Software Engineering Process in Web Application Development

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Abstract: *The methods used for the development of conventional software engineering models cannot be used directly for the development of web based applications. This paper identifies and analyses the various adaptations required in the conventional models to make them applicable for the development of web based applications.*
Keywords: *Software engineering, Web engineering, software development models, software testing.*

I. Introduction

Software engineering deals with the systematic, disciplined and quantifiable approach to the development, operation and maintenance of software. The process involved with the development of web applications is significantly different from the process of developing conventional software. So we need to use different methods and methodologies for the development of web application. Web engineering can be considered as the adaptation of conventional software engineering process. In conventional software development we are using different software process models for software development. But these models cannot use it directly for the development of web application since the content web application is frequently changes. So the conventional software engineering process needs some changes for the development of web applications.

Conventional Software development process

The software development process includes number of steps like analysis design coding testing and implementation. This is shown in the figure.
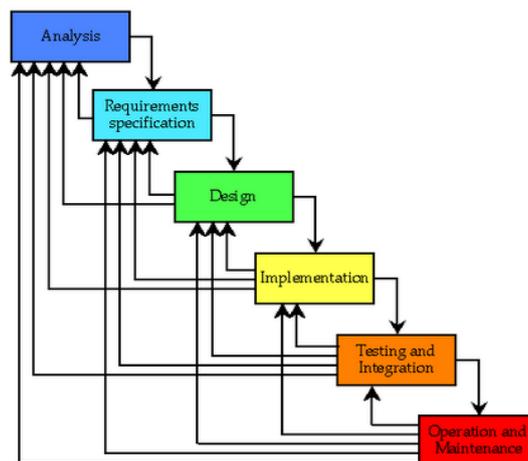
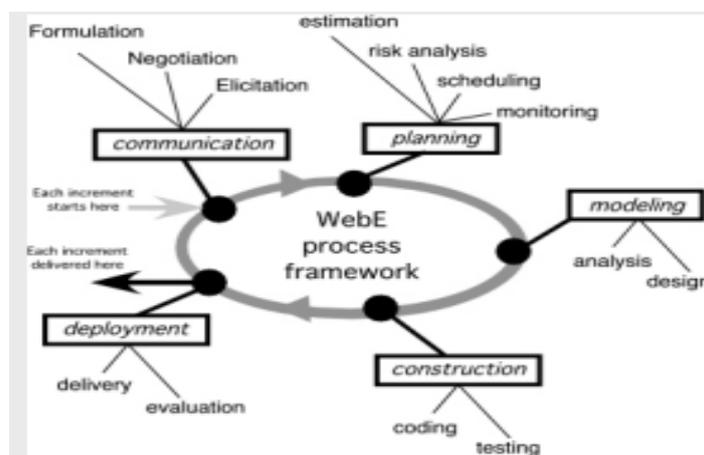

Figure1 Software development process.

Different software process models we used for the development of the software. Most of these software process models use the above mentioned steps as their basis. There are various Software development models are as follows:

1. Waterfall model
2. V model
3. Incremental model
4. RAD model
5. Agile model
6. Iterative model
7. Spiral model

Different companies use different models which ever suits for their application. Choosing right model is important in the development of the software process.

Web Engineering Process

Web application development process is different from that of conventional software development process. Web applications deliver a complex array of content and functionality to a broad population of end-users.web engineering process uses incremental development process. This is because the requirements evolve over project time and changes will occur frequently. Incremental delivery of web application allows us to manage this change. Using the available requirements the developers develop a web application and release the first increment. Then the additional requirements are incorporated to the first release and release the next increment and so on. This process may goes on indefinitely because of the frequent changes in requirements. The web engineering process is shown in the figure.

Figure1: web Engineering process models.

Problems in web application development

The web applications are developed to deliver functionalities for the large group of end users and the modifications are done freequently to adapt new changes. it is not possible to collect all the requirements at the beginning itself. The web applications always keep its information uptodate and hence making the changes is a continious process.The development of web application includes analysis,design ,implementation and maintenance. When we are developing a small application it may be sufficient to follow a reasonably linear development sequence starting with analysis followed by design, implementation and maintenance. But in the case of large applications, when we are in the implementation phase and any changes made in the design phase make the implementation costly. In such case we need to start from the beginning to accommodate new changes.

**Characteristics of simple and advanced WebApps.**

Simple web Apps	complex web Apps
• Simple Web pages	• Complex Web pages
• Less emphasis on aesthetics/user interface	• More emphasis on aesthetics, user interface
• Information content static	• Information is dynamic
• Simple navigation	• Complex navigation
• Stand-alone systems	• Integrated with database and other systems
• High performance wasn't major requirement	• Required high performance
• Developed by a single individual/small team	• Requires a large development team
• Used for information dissemination is non core applications	• Deployed in mission critical applications

Software engineering and web engineering

Web engineering process requires some adaptation in the conventional software engineering process. The web application development includes new methods and tools in addition to those used in conventional software development. Difference between Web Engineering and Software Engineering has impact on development process as given below:

Software Engineering	Web Engineering
• Software system has small user range. • User Requirements are specific • Growth and change is small • Development budgets varies in a wide range according to the size of the company • Development time is longer • Hardware and Software environments constraints are specific. • Design and development expertise is few. • Security and legal issues are not much important • Less emphasis on user interfaces	• WebApps has large user range • User Requirements are changes with time • Rapidly changing • Development budgets are small. • Development time is small. • Hardware and Software environments constraints are not specific • Design and development expertise is available in wide rang • Security and legal issues are not much important • More emphasis on user interfaces.

WebApps run on the Internet, an intranet or an extranet to meets the needs of diverse groups of users. A large number of users may access the WebApp at one time and so there may arise the need of concurrency feature. In order to protect sensitive content and provide secure modes of transmission, strong security measures must be implemented throughout the infrastructure, that supports a WebApp and also within the application itself.The important factors that should be considered in the quality of web application is aesthetic nature of content. Appropriate navigation is also important in the case of web application. But these navigation and aesthetic design is not there in conventional software engineering. This is shown in the figure.
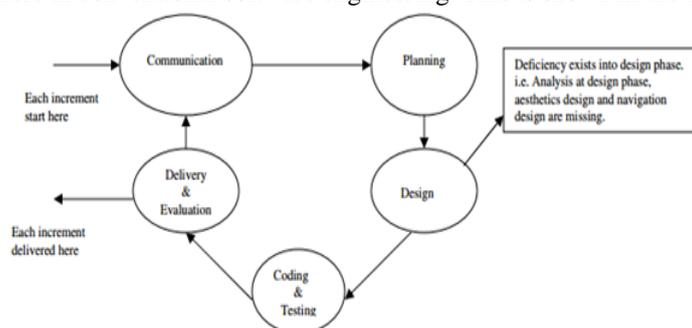
Figure2: Software engineering process model

The resulting model with adapted group of activities is shown in the following figure3. In this model, all the phases are almost same as software engineering process model. But, in the modeling phase, analysis modeling is required and in the design model, aesthetic and navigation designs are also required. Analysis activities help to understand the detailed requirements that will satisfy user needs. Analysis models look at content, interaction, function, and WebApp configuration. Content analysis identifies the full range of content to be provided by the WebApp. Content includes text, graphics and images, and video and audio data. Interaction analysis describes the manner in which the user interacts with the WebApp. Functional analysis defines the operations that will be applied to WebApp content and describes other processing functions that are independent of content but necessary to the end user. Configuration analysis describes the environment and infrastructure in which the WebApp resides. Aesthetic and navigation design are missing in software engineering process model at design phase. But, these are necessarily required at design model in WebE process model. Because, the aesthetic design describes the 'look and feel' of the WebApp. Aesthetics are an important and integral feature of WebApp design. A good attractive design of the application generates appropriate responses from users. It includes colors, layout, text size, font and placement etc. Navigation design represents the navigational flow between content objects and for all the WebApp functions.

The web application testing also need to take in to account failures in the application's required services/functionality, to verify the conformance of the applications behavior to specified functional requirements. While perform testing, various functional and nonfunctional requirements should be tested.
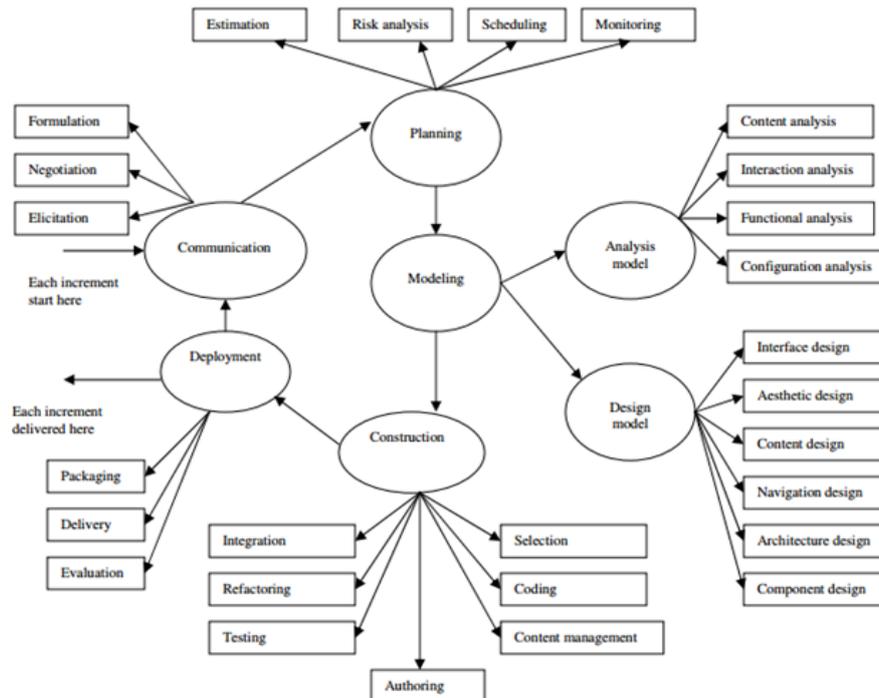
Figure3: Web Engineering process model.

While performing testing we need to include different type of testing. They are as follows

1. **Functionality Testing** –In functionality testing, we need to check the functionality of the web page.that is check whether there is any dead page,verify the data integrity and also check whether the validations provided in the webpage is correct.

2. **Usability testing -** To verify how the application is easy to use with.
- Test the navigation and controls.
- Content checking.
- Check for user intuition.

3. **Interface testing -** Performed to verify the interface and the dataflow from one system to other.

4. **Compatibility testing-** Compatibility testing is performed based on the context of the application.while perform this type of testing we need to test the operating system compatibility and browser compatibility.in addition to this the hardware and software requirements are also need to be tested.while testing the hardware and software testing, the testing should be conducted for server and client side. Also most of the web applications are now used in mobiles. So the mobile compatibility also need to be tested.

5. **Performance testing -** Performed to verify the server response time and throughput under various load conditions.

- **Load testing -** It is the simplest form of testing conducted to understand the behaviour of the system under a specific load. Load testing will result in measuring important business critical transactions and load on the database, application server, etc. are also monitored.

- **Stress testing -** It is performed to find the upper limit capacity of the system and also to determine how the system performs if the current load goes well above the expected maximum.

- **Soak testing -** Soak Testing also known as endurance testing, is performed to determine the system parameters under continuous expected load. During soak tests the parameters such as memory utilization is monitored to detect memory leaks or other performance issues. The main aim is to discover the system's performance under sustained use.

- **Spike testing -** Spike testing is performed by increasing the number of users suddenly by a very large amount and measuring the performance of the system. The main aim is to determine whether the system will be able to sustain the work load.

6. **Security testing -** Performed to verify if the application is secured on web as data theft and unauthorized access are more common issues and below are some of the techniques to verify the security level of the system.
- Injection
- Broken Authentication and Session Management
- Cross-Site Scripting (XSS)
- Insecure Direct Object References
- Security Misconfiguration
- Sensitive Data Exposure
- Missing Function Level Access Control
- Cross-Site Request Forgery (CSRF)
- Using Components with Known Vulnerabilities
- Unvalidated Redirects and Forwards

In addition to these security testing we can block the website accessing from certain areas or from certain PCs. This is possible by getting the ip address of the PCs.so by blocking PCs having certain range of IP address we can block the access of webpage from that PCs.these type of checking are commonly used for payroll applications. This is shown in figure4.
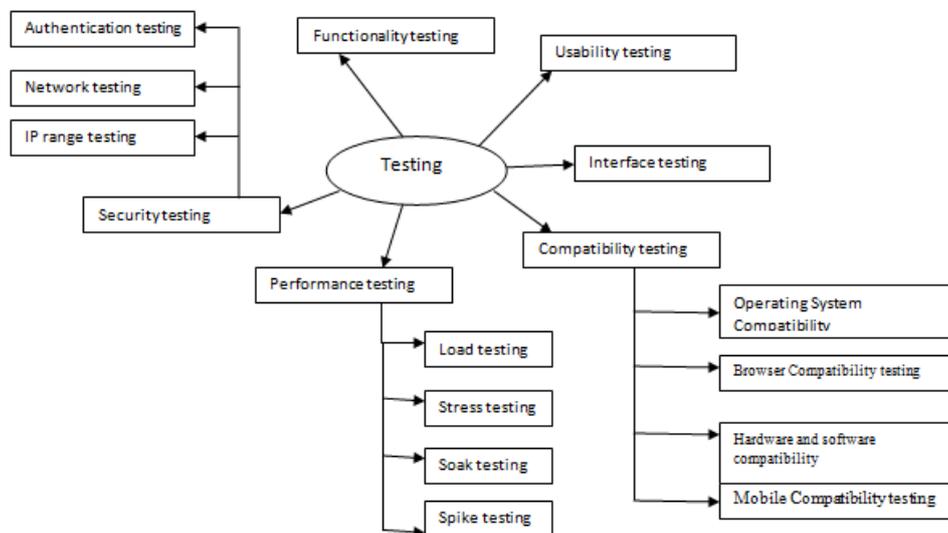

Figure4. Testing in web application.

Conclusions and Future Work

In this paper we analyze the various factors that are needed for the development of WebApps. By incorporating these factors to the conventional software process models, we get the development life cycle of web applications. In addition to this we can add the testing of the range of ip address in the testing phase. By conducting this type of testing we can prevent the access of site by unauthorized users.

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