

Technology adapted

3.1 Introduction

In developing a web enabled solution for laboratory data and document management, there are several options available for system analysis and designing, documentation and the software development.

3.2 System Analysis and design

System Analysis and designing can be done either with Structured Systems Analysis & Design Method (SSADM) or Unified Modeling Language (UML) modeling [3, 26].

Table 2: Comparison of SSADM and UML

SSADM	UML
Data: Logical Data Model	Class diagrams
Events : Entity Life History	Interaction diagrams
Process: Data flow diagram	Activity diagrams
Interfaces: Dialog design	Class and component diagrams
Quality: Requirement catalog	Experimental/explorative prototype
Acceptability: Prototyping, study of system impact on the staff	Prototyping
Organizational structure and policies: Project Initial Document	Activity Diagram
Job satisfaction: Business system option	None
User Involvement: Information gathering, testing	Information gathering, testing
Business Issues: Data Flow Diagrams, Entity Life History	Activity Diagram

According to the above comparison, it is evident that the SSADM and UML are both effective in analysis and designing a system. However due to the academic interest, UML methodology was selected [27, 32].

3.3 Rational Unified Processes

Rational Unified Process (RUP) is an object-oriented program development methodology [48]. It provides comprehensive software engineering tools that combine the procedural aspects of development (such as defined stages, techniques, and practices) with other components of development (such as documents, models, manuals, code, and so on) within a unifying framework.

RUP establishes four phases of development, each of which is organized into a number of separate iterations that must satisfy defined criteria before the next phase is undertaken: in the inception phase, developers define the scope of the project and its business case; in the elaboration phase, developers analyze the project's needs in greater detail and define its architectural foundation; in the construction phase, developers create the application design and source code; and in the transition phase, developers deliver the system to users. RUP provides a prototype at the completion of each iteration.

Rational Unified documentation was used in the project in appropriate circumstances.

3.4 Software development methodologies

Following software development methodologies were reviewed during the development process [40].

- Waterfall model: This waterfall model is an approach to development that emphasizes completing a phase of the development before proceeding to the next phase. In conjunction with certain phase completions, a baseline is established that freezes the products of the development at that point. If a need is identified to change these products, a formal change process is followed to make the change.

The major weakness of the Waterfall Model is that after project requirements are gathered in the first phase, there is no formal way to make changes to the project as requirements change or more information becomes available to the project team. Because requirements almost always change during long development cycles, often the product that is implemented at the end of the process is obsolete as it goes into production.

- **Spiral Model:** In the Spiral SDLC Model, the development team starts with a small set of requirements and goes through each development phase (except Installation and Maintenance) for those set of requirements. Based on lesson learned from the initial iteration (via a risk analysis process), the development team adds functionality for additional requirements in ever-increasing "spirals" until the application is ready for the Installation and Maintenance phase (production). Each of the iterations prior to the production version is a prototype of the application.

The advantage of the Spiral Model over the Waterfall Model is that the iterative approach allows development to begin even when all the system requirements are not known or understood by the development team. As each prototype is tested, user feedback is used to make sure the project is on track. The risk analysis step provides a formal method to ensure the project stays on track even if requirements do change. If new techniques or business requirements make the project unnecessary, it can be canceled before too many resources are wasted.



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- **Rapid Prototyping:** Rapid Application Development (RAD) was introduced as a better way to add functionality to an application. The main new tenant of RAD compared to older models is the use of prototypes. After a quick requirements gathering phase, a prototype application is built and presented to the application users. Feedback from the user provides a loop to improve or add functionality to the application. Early RAD models did not involve the use of real data in the prototype, but new RAD implementations do use real data.

The advantage of Rapid Prototyping Models is that time-to-market is greatly reduced. Rapid Prototyping skips many of the steps in traditional models in favor of fast and low-cost software development. The idea is that application software is a "throw-away." If a new version of the software is needed, it is developed from scratch using the newest RAD techniques and tools [29].

According to the user requirement of having several prototypes and few unclear user

requirements, spiral (iterative) development model was followed with the help of prototypes.

3.5 Web and Database technologies

Since the system is designed to develop as a web enabled system, there are two web server technologies which can be used for the proposed system. Those are Apache HTTP web server and Apache Tomcat web server [8].

Both of these server solutions are of free and open source. So it may not hinder the open source distribution of the proposed software. Similarly both of these servers will function equally with MySQL open source database engine [35].

Since web development language selected was PHP (see below), accordingly the web severer selected was Apache HTTP server.

3.5.1 Web development languages

Web development options considered are PHP and Java (JSP and Servlets). ASP was not considered since it is a proprietary development solution [49, 33].



Table 3: Comparison of web development languages

Feature	JSP	PHP
Programming Approach	Completely object oriented	Scripting with object oriented support
String and data manipulation	Rich library, too much descriptive and object oriented code	Rich functionality. Functional and easy coding.
Web Oriented features 1. Includes 2. Mails 3. File Uploads 4. Form Handling 5. Sessions	Almost everything is built in or supported by libraries. Complicated and too much of code.	Inbuilt functionality. Easy to use functions, written for the specific tasks

Database Access features	Standard JDBC structure/ Use EJB/ Struts framework built over JDBC. Descriptive and too much overhead or boiler plate code involved. Uses the same API for all databases using JDBC driver	Dedicated inbuilt libraries for most of the commonly used databases. Very tight integration with MySQL and PostGRESQL. The libraries and results are straight forward and easy to use.
Extensibility	Java Classes and Libraries. Runs in sandbox and hard JNI approach needed to integrate with server programs	PHP can very easily interact with programs on the server. Very good support for native code.
Dynamic Graphics/PDF	Almost everything has a ready made library	Supported internally or through libraries.
Web Services/SOAP	Add-on Libraries like Axis, JAX-WS, etc.	In Built(or NuSOAP)

Since the both solutions are open source, PHP was selected as it is more flexible and time saving solution [44, 45].

3.6 Client side form processing and data validation

Client side data validation and form processing can minimize the workload on the server machine. This can improve the response time and save the band width of the LAN or internet. Java Script will be the suitable method for the client side data validation process.

Summary

For the purpose of system development, many software development process models, web server technologies and languages were considered.

According to the requirements of the domain specialist and the time available for the development task, set of suitable models, technologies and languages were selected.

Chapter 4 will show the how the decision was made among these choices.