

Comparative Study of Web Development Methodologies

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Abstract. *The growth of the Internet and the World Wide Web has already had a significant impact on almost every aspect of personal and professional life. In this fast moving world, web applications are developed with little or no consideration to security in its development cycle. Moreover, web applications are developed using traditional software development methodologies and by less experienced developers and in result most of the web applications are vulnerable to attacks. This paper discusses special features of web applications that make them different from traditional development and also compares the existing web methodologies.*

Keywords: Secure web application development, web engineering, web development methodologies

1. Introduction

The growth of the Internet and the World Wide Web has already had a significant impact on business, commerce, industry, banking and finance, education, government and entertainment sectors, and our personal and professional life. Many legacy, private information and database systems are migrated to the Internet and the Web environments.

In the era of competition, rush to get applications on website, into clouds and onto mobile devices has left the application security of the connected world in a state of disrepair. Organizations of all sizes rushed to get new applications online without much thought about their longevity or reliability [1]. Most of the times, applications are developed with minimal thought given to security at the application development level. As long as the application works, the thought goes, the external perimeters like firewall could perform the security but they can not do it all. Security breaches continue to occur in web applications because we have not addressed a core problem with those applications: insecure web development and security testing. Web-based systems have been kept running through a continual stream of patches [2]. Poorly developed Web-based applications that are mushrooming now have a high probability of failure.

Moreover, software organizations continue to move toward Web-based systems development without many changes to their teams and development process. Web-based development lacks rigour, a systematic approach, and quality control and assurance. Software organizations often assign or outsource such projects to small teams of highly qualified, but often relatively young, developers [3]. Software development process or Software development Life Cycle (SDLC) is either a descriptive or prescriptive characterization of how software is or should be developed [4]. And, web-based development is also the disciplined process that describes how a web based application or web site should be developed. In other words, Web engineering is the application of systematic,

disciplined and quantifiable approaches to development, operation, and maintenance of Web-based applications [2, 5]. There is no doubt that web development is a sub category in the field of software development, but still it is quite different than traditional software development and needs a different development process model. In the absence of disciplined process for developing Web-based systems, we may face serious problems in their successful development, deployment, operation of and maintenance [2]. The need for systematic approach to web development was realized in 1998 and thus new discipline of Web engineering was established in university of Western Sydney, Australia [2, 6, 7]. According to website security statistics report of WhiteHat Security, 86 percent of all web sites tested by WhiteHat had at least one serious vulnerability [9]. Vulnerabilities are continuously increasing and attackers exploit them regularly [8]. Such reports reveal that web security is still an ongoing issue and web application development methodology still lack security and thus need a new process model for web which can help to develop secure web applications.

This paper compares the existing models and also discusses lack of security in them. This paper is organized as--Section II describes unique features of web applications and its development. Section III compares the different process models of web. Last section concludes the paper and describes the future work.

2. Web Applications' Features

Web application is a client/server application that uses a web browser as its client program, and performs an interactive service by connecting with different servers over the Internet. It presents dynamically tailored content based on request parameters, tracked user behaviours, and security considerations [10]. Some special features of web Applications are given in brief below:

a) Complex, Dynamic and Distributed Architecture: Most web applications are characterized by a dynamic architecture which might change and evolve during run-

time. Therefore, a specification method for Web applications should support modelling logical distributed elements, their bindings to physical elements, and algorithms for detecting system architecture during run-time [11].

- b) World wide access for heterogeneously skilled users: Web applications can be universally accessed by users of different skill levels.
- c) Variety of Information resources: Web applications must be capable of handling complex, hierarchical data as well as structured or unstructured data which may be stored in different systems and distributed over multiple sites.
- d) Security and Privacy Support: Though web applications can be accessed universally but still they should deal with private data using privacy and security management [2]. Security means dealing with Confidentiality, Authentication, Access control, Integrity, and Non- Repudiation.
- e) Real Time information: Web applications should provide real time or nearly real time information. Moreover, some Web applications should run continuously, forcing the developer to be able to add new constructs and functionality without disturbing the working version.
- f) Dynamic Support: Dynamic behaviour of applications allow to access data, manipulate it, ask the server for code, verify different types of constraints, and produce results for the users or updates for the server.
- g) Scalable: Web application must support unlimited users.

Though Web application development involves some programming and development, and adopts some of the principles of the software development, but it is also different from traditional software development. Most Web-based systems need to be developed within a short time, making it difficult to apply the same level of formal planning and testing as used in software development. Moreover, It has additional requirements for Navigational, Multimedia, Usability, Security etc. Also, the web platform is a complex ecosystem composed of large number of components and technologies. There is rare

person who is master of all these, so the web development is like “Jack of all trades”.

3. Comparison of different Web development Models

As the web engineering has become an established branch of software engineering, since then, there has been substantial activity within web engineering research community and multitude of web approaches are proposed. The evolution of web engineering related research is analyzed in various comparative studies and surveys [12]. There are large number of proposed models for web like HDM, EORM, RMM, MacWeb, OOHDM (Object Oriented Hypermedia Design Method), SOHDM (Scenario-based Hypermedia Design Method), UWE (Unified Modelling Language based Web Engineering), WebML (Web Modelling Language), UWA (Ubiquitous Web Application), W2000, WSDM (web site Design Method), WUML (Web Unified Modelling Language), OOH (object Oriented Hypermedia), WebSA (Web Software Architecture), WebRE (Web Requirements Engineering Meta model), FLIP (FuseBox Life Cycle Process), FDD (Feature Driven Development), FDMSWAP (Formal Development Methodology for secure Applications), WISDM (Web Information system Development Methodology), and WES (Web engineering Security). This leads to obvious questions that why there are so many approaches? Is there no standard? Why still large no. of insecure web applications is developed? Why they do not get completed on time? Actually, each approach focuses on some specific aspects and proposes suitable models, techniques and vocabularies. Although some of these approaches, such as HDM, EORM, RMM, Mac Web are based on E-R Modelling and are irrelevant according to underlying concepts and principles of Web development community, So these are not used. Table I shows the specific purpose of these proposed models. OOHDM has had valuable contribution to web engineering research and many of its ideas have become accepted [17].

Table I: Proposed Web development models

Existing Models	Focus	Phases
OOHDM [13]	Design of hypermedia	Requirement, Conceptual Design, Navigational Design, Abstract Interface Design, Implementation
SOHDM [14]	Integrating enterprise databases with distributed hypermedia systems	domain analysis, object modelling; view design; navigation design; implementation design; and construction
UWE [15]	Visual Modelling with Systematic Design throughout SDLC	SDLC
Web ML [16]	Design and Implementation of Data intensive web applications	Design and Implementation
UWA [18]	User centred conceptual application	Requirement Analysis, specification and Design
W2000 [19]	Notation for modelling complex applications	Navigational & Functional Requirements Modelling, Hypermedia Design, Service Design
WSDM [22]	User centred Design	User Modelling, conceptual Design, Implementation Design and Implementation
WUML[20]	Methodological Support for ubiquitous web application development	N/A
WebSA [12]	Architectural and Transformational Models to specify web site	Design Phase

WebRE[12]	Models Web systems behaviours Requirements	Node, Page, Content Modelling
FLiP/Fusebox [21]	Encourage inexpensive Design changes	Personas & Goals, wireframe, Front end development, application architecting, fuse coding, Unit testing, Application Integration, Deployment
XP [3]	Software quality, iterative Short development cycles	Iterative planning, Designing, coding, testing
SCRUM [23]	Functional Requirements fulfilment on time	Planning & High Level Design, Iterative develop, Wrap, Review, Adjust and Release
FDD[22]	Functional Requirements	Develop overall model, Develop featured list, iterative plan, design, build by feature
FDMSWAP[24]	Security & light weight user of formal methods	Requirements, Threat Modelling, Abstract Formal models of security properties, system development, verification of secure models of the system, model checking and Validation of secure models of the system
WISDM[25]	modification of multiview aspects locally and uniquely	Organizational & informational analysis, Work & Technical Design, Implementation
WES[8]	security	Application Security Requirements and Risk Assessment, Security Deign/Coding, Controlled Environment Implementation, Testing, Implementation in Production

As clear from the table II, most of the existing web methodologies are focused on the hypermedia, design, look and feel of the web applications. Few methodologies like UWE, WebML, UWA are relying on UML modelling techniques and they define the actors (users) and use cases (requirements). Of all their requirements, their functional requirements on the system are the most revealing. And the current trend is moving focus towards of the security. Methodologies like XP, SCRUM and FDD are Agile

software development methodologies but they are commonly used in organizations for the web development, so they are also considered. Moreover Agile methodologies are different from traditional development methodologies like waterfall, Iterative etc. because they involve the user involvement. Agile methodologies are similar but still they have few differences mentioned in table II.

Table II: Comparing Agile Methodologies

Agile Methodologies	Documentation Degree	End User involvement	Team Meetings	Size of Project	Iteration time period
XP [3]	Low	Active Involvement	Informal & daily	Small	1 to 6 weeks
SCRUM [23]	Low	Only Product Owners involved	Informal & daily	Any	2 to 4 weeks
FDD [22]	High	Through reports	Formal & document shared	Any	2 days to 2 weeks

None of these methodologies are considering Security as the functional requirement and end users do not have the knowledge about lack of security and their consequences. As a result of which web applications are still developed with vulnerabilities. A development method for web applications should combine traditional techniques and principles of software, security engineering with unique/special aspects of web. FDMSWAP, WES considers security as main requirement during development life cycle, but these methodologies are yet to be implemented in the real world.

IV. Conclusion and Future Work

In this paper, we have first described the special features of web application that make them different from traditional development. To better understand their differences we have discussed web architecture and the technology changes occurred in their development. As the modern web sites lack security, so security issues and their development principles are discussed. Implementing security principles in development phases can eliminate vulnerabilities and it is seen that there is lack of implementing security in web development methodologies. Methodologies like FDMSWAP and WES provide a roadmap for web application development that

will help guide organizations to a more secure system. In future, these security methodologies can be validated and new validated web development methodologies can be proposed that will consider web's special features in the phases of development cycle.

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