

Web Application Development Processes: Requirements, Demands and Challenges

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Abstract: - Web applications have certain unique inherent characteristics that make Web application development considerably different and possibly more difficult comparing to the traditional software development. In this paper, we will demonstrate the critical requirements for the Web project development process and check the suitability of the software development process models to meet the critical requirements for the Web projects.

Key-Words: - Web projects, development process models

1 Introduction

Today, Web-based systems and applications provide a complex range of varied contents and functions to a large number of heterogeneous users. With the increase in the dependency on the Web-based systems and applications, the importance of their performance, reliability and quality have become very significant [1]. Consequently, the expectations and demands placed on the Web applications have increased significantly over the years. On the other hand, the development, deployment and maintenance processes of the Web-based systems which have become more and more complex and difficult to manage, have not progressed at a sufficient rate to meet these demands and challenges [1].

Even though a great number of projects, through a great amount of Web development work have continued to take place, most of them are carried out in an ad hoc manner, resulting in poor quality Web applications that are difficult to maintain and Web projects that are not finished on time or within budget[2]. The main reasons for such problems can be traced to an inappropriate development process and design [3].

The Web project development process is a total set of activities needed to transform the requirements of stakeholders into a Web application, and to carry out the changes in those requirements in newer versions of the Web application. The main goal of the

development process concerns the organization of the software development activity [4].

Requirements play a critical role in the development process of the Web projects. There are consensus on the importance and value of the defined requirements to meet the schedule, budget and quality [5]. At the same time, there are problems in the concrete adaptation and use of available processes, elicitation methods, notations and tools.

Web projects are significantly different from the traditional software projects in several aspects which influence the suitability of the conventional software development process models, which we will discuss in next sections. Prior to that, the critical requirements for the Web project development process which had been elicited from the literature review on Web applications development processes will be discussed.

2 Specifics Requirements for Web Project Development Process

There are many studies pertaining to the actual Web applications development processes [5], [6], [7], [8], [9]. Some of these studies show some general and basic requirements on a development process, while others revealed the underlying problems in the Web applications development that cannot be addressed by current process models. In the next subsections, the

study will discuss the most important requirements of the Web applications development process. These requirements are the main reason why the traditional software development process model must be customized to suit the needs of the Web application development, or else they may not be acceptable.

2.1 Handling Short Development Cycles

The fact found in several empirical studies is that the development time of Web applications is very short, usually not more than six months, and the average is less than three months [6], [7]. As the short development cycle is so common for Web applications, it is presumed to be the first requirement in the Web application development process.

2.2 Handling Changing Requirements

The Web project requirements are always subject to change. Throughout and even after the development of the application, the technical and organizational constraints are constantly modified. This could be due to the uncertain requirements at the beginning of the development or modification of requirements after the system is completed. For this reason, the Web applications are frequently referred to as “moving targets” [5]. As a direct result of this inconsistent requirement, there is a need for a strong integration between the customer and the Web project development team.

2.3 Parallel Development Process

The strong competition has pressured the competitors to shorten the development cycle. With this sort of time constraint, only parallel development projects can meet the requirements. This means, all the methodological activities from design, implementation to quality assurance phases must be carried out concurrently. In most cases, a number of small development teams working on similar duties in parallel [6], and this requires planning on staff deployment. As such, high communication level is required in the Web project development.

2.4 Reuse and Integration

The enormous time pressure in Web application development has driven developers to reuse as many components as possible [10]. This often involves the

interoperability and integration of diverse components which were either developed internally or purchased from third parties. Therefore, usually the development process of one Web application is not done in isolation from other Web development applications within the organization itself. Commonly, a reusable component is developed for a project in coordination with other projects that will use this component. Furthermore, there are always advantages in developing a common architecture for more than one Web applications [11].

In line with the growing integration of Web applications with the customers' business processes, the need to integrate Web applications with the existing applications, or other Web applications under development has also increased. As a result, the development process has to be coordinated with the desired results and the approaches used to achieve them.

3 Web project Development Process

The wide choice of different process models reflects the large range of different software projects. The well-known software development processes can be grouped into two categories:

1. **Lightweight Processes:** It is better known as agile processes. They are suitable for smaller projects with smaller development teams.
2. **Heavyweight Processes:** Heavyweight processes are particularly used for large teams with high demands on the quality.

The terms “light” and “heavy” refer to the degree of process formalization, for instance the number of documents and models created in the project. Web projects are significantly different from the traditional software projects in several aspects which influence the suitability of the conventional software development process models, which we will discuss in next sections

In the next subsections, the study will check the suitability of the software development process models to meet the critical requirements for the Web project development process. We will look at the Rational Unified Process (RUP) as a representative of the heavyweight, phase-oriented, and iterative process models and Extreme Programming (XP) as an example of lightweight, agile process model.

3.1 Rational Unified Process (RUP)

This section describes RUP as a representative of the heavyweight, incremental, iterative, and phase-oriented processes [12]. The key concept of RUP is to describe all the activities throughout the development life cycle, including requirements elicitation, analysis, design, implementation, and testing phase. Since the RUP activities can be overlapped and carried out in parallel, it is found to be different from the classical waterfall process. There are four separate phases within each of the activities in a development project, and each of these phases is organized in a number of separate iterations. Fig.1 shows the mentioned phases and they are inception, elaboration, construction, and transition [13]. While they occur respectively, there may iterate until the project is complete.

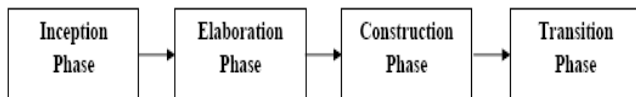


Fig.1: The four phases of the Rational Unified Process [13]

RUP can be considered as an iterative process and the iterative characteristic within a phase is subject to the objectives of that phase. For example, in the early iteration it can develop a prototype of the project under development. The prototype is used to identify the requirements of customers and users. On the other hand, several iterations in the elaboration phase are scheduled to usually implement fractions of the architecture; however, without a complete job.

To investigate whether the RUP can achieve the desired goal in Web application development projects, the study have to assess the four phases based on Kruchten's findings[12]:

Inception phase: During the inception phase, the developers define the scope of the project and business case of the system. The goal of this phase is to develop a common vision of the final product by cooperating with the customer and future users. The definition of the first phase is tricky for Web project development since the requirements of the target groups are unknown at the beginning of the project. Moreover, these requirements change continuously, causing the vision of the Web application to evolve continuously, even when the Web application may already be in use. Research to fix the vision beforehand takes a long time and it is costly. There is also a risk of the vision becoming outdated by the time the product is completed.

2. Elaboration phase: In this phase, the developers analyze the requirement of the project in detail and define its architectural foundation. The goal of this phase is to exclude the highest project risks to the widest possible extent to formulate a fixed price by the end of this phase. This includes the selection of an optimal and expandable architecture as well as the familiarization of the staff with the technologies to be used.

Since the first product version has to be built in an extremely short timeframe during the development cycle, the main concern is to calculate a fixed price to a well-defined product. Since the customers cannot be expected to be loyal to a single Website, with its competitors being just a mouse click away, it is difficult to predict the economic success of a Web application than that of a traditional software product.

3. Construction phase: In this phase, the developers emphasize on completing the analysis, performing the majority of the design and implementing the system. This means that the product is built by implementing all the components and integrating them into one product. The main challenge here is the question of whether there could be one point of time where all the components are completed since they are being handled in parallel by a team of people with different capabilities.

4. Transition phase: The developers, in this phase, deliver the system to the users by incorporating the product with the user environment. This phase can be very straightforward if it is possible to simply replace an existing application with a new one. However, unlike the traditional software, the distribution to users happens through the Web's architecture. Besides, there is usually no user training required.

3.2 Extreme Programming (XP)

XP represents the agile iterative processes. Alternatively, the study could use other agile processes such as Scrum [14], Adaptive Software Development (ASD)[15], Feature Driven Development [16], or Crystal Clear [17] in our research. XP was selected merely because it is very common.

Agile processes are created on the iterative development basis. They use feedbacks, rather than planning as their major control procedure. The feedback is driven by normal tests and advanced versions of the software. XP projects have four core values:

1. **Communication:** The goal is to provide all developers with a common vision of the system that matches the clients.

2. **Simplicity:** Encourages beginning with the easiest solution and building it again to improve it further. XP project concentrates on coding and designing that are required today instead of those of tomorrow.

3. **Feedback:** Guides the project throughout the way. Within XP, feedback is required and used at various phases of the development. The main objective of this core value is to prevent problems at the earliest possible point during the development process.

4. **Courage:** means that developers, managers, and customers should be brave enough to try new approaches and ideas.

Pair programming is the best characteristics of XP model and it is based on the belief that two individuals could see more than a single person, and being side-by-side, they can expand their ideas better than an individual who does it alone. The quality increase achieved by this approach substitutes the extra cost. Moreover, this approach ensures that the communication principle is anchored in the process and its knowledge is distributed throughout the team. To investigate whether an XP model can achieve its desired objective in Web application development projects, the study will discuss how XP model can meet the defined requirements for Web project development process.

1. **Handling short development cycles:** XP and other agile process models meet this requirement completely since the highly successive releases are one of the characteristics of XP projects. Iterations also allow to structure the short development cycles.

2. **Handling changing requirements:** The simplicity is one of the core values of XP, which means that any requirement for tomorrow's need is rejected. Instead, the close integration with the customers, combined with a rapid delivery of results, allows development and continuous requirement adaption.

3. **Parallel development of different releases:** XP does not fundamentally exclude the parallel development of different releases, because no XP project uses a cautious way of working.

4. **Reuse and integration:** The integration of the existing components requires a methodological support rather than support by the process itself. However, it should be reminded that this approach might be a challenge to achieve, because XP processes are mostly selected to solve a specific single

problem only[18]. In such scenario, it might be better to select

processes designed especially for the development of reusable software than XP in particular or agile models in general.

4 Conclusion

In short, the literature on software development processes, which searches for the ideal solution for developing Web applications, has illustrated that there is no single process studied in this section, which is able to meet all the requirements. Since the characteristics of Web application are different from those in traditional software, the software development process models should adopt and adapt the best method to meet the needs of the Web application development. Therefore, it is extremely important that Web application developers understand the typical Web application characteristics that may influence the Web applications development process. On the other hand, the development that uses the lightweight responsive process is recommended when a Web application has a lower complexity level, while a highly reliable heavyweight process is recommended if the Web project is aimed at reaching a higher complexity level.

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