provisioned in the Certification application, a new record will be created in CERT_USERS. (System: HR, Type: ONBOARDING)

Employee Separations: If the interface is from the separations authority and indicates that a user should be removed from the Certification application, the user account will be deactivated in the application. (System: HR, Type: SEPARATIONS)

External System: If the interface is from an External System and specifies a different home organization, phone number or supervisor name, then the user record in the Certification application will not be updated. The Certification application will be considered the authority. It is recommended that eventually the External System be notified that their user information is incorrect. A mismatch could also indicate that the mapping was incorrect. This could happen at the end of each Certification Period when the user mapping exercise has been completed. (System: ANY, Type: EXTERNAL SYSTEM)

2.2.5 Data Merge Process for Interfaced Credentials.

CERT_INTERFACE_PKG. User credentials from external systems are matched to existing Certification users using the mapping process / algorithm described in a section below. If the matched user will participate in the current Certification Period (based on the random selection described in another section below) then the credentials for that user will be
loaded into the Certification Set to be evaluated by the Certifiers. At this point, missing system roles will be automatically provisioned in CERT_SYSTEM_ROLES.

These automatically created roles should later be updated to provide meaningful descriptions— if the roles should be excluded from the Certification application, the status should be set to INACTIVE, such roles will be ignored in the User Interface. By default, everything on the interface for users in the current period is loaded into the base tables.

2.2.6 User Mapping Process / Algorithm.

CERT_UTILITY_PKG.map_user(). Since there is no unique identifier for Wells Fargo users across Agency mixed financial systems, an algorithm attempt to match users across the external systems based on criteria is determined. This is necessary to accommodate the eventuality that multiple external systems will contain the same user but identify that user differently. An initial mapping exercise will be required when the Certification application is first used, however an ongoing process is necessary as the external systems provision new users not covered in the initial user mapping. The following mapping attempts take place:

- Check CERT_SYSTEM_USER_MAP for system specific user mapping
- Check CERT_USERS.EID for direct match
- Check CERT_USERS First, Middle, Last for direct match
- Check CERT_USERS First, Middle, Last for direct match (remove JR/SR/II…)
- Check CERT_USERS First, Last for direct match where First, Last are unique
- Check CERT_USERS Last, Email for direct match
- Match based on email address alone for Lotus Notes interface
There will be a large one-time data mapping exercise prior to Certification application stand-up. There will also be a need for an ongoing mapping exercise when new users are provisioned in an External System and appear on the inbound interface for the first time. eAuth will also be involved to map as many users as possible to eAuth IDs—this mapping will be critical to end-user login integration.

2.2.7 Admin Open Period Process.

CERT_ADMIN_PKG.CREATE_PERIOD(). When a new Certification period is planned, this API is used to create the record in CERT_PERIODS with status NEW.

CERT_ADMIN_PKG.OPEN_PERIOD(). A process to perform all the database setup when creating a new Certification Period. This process will perform the following:

- Create new period in CERT_PERIODS
- Update NEXT_PERIOD in CERT_USERS to set the next Certification Period for users in previous Period. There should always be at least four Certification Periods into the future so that there is a Certification Period to which NEXT_PERIOD may be set when opening.
- Interface files from external systems will be processed
- Update period to OPEN to begin Certification

There are four Certification Periods each year. When each Certification Period is created, a random selection of 25% of the users will be assigned to that period. This random selection is from the pool of users in CERT_USERS. (If new users are identified on an interface during a Certification Period, they are certified in subsequent Certification Periods.) The system is designed to work this way because new users cannot be identified until after the
external system information is merged into the base tables—which requires that the period users be known in advance.

2.2.8 Admin Close Period Process.

CERT_ADMIN_PKG.CLOSE_PERIOD(). A process to wrap up the database records needed to close the currently open Certification Period. This process will perform the following:

- Update the period to CLOSED to end Certification
- Generate Certification result reports for external systems

2.2.9 Admin Add New System Role.

CERT_SYSTEM.Roles. Unrecognized roles on the interface will automatically be provisioned in CERT_SYSTEM.ROLES. A manual process was used to create additional System Roles as well as update exiting roles. The following fields should be populated for each System Role which are eligible for certification within the Certification Application:

- **System** = the external system in which this role resides
- **Role** = the unique role name identifier
- **Common Name** = the displayed name of the role, if any
- **Status** = indicates whether this role participates in the Certification process
- **Description** = narrative describing the functionality that this role gives to grantees.

This narrative is visible through the GUI.

- **Application** = the application to which this role belongs, for systems such as I-Web
2.2.10 Create Certification Period.

CERT_ADMIN_PKG.CREATE_PERIOD(). The process will create a new Certification Period in CERT_PERIODS. The new period will have a status of NEW. See Admin Open Period Process.

2.2.11 Close Certification Period.

CERT_ADMIN_PKG.CLOSE_PERIOD(). The process is created which will close the Certification period. This will change the status of the period in CERT_PERIODS to CLOSED at which time Certifiers will no longer be able to use the Certification Application. Closed periods can be re-opened by calling the CERT_ADMIN_PKG.OPEN_PERIOD() API as documented earlier—a period may be re-opened only if no other period is already open.

2.2.12 Merge User Process.

CERT_ADMIN_PKG.MERGE_USERS(). This API will allow the Certification administrator to merge two Certification users who are in fact the same user. This process will be useful during the Certification period when a user is not properly mapped on the interface from one or more External Systems. In this case, two users may be specified, the first user will be unaffected, all records for the second user will be re-assigned to the first user. This will include Certification records at User/Role level. This will not affect historical records such as Activity logs or Interface records. A record will be put in the Activity log which indicates that the merge took place.

2.2.13 Add Role.

CERT_ADMIN_PKG.ADD_ROLE(). This API is used by the GUI to assign Certification roles (CERTIFIER, REPORTER, ADMIN) to system users. New roles are added
in the ACTIVE status. If a role exists in INACTIVE status, the role will be activated by this API.

**2.2.14 Remove Role.**

CERT_ADMIN_PKG.REMOVE_ROLE(). This API is used by the GUI to unassign Certification roles (CERTIFIER, REPORTER, ADMIN) to system users. Existing roles in the ACTIVE status will be set to INACTIVE. This API has no effect if the requested role is not already assigned.

**2.2.15 Send Employee Emails.**

CERT_ADMIN_PKG.SEND_EMPLOYEE_EMAILS(). This API is used by operations to send out the batch of UACS emails to each employee affected by the current certification period. Only users with certifications remaining will receive the emails. Email batches are sent twice during each UACS Certification Period. First, at the beginning of the period when it first opens, and second, late in the Certification Period as a reminder. Any users with uncertified role-orgs will receive the emails when sent, this necessarily means that only a subset of users will receive the second batch of emails (only those users that have remaining uncertified role-orgs). When run, this API inserts records into II_EMAILS, and also logs an event in the CERT_ACTIVITY_LOG.

**2.2.16 Send Supervisor Emails.**

CERT_ADMIN_PKG.SEND_SUPERVISOR_EMAILS(). This API is used by operations to send out the batch of UACS emails to each supervisor with employees affected by the current certification period. This API is run in conjunction with “Send Employee
Emails”. These two APIs will eventually be incorporated into the Admin GUI. When run, this API inserts records into II_EMAILS, and also logs an event in the CERT_ACTIVITY_LOG.

2.3 Reports. Reports are generated manually during Phase 1 with some functionality being implemented in Phase 2 through the GUI. Reports are accessible through the GUI using the “Reports” tab which will be enabled for all users assigned the Certification REPORTER role. Reports may be generated during an OPEN certification period, or at the end of a CLOSED certification period. There are different categories of reports: the canned reports are the official record generated at the end of the certification period–these reports are furnished to the external systems to act upon the certifications made by the supervisors during the period; there are also adhoc and admin reports which are used informally to gauge progress during a certification period, or to investigate issues during/after a certification period. The Certification ADMIN role will be required to run the administrative reports.

All reports are served from the same GUI page within the application and will share substantially similar report parameters. This design will support the rapid additional of new reports which may be deemed necessary.

The following reports will be necessary:

2.3.1 Canned Report: ASC B&F Security. This report are run at the end of a CLOSED certification period. This report generates a list of certification actions which were produced as part of the certification period. This report includes actions for all external systems excluding I-Web. Anyone with the REPORTER role may run this report. This report is generated as a read-only PDF.
2.3.2 Canned Report: I-Web Security. This report are run at the end of a CLOSED certification period. This report generates a list of certification actions which were produced as part of the certification period. This report only includes actions for I-Web. Anyone with the REPORTER role may run this report. This report is generated as a read-only PDF.

2.3.3 Canned Report: Regional Report. This report are run at the end of a CLOSED certification period. This report generates a list of certification actions which were produced as part of the certification period. This report only includes actions within a specific Region or Organization. Anyone with the REPORTER role may run this report. This report is generated as a read-only PDF.

2.3.4 Canned Report: Uncertified Users. This report are run at the end of a CLOSED certification period. This report generates a list of user role-orgs for which no certifier action was made during the certification period. This report is unrestricted, however if the size of this report is sufficiently large additional restrictions may be necessary. Anyone with the REPORTER role may run this report. This report is generated as a read-only PDF.

2.3.5 Adhoc Report: Full Report. This report are run at any time on periods either OPEN or CLOSED. This report generates a list of user role-orgs and associated action or lack thereof for a specified certification period. This report is unrestricted, however if the size of this report is sufficiently large additional restrictions may be necessary. Anyone with the REPORTER role may run this report. This report is generated as a read-only PDF, or an Excel file or HTML page.
2.3.6 Admin Report: Full Report. This report are run at any time on periods either OPEN or CLOSED. This report generates a list of user role-orgs and associated action or lack thereof for a specified certification period. This report is unrestricted, however if the size of this report is sufficiently large additional restrictions may be necessary. The admin report is similar to the adhoc report but includes additional fields. Anyone with the REPORTER and ADMIN role may run this report. This report is generated as a read-only PDF, or an Excel file or HTML page.

2.3.7 Admin Report: Login History. This report are run at any time. This report generates a historical list of user logins from the Certification activity history. Anyone with the REPORTER and ADMIN role may run this report. This report is generated as a read-only PDF, or an Excel file or HTML page.

JDeveloper Application Design: The Certification application is being developed using Oracle JDeveloper 11 using Oracle ADF Business Components for the data model, and JSF for the presentation layer.

3.1 ADF BC Data Model. ADF BC (Application Developer Framework Business Components) is the new Oracle term for BC4J (Business Components for Java). The two terms will be used interchangeably.

The following entity objects are created in BC4J to allow the application to update data in these underlying tables. Data which is only displayed will not require an entity object as read-only access can be accomplished through a BC4J view object.

Entity Objects:

- Periods (CERT_PERIODS)
- SetCredentials (CERT_SET_CREDENTIALS)
- SetUsers (CERT_SET_USERS)
- SystemRoles (CERT_SYSTEM_ROLES)
- Users (CERT_USERS)

View Objects (* indicates updateable):
- Admin\AdminInterfaces
- Admin\AdminInterfacesUsers
- Admin\AdminInterfacesCredentials
- Admin\AdminUserCertifications
- Admin\AdminUsers
- Reports\reportLovActionCredential
- Reports\reportLovActionUser
- Reports\reportLovApplication
- Reports\reportLovFiscalYearAll
- Reports\reportLovFiscalYearClosed
- Reports\reportLovOrgs
- Reports\reportLovPeriodAll
- Reports\reportLovPeriodClosed
- Reports\reportLovRegion
- Reports\reportLovSystemAll
- Reports\reportLovSystemASC
- CertCredActionsView
- CertCredentialsView *
- CertHomeOrgsView
- CertPeriodsView
- CertUserActionsView
- CertUsersView *

Figure 6: Application Module

- Figure 6 should contain no variables which require passivation
- Key Methods:
  - getCertifierCn()
- `getDatabaseTransaction()`
- `getUserCn()`
- `handleAddRole()`
- `handleAdminClosePeriod()`
- `handleAdminCreatePeriod()`
- `handleAdminOpenPeriod()`
- `handleCertify()`
  - Called by certify button on review page. Causes temporary certifications to be moved to the action/remarks columns and committed to database
- `handleCertifyMultipleRoles()`
  - API called on Roles page when multiple records are selected and mass certified
- `handleCertifyMultipleUsers()`
  - API called on Users page when multiple records are selected and mass certified
- `handleRemoveRole()`
- `handleReviewPrevious()`
  - Does nothing. Used to be necessary when filter functionality was active.
- `handleRoleContinue()`
  - API called when user continues from Role page.
  - call `handleReviewPrepareUserReviewNew()`
  - call `handleReviewPrepareRoleReviewNew()`
o handleRoleFilter()

o handleRolePrevious()

o handleSearch()
  • Perform search by filtering the CertUsersView

o handleUserContinue()
  • Apply filter criteria to the CertCredentialsView after user selections made on
    the User page.

o handleUserFilter()
  • Filter the displayed users based on selection. Deprecated.

o handleUserPrevious()
  • Does nothing. Used to be necessary when filter functionality was active.

o launchCertification()
  • This API is called when the user initially logs in. The request parameters are
    passed, this API makes several database calls to construct the user context
    including which Certification roles are assigned, the current period, whether
    the current period is open, etc.

o setUserCn()

Page Binding Plan:

o Search Page,
  • This page contains a form with multiple search options. The following fields
    are presented: Organization field will be free form text. User Last Name will
    be free form text. Supervisor Last Name will be free form text. The user will
click a Search button which will set the where clause of the User BC4J view and set the max fetch size so that records are returned. The user will be redirected to the Search results page.

- gHomeOrgList stored in Session Bean
- gSearchUserLastName stored in Session Bean
- gSearchSupervisorLastName stored in Session Bean

Search Results Page,
- This page contains a JSF table showing a list of users. This table will be bound to the User BC4J view. The user may select multiple records using the multi-select checkbox on each record. Fields will be read-only except Action will be a combo box and Remarks is free form text. Remarks is required if Action is set. The user selections will be stored in an array in the Session Bean. The user will click a Continue button which will set the where clause of the Certification Set BC4J view. The user will be redirected to the Details page.
- gUserList stored in Session Bean

Certification Page,
- This page contains a JSF table showing a list of User-Role-Orgs. This table will be bound to the Certification Set BC4J view. Fields will be read-only except Action will be combo box and Remarks is free form text. Remarks is required if Action is set. All records will be selected by default, the user may deselect multiple records using the multi-select checkbox on each record. When the user then clicks Continue, the user updates will be posted to the
database by BC4J and Certifier records created if appropriate. The user will be redirected to the Review page.

- gRoleList stored in Session Bean

  o Review Page,

  - This page contains a JSF table showing a list of User-Role-Orgs. This table will be bound to the Certification Set BC4J view in read-only mode. Only records previously certified (Action != null) will be shown, so the where clause will be the same as the Certification page. The user will click a I Certify button which will commit the changes to the database. The user will be redirected to the Thank You page.

  o Thank You Page,

  - This page contains a short narrative which thanks the user for participating in the Certification Period. The user is allowed to return to the Search page to perform additional Certification activities.

  o Welcome Page

  - This page contains a splash page for the application and an invitation to authenticate. During authentication, the user will be redirected through an eAuth integrated login process.

  o Main Menu Page

  - Note: The main menu page was not created in favor of using tabs instead.
3.2 JSF Page Design, User Interface Flow.

3.2.1 Welcome Page. Initial splash page. This page has been removed in favor of having the user navigate directly to the login URL: http://iweb.wellsfargo.com/login/login_cert.jsp.

3.2.2 Main Menu. Menu page which will instruct user to choose between Certifier, Reporter, Administrator. This functionality is implemented using tabs within the application. Not all users will be able to perform multiple use cases. Tabs for functionality not available to a particular user will be disabled.

3.2.3 Certifier Use Case. Certifier use this series of pages to perform Certification of users. This series of pages will be transformed into a workflow using a train rather than multiple tabs as it is rendered in the following preliminary screen captures. The narrative shown in the Information boxes is currently filler and may be changed in any way.

A) Search. The Certifier will use this page to search for users within the set of users eligible for Certification during the current Period. Only UNCERTIFIED users who have not already been acted upon will be returned by this search. Any Supervisor may search for any Users by the following fields: Organization, User Last Name or Supervisor Last Name. Ability to search by Supervisor Last Name assumes that we have the data from HR to permit this–this assumption is logged in the assumptions section of this document. The user will have the ability to select multiple organizations using a list control.
Figure 7: Search Page

B) Search Results. From Figure 7 the Certifier will review the results of their search and select an appropriate ACTION. The Certifier selects the users which they would like to work with by using the checkboxes. Clarification needed on desired functionality here. The user will have the option of returning to the previous step to reset their search criteria. ACTIONs include: RETIRED, SEPARATED. Remarks may be entered for any Action.
Figure 8: Search Results and Certify

C) Certification Details. Figure 8 specifies results and certifier will certify each Role and Organization for individual users filtered based on their search criteria, and select an appropriate ACTION and RESULT for Role-Org specific certifications. The Certifier selects the users which they would like to work with by using the checkboxes. Clarification needed on desired functionality here. The user will have the option of returning to the previous step.

ACTIONs include: ROLE/PROFILE IS CORRECT, ROLE/PROFILE NEEDS TO BE UPDATED, REGION/UNIT NEEDS TO BE MODIFIED, DEACTIVATE

REASONs include: MODIFY REGION/UNIT, JOB DUTIES CHANGED, OTHER. Reason may only be selected if Action is selected.
Remarks may be entered for any Action/Reason.

* Remove Reason?

D) Review. Figure 10 shows the certifier role by which certifier will be shown their certification decisions from the Certification Details page (this page will also change to show decisions at the user-level). The user will have the option of returning to the previous step. This workflow uses tabs, these tabs will be replaced by a train-type workflow. When user chooses to Certify, pop up a warning window for user to confirm.

- No need for selection on this page
- “I Certify” button needed
Thank you.

Figure 10: Review Certification

E) Thank you. From Figure 11 the Certifier will be notified that their Certification decisions have been recorded in the database and they may start the Certification process again by returning to the search page. Again, the current screen captures show tabs but these will be replaced by a train-type workflow for the Certification use case.

Warning message presented to user indicating that if they wish to change the access for a given user they need to submit the proper paperwork to the External System.

Figure 11: Record Certification
3.2.4 **Reporter Use Case.** Reporter will use this series of pages to generate reports on open/closed periods.

*These pages will be part of Phase 2–During Phase 1, this will be done manually via database scripts.*

3.2.5 **Administrator Use Case.** The Certification system administrator will use these pages to perform admin functions including open/close period, batch interface uploads, etc.

*These pages will be part of Phase 2–During Phase 1, this will be done manually via database scripts

3.2.5 **Admin: Manage Periods.** Figure 12 shows manage periods page will be used by the certification system administrator to open, close and create new periods. Only one period may be OPEN at a time. Periods are initially created in a NEW state. After a certification period has run its course, the status is updated to CLOSED.

![Figure 12: Period Management](image)
3.2.6 Admin: Manage Users. Figure 13 shows manage users page will be used by the certification system administrator to assign certification system roles CERTIFIER, REPORTER and ADMIN. This page will also be enhanced to allow the administrator to update user data fields which may have been incorrectly set from an external system. The admin will also have the ability to merge duplicate users into one Certification user on this page.

Figure 13: User Management

3.2.7 Admin: Undo Certifications. Figure 14 shows undo certifications page will be used by the certification system administrator to undo certifications incorrectly made by supervisors.
Figure 14: Undo Certifications

3.2.8 Admin: Manage Interfaces. Figure 15 shows manage interfaces page will allow the system administrator to review the results of past interface runs. Errors can be reviewed in the interfaced users and credentials—the interface files not yet run can also be reviewed. This list of problem records is an indicator of records which require deeper investigation to maintain integrity of the Certification system data.
3.2.9 Error Page. Figure 16 shows error page which will be shown to users not authorized to use the Certification application with one of the valid use cases based on their application role (Certifier, Reporter, Administrator). The user will be instructed to contact the Certification Application administrator if they feel they should have access to the application.

Figure 16: Problem Launching App
The error page may display any of the following errors:

- A problem was encountered verifying the authenticity of your eAuth login. Please attempt to log in again, if this problem persists, please contact the Certification application administrator (Error code = Login Mismatch Error).

- A Certification application profile could not be matched to your eAuth account. Please contact the Certification application administrator (Error code = User Match Error).

- The Certification application requires Wells Fargo eAuth Assurance Level 2. Your account appears not to meet this requirement. Please contact the Certification application administrator (Error code = eAuth Assurance Level).

- The Certification application profile to which your eAuth account is linked is INACTIVE. Please contact the Certification application administrator (Error code = User Inactive Error).

- The Certification application profile to which your eAuth account is linked does not have any Certification roles. If you are a supervisor and require access to the Certification application, please contact the Certification application administrator (Error code = No Role Error).

- Your Certification profile is active and your account is able to perform certifications, however the current Certification Period is not OPEN. Please contact the Certification application administrator for information about when the next Certification period will open/close (Error code = Period Closed Error).
An unexpected error occurred while linking your eAuth account to a profile in the Certification application. Please contact the Certification application administrator (Error code = Unknown Error).

3.3 Software Interface.

3.3.1 External System Interface. For Phase one, the interface with the external systems will consist of a set of three staging tables. External systems will provide the Certification system administrator with flat files in a yet to be determined format—these files will then be staged in the interface staging tables and the data will be loaded by invoking the interface processing code in CERT_INTERFACE_PKG.

3.3.2 User Interface. The user interface will be designed and developed in JSF using Oracle JDeveloper. The user interface will adhere to the I-Web development standards but will be branded with the I-Web logo. The application will be accessed directly, not via the I-Web Welcome page and Dashboard. The application will still facilitate eAuth authentication through modification of the existing I-Web login security framework.

Summary

This chapter explained the data model, dataflow, design, implementation and analysis of data from external interfaces using the UI application to generate reports for business requirements and auditing purpose. In the next chapter, the results achieved by this implementation and the inferences are listed out.
Chapter V: Results, Conclusions, and Recommendations

Introduction

This chapter explains the business requirements achieved by the organization by implementing the new UI application using Oracle API’s. This chapter also explains the key conclusions, important recommendations and answers the project questions.

Results

The organization now has a robust and a user friendly application which meets the user requirements. The UI Application now help users in visualizing critical data and also help the supervisors to certify the uses dynamically during every quarter to keep track for auditing purpose. The fully integrated UI Application uses various API’s in the background which are developed using oracle PLSQL programs to full fill the business needs. This project implementation helped to improve the efficiency of decision making process.

The UI application was flexible and easy to use for the end-user. The reports generated during certification process period helps the supervisors for auditing purpose and also helps make them business decisions.

The documents developed by the developers while developing the application should be such a way that the end-user can refer them in future for further assistance or can be used as training materials.

Project Questions

Q) What type of data mapping integrations implemented for external systems?

A) The Integrate the data mapping from all different external sources the implementation method used is an ETL Process approach which helps the all the data to
extract from various external source files, transforming all the data and loading into the appropriate base Db tables. The algorithm is written using oracle PLSQL API’s which helps the following steps.

**Receive:** Business email the interface file(s) for each external system to you. There are almost 20 systems to which UACS interfaces and needs to import file before the Certification Period can begin. Those agreed-upon formats are eventually massaged, transformed or edited into the standard format.

**Clean-Up:** The files only conform to the agreed-upon format half the time. This step requires that you clean up and/or massage the data so that it can be loaded into the UACS interface tables. Past errors at this stage have included:

- First name and Last name reversed
- Column names spelled incorrectly
- Worksheet names spelled incorrectly
- Required fields missing (first, last names, home org, access org, role, …)
- Truncated fields (Middle name cut off at 3 characters, …)
- Junk data
- Merge columns (Home org reported as columns Region, District)
- Split columns (Full Name column instead of First, Middle, Last)

**Transform:** Some files (such as HR) provided by the Systems have multiple tabs, or otherwise need to be re-formatted into the standard file format. There is a batch file for each system which accomplishes such transformation. The transformation process will generate an
Excel spreadsheet in the standard format. For instance—the HR transformation will create five separate Excel files, one for each type of interface contained in the single HR file we receive.

- For each file marked as “transformed” below, you must transform the file into the standard file format using the transform_xxxx.bat files under C:\working\UACSInterfaceParser\Validate

- These system filename prefixes, and Excel workbook names (in parentheses) are:
  - HR File:
    - HR–SEPARATIONS (Separation) transformed
    - HR–ONBOARDING (OnBoarding) transformed
    - HR–SUPERVISORS (SupervisorOnBoarding) transformed
    - HR–UPDATE (ReassignUserHomeOrg) transformed
  - ASR–EXTERNAL SYSTEM
  - IAS–EXTERNAL SYSTEM
  - FTRS–EXTERNAL SYSTEM
  - BVAS–EXTERNAL SYSTEM
  - IBS–EXTERNAL SYSTEM (IBDB) transformed
  - FFISSTAB–EXTERNAL SYSTEM (FFIS) transformed
  - FFISUSID–EXTERNAL SYSTEM (FFIS) transformed
  - NFCUSER–EXTERNAL SYSTEM (NFC) transformed
  - NFCROLE–EXTERNAL SYSTEM (NFC) transformed
  - NITC–EXTERNAL SYSTEM
  - PAS–EXTERNAL SYSTEM transformed
- POSS–EXTERNAL SYSTEM
- WCF–EXTERNAL SYSTEM
- FDW–EXTERNAL SYSTEM
- MITS–EXTERNAL SYSTEM
- IWEB–EXTERNAL SYSTEM (direct interface, there is no file)
- PAYCHECK–PAYCHECK (PaycheckData)

**Load:** The files are loaded into the UACS interface tables using the SQL Loader and Parser. The Parser/batch script utilizes a standard file format described in which specifies a list of user-credentials, all interface files being loaded must eventually conform to this format.

- Set the database credentials in resources.properties file to point to Production.
- Load the standard format files using the batch file for each interface file in the format
- Review the files staged in CERT.CERT_INTERFACE, CERT.CERT_INTERFACE_USERS and CERT.CERT_INTERFACE_CREDENTIALS. Note the interface CN for each file and use those CNs to process the files in the next step.
- Ensure that there is data in the CERT_INTERFACE* tables for every file loaded. Perform a rudimentary check that the data was actually loaded into the Interface tables–those interface tables are the system of record out of which we report to auditors sometimes.

**Q:** What kind of certifications are done by financial supervisors using CERT?
A) The Agency supervisors use UACS UI Application to certify all the users during when the period is open for 6 weeks. During Certification Period, emails are sent out to Supervisors and Employees who still need to take action during the current period. If an employee has an UNCERTIFIED (null) Role, or a Supervisor has an employee with an UNCERTIFIED (null) Role, they will receive an email.

Q) What type of data is being Audited?

A) Activity Log Events: The activity log will maintain a history of audit events including database activities done through stored procedure which include activity logging. This table will constitute the audit log of the Certification system in combination with the certification records in the CERT_SET_* tables.

Activity Log History for a User:

select * from cert_activity_log where user_cn = &user_cn

- login attempts

- what other events are going to be tracked in the Activity log?

Q) What are the security implementations on data?

A) The eAuth login process happens entirely on the eAuth server—upon successful authentication, the user would be redirected back to the Certification application. All we are given is Last, Middle, First names, Email and eAuth unique ID. The unique ID is the key for the user (users may change their eAuth usernames in the future, so we are not given that). Each of our users would be matched to a unique eAuth ID. eAuth has performed mappings for other customers. After a mapping, each of our users (admin, supervisor, reporter) would have an associated eAuth ID specified. The users will not be 100% mapped, and as our user list
changes we would want a dynamic process to map them at run-time. I-Web has such a process

**Q)** What are the benefits to client for implementation of the project?

**A)** The client would have a centralized application by which all the organizational data can be audited and all the certification can be dynamically done every quarter which helps for year end reporting. All the data can be in track and sophisticated in a common data base to run all the applications and auditing. This help the organization to secure critical data and make better financial decisions.

**Conclusion**

The organization now has a centralized application which addresses all the limitations such as monitoring, adjusting, and validating employee data. The data that was in crude form was processed in order to satisfy the need of the end user for this kind of analysis. The user data and roles from different sources, legacy systems, interfaces kept in track for audit. The UACS UI application which not only allows supervisors to certify their subordinates from various source systems but also used for auditing purpose on a fiscal year basis.

As it is a financial industry having secured and critical data this centralized application helps to make business decisions, to reduce invalid transactions, etc. The users and their roles data was integrated from various external system and legacy system databases. The CERT application improves the performance and security of the user roles information and visualization of any abnormalities in the data. The client’s application provided the flexibility to obtain the data against various levels of business hierarchy and over a selected range of users on a quarterly basis.
Recommendations

The Certification application for financial management though it is a centralized process which addresses and resolves lot of business needs there can be still some enhancements to the algorithms and processes which help automate lot a steps by which it can reduce lot of manual intervenes within the current system.
References

Szymanski, F. (2011). *Four agile tips to eliminate rework in application development.*