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Contracts Database: Part of the Solution

Michael J. Caprioli
Regis University

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College for Professional Studies Graduate Programs
Final Project/Thesis

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Contracts Database: Part of the Solution

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School for Professional Studies

Master of Science in Computer Information Technology

Contracts Database 2

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MSCIT Program

Graduate Programs Final Project/Thesis

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Abstract

This document reviews the results of the implementation and aftermath of the Contracts Database, a 3 tier system using Java technology. Executive management at Intercontinental Research Foundation (IRF) decided to create a line of web applications for the research analysts to use as tools and create some consistency in the business process. The Contracts Database would be the first product in this initiative. This application would serve as an online database to be incorporated into the research analyst's daily routine. This document demonstrates the successful development of a web application and the potential pitfalls of trying to change business methodology.

Acknowledgements

I would like to thank God for providing me with the following people who have supported me over the years and throughout this project.

My wife, Amy, I love you and all that you are and all that you do for me.

Mom and Dad – Thank you for your continued help, support and understanding throughout the years

Thomas and Nicole Caprioli – Thank you for instilling in me the confidence to take on and accomplish anything

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Tyler J. Bessette – Thank you for the feedback and mostly, the friendship

Raymond Robertson – Thank you for providing me with your valuable expertise

Joseph Gerber – Thanks for steering the ship!

Gratefully,

Michael

Contracts Database: Part of the Solution

Chapter One

1.1 Introduction to Intercontinental Research Foundation

In 2004, Intercontinental Research Foundation (IRF) was a world class provider of market intelligence and advisory services for the information technology and telecommunications industries. IRF's diverse product and services portfolio spans five key areas including: print publishing, online publishing, market research, education and training, and global marketing solutions. IRF provided IT professionals and business executives in the investment community with the ability to make fact-based decisions on technology purchases and business strategy.

IRF employees enjoyed a team oriented working environment. The company had always promoted an environment where ideas and innovations were not only encouraged but, put into action. Many of IRF's most successful products were a direct result of the employee's own special vision and hard work.

Permitting such wide freedom in business practice eventually allowed the Research Service department within IRF to lose the competitive edge they had strived to earn. This lack in structure created the opportunity for a series of enterprise web applications to be developed.

1.2 eApplications – Contracts Database

The first of this series was the Contracts Database. The Contracts Database project provided an online content management and search tool for contracts based in the industry of science and high technology. Developed using Java technologies, the website provided a new business flow. In the past, researcher analysts kept personal record of contracts that they had

reviewed and discovered. There was no central location for this information. The analysts needed to have easy access to recent contracts when they were hired to write documents and research papers. Within each individual list of contracts, there was a lot of overlap. Also, it was impossible to view another analyst's list without the owner's permission. The goal was to keep a database of these contracts for the company's use. Moreover, outside sales would provide a much needed boost to the Research department's profit margin.

To fully automate the data storage process, a website portal to the Contracts Database had been developed. Internally, the website was accessible to anyone who was granted a login ID. External users had to pay for access rights. An administrative user maintained the information and research analysts were able to create contract entries by owning the rights to add records.

During the Information Age, speed and accuracy determine the difference between excellence and mediocrity. Applied equally, these two characteristics elevate performance quality. At Intercontinental Research Foundation, analysts need to gather a high percentage of past research repeatedly. The time wasted during this repetitious activity cost the firm. Not only does funding this wasteful process have a negative effect on the bottom line but, the company's reputation would suffer as well. Who wants to pay for information that could be gained in half the time and cost less?

To improve upon the time it took to gather information, the database was viewed as a critical implementation. Using Java technology allowed the application to be very scalable and reusable. Scalability allowed easy changes and upgrades while, reusability would facilitate the development of future projects possessing similar attributes. With this tool, research analysts gained the ability to quickly and effectively access high tech contracts to put into their papers and documents.

1.3 Obstacles

From the inception of the project, the end users' adaptability was viewed as critical to the success of eApplications. The Contracts Database would rely on how quickly the research analysts would accept a change in their work habits. In the past, research analysts were encouraged to store past reference material on the network. This was for data back up and legal reasons.

If a writer wanted to find out if anyone else had already discovered the appropriate information during a previous job, that writer would have had to ask every other employee. Past research could only be reused by one analyst unless operating system based access rights were granted to another person. Both of these necessary steps to share information absorbed too much of the analyst's time and the client's money. The users needed to accept the database and incorporate it into their daily routines. The project team would need to portray the software as a worthwhile tool.

Executive management believed that the Contracts Database would demonstrate the potential of the eApplications line of products. However, market forecasting in eCommerce was a daunting task based on changing trends. Consequently, pricing the web application was difficult for the management team assigned to the Contracts Database. There were only a handful of similar tools on the market and even this small selection did not offer quite the same functionality. Determining a competitive price range was perceived to be a problem.

1.4 Applicable Questions

This project dealt specifically with referencing technical contracts from around the world. A client would speak with one of the research analysts regarding a possible job. Once the requirements were agreed upon, the analyst could then approximate the amount of time needed

for completion. The base rate for research averages two hundred dollars an hour. Our clients pay this amount upon delivery of the finalized document. Would the system bolster income? Would the analysts utilize the system to its potential?

This project was to be a launching pad for the development of tools viewed to facilitate the analyst's job. Session tracking had been utilized to allow users to log in and save searches. Also, the log in functionality permitted database access to be sold to outside buyers. The new system was economically realistic. This product promised a great advance in the research Intercontinental Research Foundation delivered. Both time and money would be saved. What degree of success would the system deliver?

1.5 Limitations on Scope

Establishing the goal of the project was decided early on during the planning phase of the Contracts Database. The problems with the current system had been stated by the business executives. With these details, the objectives of the team were easily decided upon. The executives agreed that the Contracts Database project would be deemed a success if the objectives were met. Stating exactly what would be delivered, the project charter was signed by all of the major stakeholders.

The eApplications Contracts Database would be limited by the amount of data entered by the research analysts. The system was not designed to scour the Internet for solutions. A tool for data storage and retrieval, the Contracts Database was only as useful as the data recorded within the system.

Therefore, it was stated in the project charter that post deployment training and technical support would be the only services provided by the Information Technology department.

Application usage strategy had been left for the department supervisors and managers to decide upon.

Functional Limitations

- Finite set of criteria to search the database
- Within an individual contract, all of the fields are not required
- Granularity of search extends only to state wide (not city)

1.6 Definitions of Terms

API – *Application Program Interface* - a set of routines, protocols, and tools for building software applications. A good API makes it easier to develop a program by providing all the building blocks. A programmer puts the blocks together. In this document, API refers to the JAVA programming language's API which is a set of built in classes

Back end – refers to the part of the application on the server side including databases and source code.

COM - A software architecture developed by Microsoft to build component-based applications.

Front end – refers to the part of the application on the client's side. Usually refers to the user interface.

JDBC – *Java Database Connectivity* – part of the Java API that allows a connection and interaction to a relational database

JVM - *Java Virtual Machine* - platform-independent execution environment that converts Java byte code into machine language and executes it

JSP – *Java Server Page* – a server side technology which has the capability to incorporate HTML and Java code in the same file

Model-View-Controller – object oriented design pattern used to separate the user interface from the data models. The model represents the structure of the data. The view is a collection of classes representing the user interface. The controller connects the view and the data.

OOP – *Object Oriented Programming* – type of programming where the programmer defines a data structure that includes both data and functions. The data structures are called objects. The programmer can also create relationships between the objects in a hierarchy.

1.7 Summary

This document shows how one area of the firm tried to improve its business processes with the creation of a high tech web site. Within Intercontinental Research Foundation's infrastructure lied a major rift of information flow and continuity. Business process was inconsistent. Distinct methodology and procedure did not exist. Rules for standardization needed to be created and enforced.

Intercontinental Research Foundation needed to determine a more efficient way to pool resources and increase information availability. This project was the launching point for a series of database access tools that would facilitate the researcher's work. A competitive edge had to be brought back to Intercontinental Research Foundation.

The author was hired by executive and project management to join the software development team as a Java developer for the Contracts Database. The author contributed in all phases of the system development life cycle. The role of a developer on the project involved participation in object, interface and database design and development.

This report will prove how business process can only be facilitated through a high tech solution if there is a strategy emplaced to uphold the solution. The Research Services department had a system developed for tracking contracts and deals within the high technology and science industry. This online tool, part of the new eApplications initiative, was thought to lead to the creation of future systems targeting different areas of research. Future divisions within the company would improve by adopting a similar approach.

Would the Research Services department set a good example?

Chapter Two: Review of Research

2.1 Overview of All Research and Literature

Most of the research for the Contracts Database had been completed prior to the author being brought on board at IRF. However, this chapter will provide a summary of the actions taken by the project team to gain a better understanding of known web application solutions. Further research for the benefit of this document was conducted in regards to applications and business process.

There existed definitive target areas for the project team to consider during the initial stages of the Contracts Database. These areas included relational database products and programming language.

Based on business needs, the team decided that Research Services would benefit the most from a web application. Another non web-based alternative considered was using Microsoft Excel. With the idea that a workbook be designed to handle data entry, Excel would be used as a data repository. However, many members of the Research Services group had experienced similar attempts and found the results unsatisfactory due to convenience.

The key to the Contracts Database was going to be accessibility.

2.2 Literature and Research

The main consideration for the Contracts Database project team was deciding on system architecture. We use terms like scalability, reliability, availability, maintainability, usability, and security to describe how well the system will meet current and future needs (Suh, 2005). The system as a whole would need to meet these standards.

Client-side processing has grown very popular in recent years because it improves the overall application's responsiveness. Any web application will do at least some server-side

processing (Suh, 2005). Studies have shown that the programming-language choice affects productivity and code quality in several ways (McConnell, 2004). With this in mind, the project team began to research programming languages, reviewing Active Server Pages (ASP), PHP Hypertext Preprocessor (PHP) and Java.

The major characteristics for comparing these three languages were cost, compatibility and functionality.

Language Comparison – ASP 3.0, PHP v4.1 and Java 1.4

Cost – ASP needs to run on a Windows platform server with Microsoft's Internet Information Server (IIS) installed. PHP and Java run on Linux which is freely available. PHP and Java are both open source APIs. Also, for a database, ASP uses Microsoft SQL Server which is relatively expensive when compared to PHP which generally uses the free database MySQL. Java Database Connectivity (JDBC) is built into the API and allows programs to connect to any database.

Compatibility – PHP and Java programs can run on various platforms like Linux, Unix, Windows and Solaris whereas ASP is mainly associated with Windows platforms.

Functionality – All three programming languages provide nearly the same amount of functionality. There was one noticeable shortcoming in PHP in regards to session management. Although PHP is object oriented, version 3 did not have the capabilities to store an object within a session variable (php.net).

At this point in the research, the project manager decided to rule out Microsoft's ASP technology. Java was favored over PHP because of session control and general extensibility.

Therefore, the only two databases that were researched were Oracle and MySQL. IRF already had licenses for Oracle.

Database Comparison – Oracle and MySQL

Cost – MySQL is an open source database. It is a low administration database with no need for highly trained, costly administrators. As mentioned above, IRF had already purchased enough licenses for future expansion. Executive management concluded that there would be no budget impacts regarding database selection for the Contracts Database.

Compatibility – Both databases work well with Java and PHP. There is a third party tool by Zend Technologies for Oracle/PHP integration. "…two areas Oracle and Zend are working to shore up for PHP are scalability and interoperability" (Taft, 2005). There is a strong movement in the industry to incorporate the Oracle and PHP technologies. Oracle has built in JDBC drivers for running database connections from Java applications.

Functionality – Functionality between the two relational database management systems (RDMS) is nearly the same. The current version of SQL is supported by both along with stored procedures.

Based on this research, the project team decided to use Java because of the overall functionality. Oracle was selected based on the licensing having been purchased prior to project initiation.

Business Process Research

Further research on incorporating web applications into an existing business model was done in preparation for this document. A broad search on the topic revealed the distinction between business process management (BPM) and business rules.

According to Bitpipe.com, business process management is the systematic approach to improving an organization's business processes. BPM activities seek to make business processes more effective, more efficient and more capable of adapting to an ever-changing environment.

A business rule is a statement that defines or constrains some aspect of the business. It is intended to assert business structure or to control or influence the behavior of the business.

2.3 Summary of Known and Unknown about the Topic

The development and maintenance of most web applications is chaotic and far from satisfactory. To successfully build and maintain large, complex web-based systems and applications, web developers need to adopt a disciplined development process and a sound methodology (Suh, 2005). A web development process outlines the various steps and activities of web-based systems development (Suh, 2005). Satisfying the expectations and needs of different types of users with varying skills is not easy (Suh, 2005).

Although there is formula for system development, there is no definitive methodology for incorporating the system into the business model.

2.4 Contributions to the Field

The Contracts Database was an excellent example in execution of the Systems Development Life Cycle. The SDLC provided the framework for administering technical skills efficiently. Each stage was handled accurately and effectively.

However, this document should prove as a lesson to project managers and executive management. The author wants to reveal the disparity between high tech solutions and business processes and how incorporating the two together leads to success.

One of the habits from Stephen Covey's "The 7 Habits of Highly Effective People" is the concept of beginning with the end in mind. The process of visualization will enlighten technical managers. By organizing a mission statement for the project, project managers will clearly define a purpose behind high tech solutions.

Chapter Three: Methodology

3.1 Research Methodology

Research for the Contracts Database was conducted prior to the author being hired by IRF. The author was hired to develop the Java components of the application. After initial acclimation to the department, the author was given the results of the research that had been conducted. The information provided depicted how to proceed with the project, how to measure progress, and what would constitute success.

In the author's estimation, a qualitative approach was used to gather the data necessary to calculate procedures for system development. This approach involved the use of qualitative data, such as interviews and documentation. Knowledge of business needs was utilized to determine which direction the company should proceed.

Gathering data was facilitated by distinguishing between each particular business need on a case by case basis. Observing the Research Services department's daily experiences aided in deciding the features of the new system. The underlying issues of the existing business process became apparent.

The author reviewed a variety of text books and Internet authorities to gain the knowledge necessary to prepare and complete this document.

3.2 Proposed Project Plan

The Contracts Database application was designed and developed utilizing the System Development Life Cycle. From start to finish, the project was delivered in about 9 months.

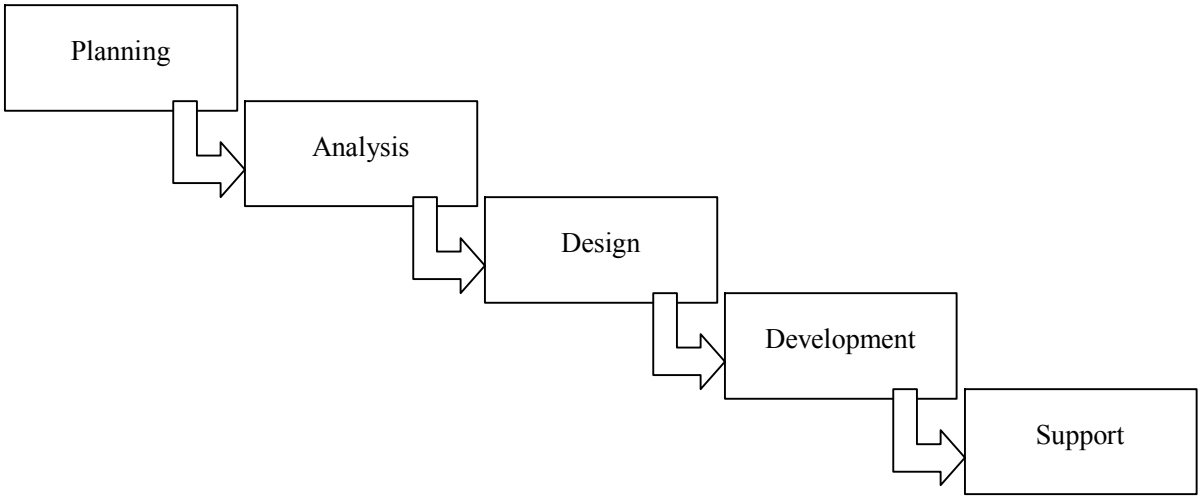

Figure 1: Phases of the System Development Life Cycle

Phase I, the Planning phase of the life cycle, addresses project fundamentals.

- Defining the problem with the current methodology.
- Generating the project schedule.
- Confirming the reality of the scope of the project.
- Allocating personnel to cover the work load.
- Assessing hardware and software needs.

During Analysis, the project manager gathered information depicting resolutions to the problems found in Phase I. Then, he defined system requirements, organized the requirements into a hierarchy and considered any possible alternatives. After gathering information to define system requirements, prioritization and feasibility of the requirements must be decided. Recommendations can then be made to executive management about the direction the project is headed.

These recommendations evolve into a system design in Phase III: Design. The application architecture consisting of the user interface, Java classes and database should be determined. Mock ups and page functionality would be created. These designs form the groundwork for the Development phase. Here, the Java classes would be written. The database would be created. A fully functional prototype would be constructed and testing operations could begin. Once this was done, personnel training for the end users could commence.

The system would be maintained on the network with 24 hour technical support. Future enhancements would be decided upon based on feedback from the business unit.

3.3 Procedures within System Development Life Cycle

This section describes the model used to develop the Contracts Database. The System Development Life Cycle serves as an outline for construction of the project.

3.3.1 Phase I – Planning

During the Planning phase of the life cycle, the project manager provided the initial structure for the project. The following events took place.

- Project Launch Meeting
  - Project status reporting frequency considered
  - Review of project scope
  - High level project plan overview
- Review of business problem and needs
- Scope exclusions and inclusions
- Review of constraints, risks and assumptions
- Plan of project costs
  - Time
    - Initial project timeline
  - Budget
- Architectural considerations
- Review of analysis phase actions
  - Start of next phase
  - Schedule of next phase

3.3.2 Phase II - Analysis

During this phase, the project team gathered information depicting resolutions to the problems found in Phase I.

- Define system requirements.
- Organize the requirements into a hierarchy.
- Consider any possible alternatives.

Project management and development leads met with business analysts, research analysts, writers and executive management to gain an understanding of the business processes currently in place within the research division of IRF. First, it must be understood that this division contains the largest number of employees as compared to the rest of the company. Having stated this, the desire to limit the number of attendees to only the major stakeholders for the Contracts Database web application project requirements gathering sessions was a predetermined agreement made by the project team and upper management.

3.3.3 Phase III – Design

Due to the web centric nature of the eApplications product line up, the proposed solution was to base future eApplication development on the Java 2 Enterprise Edition (J2EE) platform. Development would primarily utilize the Java Server Pages (JSP) and Java Servlet Application Programming Interface (API), with relational database access Structured Query Language (SQL) using Java Database Connectivity (JDBC). Product designs would be developed around component based design methodology.

Object-oriented programming provided greater flexibility, modularity and reusability. An object had properties and behaviors. Properties could be described by using data, and behaviors were described by using methods. Objects were defined by using classes in Java. A class would provide a template for the concrete realization of business needs.

One or more classes that are arranged in a treelike hierarchy presented the option of expandability for future eApplications. A child class would be able to inherit properties and behaviors from its parent class. Java granted eApplications this breadth. The following diagram illustrates a parent-child relationship of Java classes.

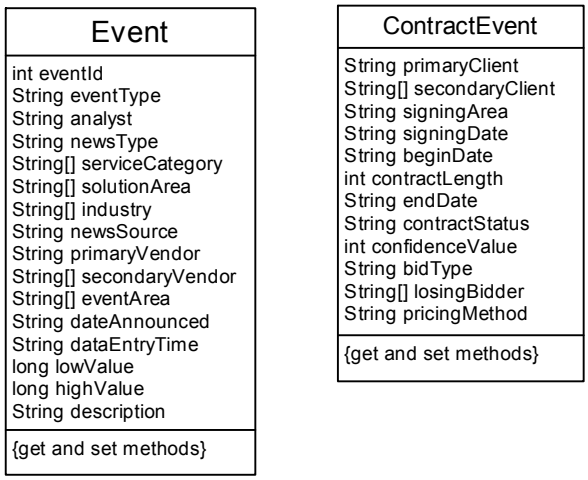

Figure 2: Event and ContractEvent Classes

Another factor in choosing Java was its programs could run on any platform without having to be recompiled. Java can run on most major hardware and software platforms, including Windows, Macintosh and several varieties of UNIX and Linux. Due to the platform independence of a Java deployment, the specific brands of the components in this environment were not as critical as the services provided by each component and the level of JVM compatibility. Therefore, changes to the Information Services department of IRF web platform could occur in a planned fashion without requiring significant reengineering of the products within eApplications. Existing Linux servers would not need to be changed. No costly upgrades would be needed.

In addition to offering portability and compatibility with the current environment and extensibility into new platforms if necessary, the use of server side Java components would

allow for the creation of a local code base which could be used and extended in a variety of applications. This local code library could be made available as an API to multiple developers, eliminating redundant development efforts. The code library could be published via JavaDoc technology, giving developers an abstract insight into the makeup and functionality of available components, greatly increasing efficiency and interoperability of future development efforts.

The system would use a model-view-controller, 3-tier architecture. This type of architecture separates the presentation layer from the business logic and data tier.

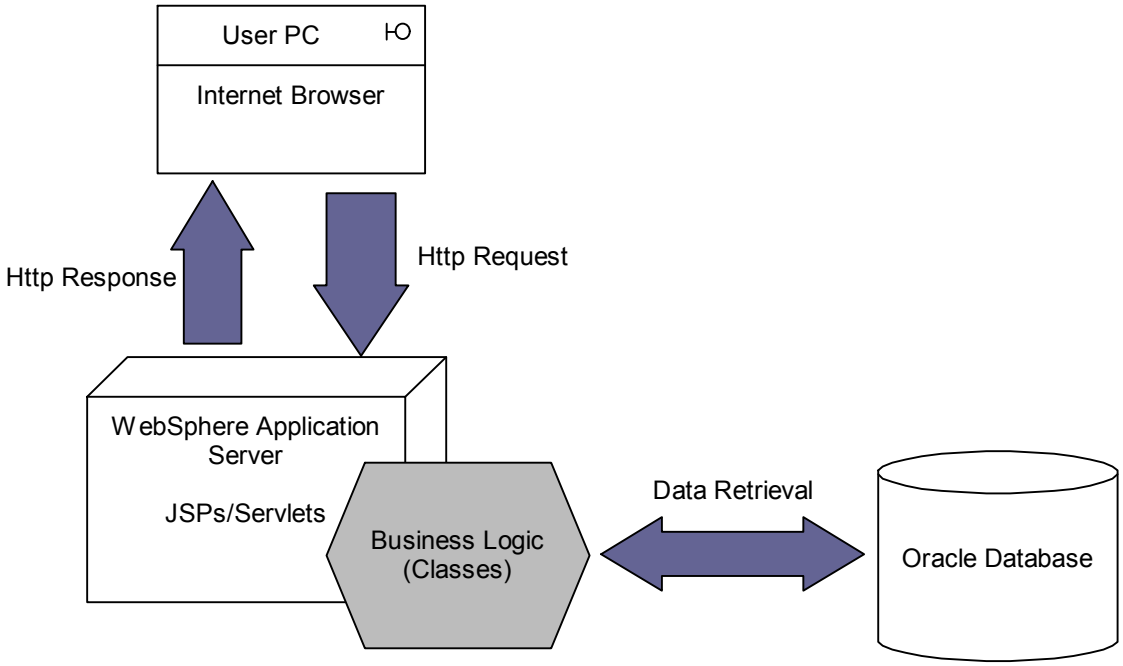

Figure 3: System Architecture

During the Design phase, the following key tasks were handled:

- Solidifying network and application architecture.
- Design of the database with a working relational model.
- Design of the user interface.
- Planning the integration with existing systems.
- Readying a viewable prototype

3.3.4 Phase IV – Development

The major system level requirement for all eApplications development efforts was compatibility with the IRF information systems architecture. As this architecture housed a number of different web and application server platforms, there were many possibilities. Moreover, this environment was scheduled to undergo a significant change within the next year, as part of the Information Services effort to develop a next generation of the IRF.com web site. Therefore, maximum portability of the application was required.

The front end piece, which contained the user interface, consisted mainly of Java Server Pages. JSPs contained the images, links, buttons and resulting data that a user would see while using the web site. Another group of developers focused on the back end. The back end comprised the controller servlets, Java objects and main functionality of the web site. While a JSP would allow a user to interact with the web site, the back end delivered key details such as all data transfers, user access control and site navigation.

In addition to the system requirements enforced by the current network infrastructure, eApplications all required localized authentication and access control facilities. These facilities were required to manage access to the individual applications, as well as to define the context and state of each user as applied to the eApplications products, providing an Application Program Interface for future implementation of security rules and personalized functionality.

The requirement for localized access control and session management was addressed with the development of a localized authentication class which could be used throughout the eApplications product line. This class would serve as a traffic manager, verifying that a user has legitimate access to requested resources and determining a user's personal profile from local

records. Each instance of the class stored session persistent user profiles, allowing application programs to track user context and state. The following diagram shows the relationships of the Java classes used for authentication.

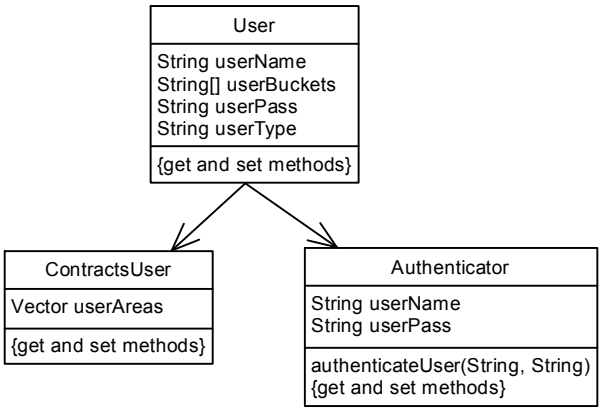

Figure 4: User Classes

3.3.5 Phase V – Support

When the Contracts Database would be released into production, technical support would provide 24 hour, 7 day a week support for the system. Application and database servers would be monitored for performance and errors. The call center was notified that a new product had been released. The technical support team would add the Contracts Database into the normal support routine.

3.4 Deliverables

This section reviews what the project team promised to produce during the system development life cycle. On time completion of these deliverables would determine the success of the project.

- **Project Charter (end of Planning Phase)** - The Project Charter describes the work to be performed on a project. It defines the business need, the scope (what is included as well

as what is excluded), and sets the direction or approach that will be taken to meet the business need. Executive management's approval of the Project Charter is needed to conclude the Planning phase and move forward into the Analysis phase of the project lifecycle.

- **Project Work Papers (end of Planning Phase) –** these separate documents include the following:
    - Project Schedule – time and budget
    - Team roles and responsibilities
    - Software and Hardware Profiles

- **Use Case Diagrams (end of Analysis Phase)** – a multitude of diagrams which described the functionality of the Contracts Database by specifying scenarios based on user interaction. Each scenario was one particular set of interactions between the user and the objects involved.
- **Technical Requirements Document (end of Analysis Phase)** – formed from a rudimentary list of business needs. This document formalizes the expected functionality of the system to be designed.

  User needs delegated the following functionality:

  - Allow administrative user contract creation capabilities
  - Allow administrative user contract edit/update capabilities
  - Allow administrative user contract deletion capabilities
  - All users should have the ability to search through contracts limited by regional access rights
  - All users should be able to save the results of a search
  - Power users and above should be able to download a contract's details
  - Search page results should be displayed with sortable columns
  - Search page results should have links to subsequent pages
  - Every page within the application should have a log out button or link
  - Search criteria is populated based on user access levels
    - Internal users will have access to all regions
    - External users will need to purchase access to individual regions

- Users should have the ability to change their login passwords from within the system
- Session managed user access control

- **Database Design (end of Design Phase)** – the information stored in the database. The goal of the design process is to achieve minimum redundancy and eliminate chance of error. The database design would be a cooperative effort between the Java developers and the database administrator. The data in a relational database needs to coincide with the Java objects. There would be a direct mapping between the objects and the database tables.
- **Entity Relationship Diagram (ERD) (end of Design Phase)** – (according to Webopedia.com) "a graphical representation of entities and their relationships to each other, typically used in computing in regards to the organization of data within databases or information systems. An entity is a piece of data – an object or concept about which data is stored. A relationship is how the data is shared between entities."

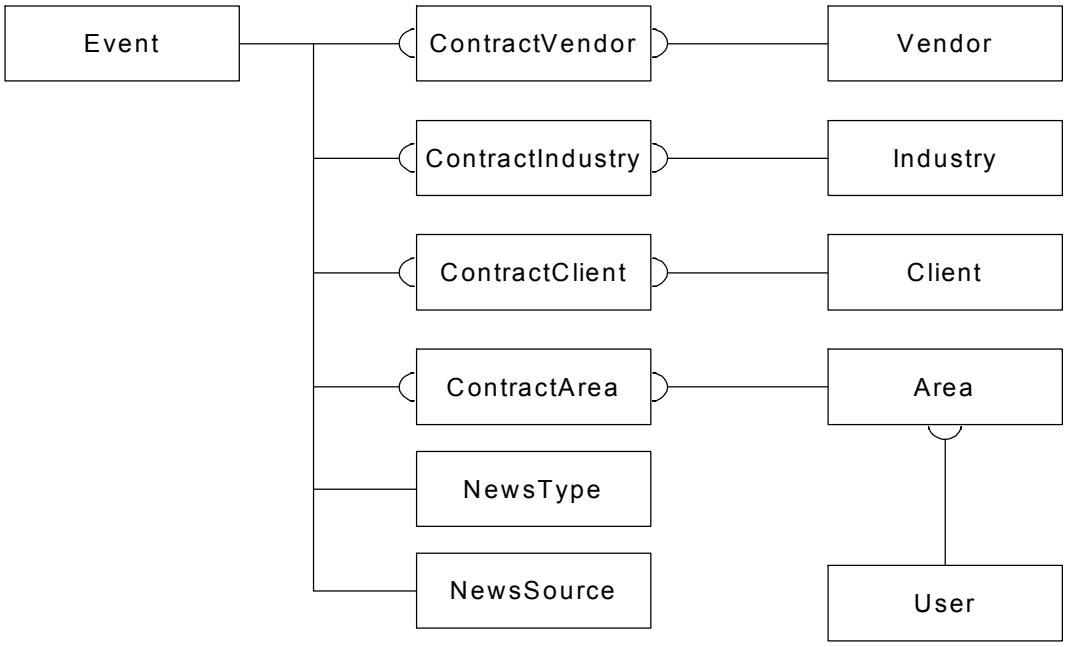

Figure 5: Entity Relationship Diagram

- **Java Class Diagram (end of Design Phase)** – similar to the ERD, the diagram showed the relationships between the Java objects. Class attributes such as variables and methods were detailed in the diagram. The member variables would help determine data types in the database.
- **Test Plan (middle of Development Phase)** - defines the scope of the testing effort, the test environment requirements and the functions the test cases will exercise. This document serves as a guide to the developer during the unit testing effort. The quality assurance team would need to approve this document.
- **Web Application (end of Development Phase)** – a fully functional web application based on the business requirements would be developed and implemented into the testing environment. Once quality assurance had finished testing, the product would be installed into the production environment.

3.5 Resource Requirements

Programmers are more productive using a familiar language than an unfamiliar one (McConnell, 2004). Based on similar logic, the author was hired by IRF as a Java developer. The role constituted the development of back end Java components such as classes and servlets along with aiding in the design of the database.

- Project manager – responsibilities included:
  - Understanding of company goals
  - Identified skills of team members
  - Made certain that all deliverables were constructed on time and within scope
  - Coordinated all preparation for the project
  - Ensured team members understood the requirements as defined by the deliverables in Phase I & II
  - Facilitate communications between all parties
- Business analysts –

- Requirements gathering and leveraging
- Liaison to Research Services

- Web Designers –
  - Constructed front end components
  - Tested integration between front and back ends

- Web Developers –
  - Constructed back end components
  - Continued testing of application with each revision

- Database administrator – created relational database

- Quality Assurance Engineer – conducted final testing efforts for release approval

3.6 Outcomes

All deliverables were to be produced during the phases as mentioned above. This would constitute a successfully project life cycle. Using the System Development Life Cycle would help the project to be successful despite the fact that most information technology projects do not deliver within the constraints of time, budget and functionality (Beck, 2000).

3.7 Summary

This chapter explained the methodology used to create a web based application. The Contracts Database was developed using a 5 phase system development life cycle. The web application was positioned to pioneer a new line of web applications and software tools within the company.

Chapter Four: Project History

4.1 Project Initiation

The Contracts Database project manager proposed the idea for a web based solution in order to gain an advantage over competitors by having the ability to deliver the company's product not only in a timely manner but, quicker from end to end than other firms in the industry. The information technology department held a short series of meetings.

Based on the lack of standardization, executive management was pleased with the notion of a long standing Internet application unifying part of the business methodology. Designed to utilize the object oriented nature of the Java language, the application represents a possible trend within the IRF infrastructure. Future solutions may be designed around the Contracts Database. Portions of the system would actually be reusable. Saving time and resources, an object oriented design could focus on the interaction between current and future systems.

4.2 Project Management Methodology

A project should complete a goal with the purpose of solving a business need. The goal should have specifications. These specifications must be met in order to deem the project a success. The specifications should be held to certain guidelines. These guidelines are defined by the triple constraints which are budget, time and scope.

Scope refers to the specifications and amount of work to be done on a project. The time attribute pertains to keeping a project on schedule. Cost reflects the attention paid to budget. Resource management is also a key element of project management. The Contracts Database team leads were ever mindful of the amount of time and personnel needed to complete this complex web application system.

The business analysts met with the major stakeholders of the Contracts Database. Within these meetings, the scope statement was agreed upon. A project schedule was confirmed.

Timely delivery for system deployment was achieved through the creation of milestones. A milestone registers a considerable event towards completion of the project. Milestones help shape the outcome of the project and steer the development team towards successful fulfillment and desired results. The entire project schedule was broken down into milestones with specific dates set denoting deadlines.

4.3 Project Milestones

This section reviews the major events which continued to push the Contracts Database project towards completion.

1. Project Charter Approved - Scope, time and budget defined
2. Technical Requirements Document - Finished
3. Database Design - Completed
4. Java Classes and Objects - Designed
5. Database Created
6. Java controller servlet compiled
7. Authentication classes developed
8. Java Server Pages - prototypes designed and developed
9. Java Classes - developed
10. Test plan formed
11. Prototype of Contracts Database – completed
12. Quality Assurance approval
13. Training Completed
14. Contracts Database Production Implementation Performed

4.4 Project Plan Changes

The project plan was affected by a small variety of events that took place. From past experiences, the project manager had already buffered enough time for project completion.

- One developer was pulled from the project. This happened early enough that it did not have a major impact on resource management.
- Business executives decided to use existing hardware. Hardware resources needed to be reallocated to house the testing environments.
- The business area needed more time than anticipated to decide on requirements. The Analysis phase was extended by 1 week.
- Business executives increased the budget on the project to provide for expanded human resources.
- Deciding upon a suitable user interface took longer than anticipated. This impediment proved difficult for the design team to overcome. The project plan's timeline was manipulated to handle this process.
- Network resources had been dedicated to the eApplications group of software. However, a new database server was integrated into the architecture. The testing environment had to be reconfigured. The project plan was affected. The development timeline was altered.
- One developer had surgery. The project manager needed to reallocate resources to handle the workload. The phase was delayed for two weeks due to lack of personnel.
- The end users required an extra week of training. Although installation of the application was not delayed, product release was postponed for two weeks.

4.5 Project Goals Accomplished

A project can be deemed a success if the end results delivered what was expected. Does the system functionality equal the anticipated functionality? Does the system perform up to the clients standards? The project was initiated based on a solution to a problem with the current work methodology. Did the project team deliver a system which could be incorporated into a

new business approach for the research analysts? The team leads and major stakeholders organized a project review. Within this section, the project review results are summarized.

A project can be viewed a success by determining whether or not the deliverables met the expectations of the stakeholders. Overall, the main deliverable of the Contracts Database project was an easily accessible, readily available database. This database was to be used by research analysts within the company as a storage and reference tool. The system should have been marketable to external clients for both system functionality and information value.

Meeting the technical system requirements, the Contracts Database was delivered as a fully searchable web application. This tool was expected to facilitate the job of the research analysts and improve productivity. By providing analysts with helpful information, the application improved research return times and increased the time to cost ratio for the business. Analysts were able to finish reports for IRF customers in a shorter time.

However, the project did not successfully change the way research analysts did their job. Should this be viewed as a project failure or a post-project life cycle management failure? Research analysts were still using their own methods for data gathering, organization and report creation. Since changing the research analysts work habits was not within the scope of the project, the Contracts Database project team was not at fault for the manner in which employees used the web application. The client was satisfied with the web application itself.

4.6 What Went Right and Wrong

The process of selecting the project team united a group of individuals which formed a potent working body. Criteria included background and work experience, leadership and strategic expertise, technical expertise, interpersonal competence and, for some team members,

managerial ability. Executive management chose a project manager. The project manager decided on the rest of the team with help from each team member's direct supervisor.

Executive management did not divulge information about the network architecture changes that would invariably take place during the project's life cycle. This information would have granted the project manager the foresight to accommodate such a change into the timeline.

There existed advantages and disadvantages with the decision to limit the attendees of the requirements gathering sessions. The meetings were easier to facilitate since only a handful of people were interviewed at each session. However, not all opinions were represented. Once meeting minutes were posted on the company intranet, certain individuals expressed their feedback to their managers.

The design of the user interface was a constant deterrence while trying to complete the design of the Contracts Database. Business area representatives were continually returning user interface prototypes with changes. Project team leads tried to satisfy the often conflicting views of the end users.

Utilizing the object oriented nature of Java, the Contracts Database system design was greatly facilitated. The application programming interface of the language provided enough breadth to create a robust system that complemented the chosen architecture. Similarly, the development phase was facilitated by the choice of programming language. For example, Java development was divided into two separate focal areas. The advantage of this approach was best demonstrated when one of the front end developers went on medical leave due to surgery. Project management easily reallocated team members. Back end development had already advanced ahead and was only minimally impacted by the loss.

Training sessions were held prior to product launch. Application testing was in its last stages when the training occurred. This created an opportunity for the users to provide feedback about the system back to the project manager and team leads. Since there had been no operational documents written for the end users, the group of trainees required extra time to learn the system.

Product release was delayed due to the week of advanced training the end users necessitated. However, the web application was delivered on time and was implemented into production on schedule. The delay caused external accounts to be activated at a later date than anticipated. The client was not happy about the delay but, did not report any major impact on business seeing as there was only one external customer at the time.

4.7 Impact of Project Variables

Project management had to adjust the project timeline in accordance with certain variances which had a direct impact. Budget, resources, business area influence and technical architecture issues all affected the project at different times during the system development life cycle.

The project plan was not greatly affected by an initial change in personnel allocation. Executive management had decided to increase the project's budget and allow more developers to be assigned to the project. The project manager knew this ahead of the planning phase and adjusted his task completion directives accordingly.

The business area continually influenced the project plan by reconsidering system functionality. User interface design was the main requirement with which the business area seemed to be most undecided. The project manager needed to leverage the team's human

resources in a manner to not hold up overall site construction. Personnel were shifted to handle the outcome of meetings with the research analysts, business stakeholders and interested parties.

4.8 Analysis of Results

4.8.1 Phase I – Planning

As mentioned in section 4.2, a project is designed to solve a business problem. The research analysts did not have a standard methodology for conducting research. After speaking with representatives from the Research Department, there were very few commonalities among the different approaches taken towards research completion. Part of the business problem was the absence of data availability. The Contracts Database project team provided a solution with a highly accessible data storage tool. The Contracts Database was meant to provide a starting location for the research process.

4.8.2 Phase II – Analysis

Most of the issues of this project can be blamed on the Analysis phase. Limiting the number of attendees to the requirements meetings proved to be the catalyst for constantly updating the system specifications throughout the next two phases. Many suggestions and recommendations about the system requirements were not recorded initially. The technical requirements document was altered after it was agreed upon and supposedly finalized. This caused delays later on in the life cycle.

4.8.3 Phase III – Design

Since the requirements were being modified regularly, the look and feel of the user interface was not solidified during Design. Too many conflicting opinions were being expressed.

Using component based design methodology associated with object oriented programming granted eApplications a starting point for code reusability. The User class, for example, was created as a possible parent class for future eApplications. As a data store, the Contracts Database was meant to be a beginning to business process unification. The application served as a virtual file cabinet for IRF's business analysts and writers to collect valuable information. The online database provided easy user access because it was web based.

4.8.4 Phase IV – Development

Developing the Contracts Database with an object oriented language provided many advantages. The application was transparent to the hardware it resided upon. As stated in section 3.3, future applications within the eApplications product line would be able to use the existing objects. Development of these future products would be faster and cheaper.

Training time was extended. The product was delivered on time but, the release of the product was delayed.

4.8.5 Phase V – Support

The support team utilized members of the project team as knowledge resources. After the ninety day support period had completed, executive management reviewed the status of the Contracts Database. This action was taken in order to report to the Technical Services department about the state of the application. There were no serious technical issues outstanding at that time. All minor technical issues had been resolved. Technical Services were given an easily maintainable system to support.

4.9 Results Summary

- Requirements gathering not an effective part of the Analysis phase
- Business area delayed construction of the web sites user interface
- Division of project into two teams, business and technical allowed development team to maintain construction initiatives
- Java programming language separation of front and back end provided advantage when overcoming deadline obstacles
- Contracts Database was a technically sound application
- Project team not completely at fault for the research analysts' lack of use of the system

Chapter Five: Lessons Learned and Next Steps

5.1 Lessons Learned

Having a team made up of both technical and business minded individuals can have both a positive and negative impact. By separating the team into a business and a technical group, the project manager allowed division of labor to facilitate the team's job. The business analysts on the project gave the client a point of contact to the project. However, this constant feedback from the business delayed the decision making process.

The project manager had imposed a barrier between the project team and the Research Department by not including the end users in the requirements meetings. Solid requirements gathering proved vastly important for successful project management. Requirements should be finalized before system design begins.

Posting the meeting minutes on the intranet can be a valuable tool in keeping employees up to speed with the company's progress. After the requirements document had been approved and posted, almost everyone in the department had a comment about the specifications of the system. This showed how the supervisor's failed to represent their respective departments during planning and requirements gathering because not everyone's needs had been addressed.

An integral part of any project can be the technology chosen to complete the task. The nature of object oriented programming allows developers to focus on different tasks with no dependencies on each other. Once the class components had been written, they could be incorporated into the user interface to perform the actions necessary to fulfill the project specifications.

The project manager's decision to add a time buffer to the life cycle proved to be paramount. Drawing upon experience and learning from past mistakes is a valuable lesson

which should be given as much attention as any other during a project. Unforeseen events can happen at any point during a project. The project manager showed great foresight in anticipating such events by estimating more time to complete the project. The scope of the project should be appraised carefully. Believing in realistic deadlines is advantageous for a project manager.

Not providing technical documentation can make training difficult. There may be need for a document containing operational basics. The technical abilities of the end user or client should never be overestimated. Even basic computing skills should not be assumed.

A support infrastructure similar to the design and development infrastructure proved quite effective. Division of labor based on product knowledge was an efficient technique to resolve issues and troubleshoot. Project team members provided assistance. Incidents were directed to the appropriate team member based on the individual's skills and role on the project team. Turnaround time on incidents was impressive.

5.2 What Should Have Been Done

The requirements gathered initially were very limiting. Without representation for everyone within all of the research areas, the product did not receive the necessary amount of input to create a diverse and powerful system. The Contracts Database would possibly have been more marketable with a broader range of features. At the very least, the research analysts would have received a tool better suited to assist them. The web application would have been tailored to fit the exact needs of the group.

Supervisors held an open forum to all employees. When it had adjourned, the end users still had no concrete information on the system they were getting and how to use it successfully. From here, it would have been more efficient to break down the analysts' needs into two

categories: necessities and enhancements. This would have at least opened up channels to a future upgrade project instead of the minor redesign which delayed development.

Furthermore, if the research analysts knew the nature of the tool which was being constructed for them, there may have been a chance that they would have figured out how to fit it into their work patterns. Even after performing the second round of input recording from the research analysts, the project team still only had what can now be viewed as an insufficient amount of ideas.

Reviewing the requirements early on during the design phase would have shown the project manager that the functionality of the system was quite rudimentary. Also, the business analysts on the project may have been able to foresee the fact that the web application did not offer anything to set it apart from other applications. The lack of marketability may have shown through.

Executive management was clear when conveying the need for a web enabled database application. The project manager should have asked executive management whether it was the team's responsibility to determine whether the product would be appealing to outside firms. This clarification may have raised awareness.

The web application would have been better slated as an internal tool only. However, after the product had been introduced, no formal effort was made to incorporate the tool into the daily life of the research analysts. Basing success on the retail value of the Contracts Database to external users condemned the project before it even started.

Similarly, the business analysts should have planned on ways to incorporate the new application into the business process. By examining and discovering new business methods early in the system development life cycle, usage of the web application would have increased.

Also, training might not have been extended since the users would already have been familiar with the system.

Change management should have been utilized on the Contracts Database project. A formal process for communicating design change would have removed the need to manipulate the project manager's original task allocations. In addition, by prioritizing any alterations to the existing requirements documentation, development could have proceeded without incident.

Unfortunately, the development phase saw a slight deterioration in productivity once the requirements started to be modified and comprise the design. It was difficult for the project manager to completely and accurately define the needs for the product. With outside factors such as technology changes and business competition, business needs were constantly changing. This is why it would have been necessary to emplace a process to manage change.

Change requests should have been formally submitted to the project team. This would have allowed the request to be properly understood. After reviewing the change, the project team could analyze and evaluate the level of impact that this change may affect the project. A course of action for the project team would then be decided upon. Any alternatives to this course of action would be determined as well. These options would then be delivered to the requesting party who decides which route to take.

Entering up to date contracts was key in retaining a marketable appeal for the product. Executive management failed to allocate data entry personnel soon enough. The data in the system became stagnant.

Supervisor training should have begun sooner. The estimated buffer zone within the project's timeline had been subsequently reduced due to random events. Therefore, only one week remained for training before the originally planned product release date.

Producing a technical manual or user's guide for the web site would have been wise. With learning material to assist them, the business analysts would have been more successful in teaching the end users.

5.3 Meeting Expectations

If a project's success is measured by the level of accuracy in meeting system requirements, the Contracts Database was a complete victory. Does the product do what both the project team and client said at initiation? Or, did the client promise that if the project team delivered a tool, certain results would occur?

Although slightly delayed, the Contracts Database was presented to the stakeholders and customers possessing all desired functionality. All client requests were honored. Every requirement was addressed and handled by the application. Therefore, the product itself met all of the involved parties' expectations. Unfortunately, business process was not impacted in the anticipated and desired way. The research analysts work methodology and business process was not improved.

There was a gap between marketability and the business needs. The Contracts Database project would have been better suited to have been left as an internal tool for research storage. However, the executive decision to rely on outside usage as a measure of achievement set the level of expectations for the Contracts Database too high.

The Contracts Database project did not live up to expectations even though the web application itself functioned flawlessly.

5.4 Next Steps for the Contracts Database

If the eApplications program continued, the Contracts Database would be in need of rescuing. Problems with the product should be determined before management should consider different solutions. Creating a list of certainties about the product itself would help lead to a remedy.

Five Major Issues

- The website is not used by all research analysts
- Those who use the website use it sporadically
- The database contains stale data
- Outside clients are not interested in the system
    - Cost is too high
    - Website is not up to date
    - Data too limited
- Tool contains only IT Contracts information

Based on this information, the business would be able to form a strategy to fix the lack of appeal in the Contracts Database. There are two central areas which management should focus on. If eApplications products of the future were still going to be sold to outside buyers, the marketability of the Contracts Database website, therefore, would remain a priority. Of course, the utilization of the tool by all research analysts would be a primary objective for all supervisors in the Research Services department.

A hiring phase searching for data entry personnel to populate the database would solve the problem of retaining an up to date database. The entry clerks would investigate the release of contract information and use the website to transpose their research. A variety of resources

would be available for this research. Contract information would be obtainable from magazines, newspapers and any other periodical to the vast expanse of the Internet.

The Contracts Database should be expanded to hold a variety of information. Limiting the search engine to hold only information on technology contract events inhibits the general usefulness of the web site. If the web site held different types of data, the analysts would be able to consult the database to apply the information to a wider range of research. Furthermore, data upkeep and expandability would increase internal interest and usage as well. With a regularly updated application and a broadened range of utility, department supervisors should have veritable ammunition for encouraging use of the application. The supervisors need to come up with a work methodology that unifies the department.

The ability to apply past research to future consulting opportunities and white paper assignments increases the profitability of the online tool. Moreover, added content increases dollar value for the outside customer. However, reviewing the market for similar tools and investigating a lower cost for access rights to the Contracts Database remains a necessary action.

These adjustments would help the IRF's sales team in presenting an attractive web application.

5.5 Conclusions

Overall, this project attempted to address two problems that existed within the Research Services Department:

1) Lack of structure in business approach
2) Absence of data availability.

The Contracts Database solved one of these problems but, was expected to solve both. Any high tech solution can address tangible problems. Providing data availability was attainable

through adherence to the system development life cycle. Web applications provide highly accessible business tools.

Planning a strategy concerning how the business will utilize a new web application cannot be overlooked. This can cause a chain reaction of negative effects. Information in an online database application needs to be kept recent and fresh. When the data became stagnant in the Contracts Database, neither internal nor external users wanted to use or buy the system.

Management needs to be notified at the first sign that a system is not being used to its potential. If there had been early enough warning, perhaps the Contracts Database could have been saved. Observation and communication might have avoided the eventual failure of the web application.

Web applications can only be as useful as the efforts of its users. A high tech solution can only solve the problem it has been designed to address. Web applications provide the tools necessary to aid business process but, only if the business methodology is adapted to use those tools. All managing parties involved in this project failed to notice this seemingly obvious point.

5.6 Summary of the Contracts Database Experience

Did the Information Technology department set a good example on how to implement a high tech web application? Yes. Did the Research Services department set a good example on how to facilitate the integration of a high tech web application into the business methodology? No.

During the analysis phase of the project's life cycle, the intentions of the entire eApplications initiative could have been questioned. As mentioned above, the Contracts Database would stand as the first of many tools which would facilitate the research analysts'

efforts. If this was the focus of the new program, why were the research analysts only partly involved in deciding the initial requirements?

In all, this technical system was only a piece of the solution. When a high tech venture is the answer to a business problem, it does not mean that management can avoid planning on system utilization. The earlier a project team addresses the issue of planning for a web application's usage and integration into business methodology, the greater the chance that the web application will be a success. If this way of thinking had been adopted during the Contracts Database initiation, the entire eApplications movement would have been better off.

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