Web-Based Applications Development in Small Firms

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Abstract: - This paper introduces and describes software ware process model for web-based applications development and its special features in the context of 'young' (start-up) small software firms , which is capable of being 'tailor able' to the particular stage of organizational development of small 'young' software companies . We comment on the current trend of development, its drawbacks, and then propose some guidelines to improve the quality of such practice. These guidelines are being investigated and it turns out to be very convenient and helpful.

Key-Words: - Web-Based Applications, Software Process, UML, Small firms ,Agile development, project management

1 Introduction

Web-based applications are becoming so popular in our daily life in the sense that it would not go a single day without we use them. These applications range from simple to sophisticated ones, where millions of dollars in revenue are generated. Developing, testing and quality assuring these applications become a challenging task [1].

Although the development of web-based applications made many improvements, there is still a lack of an established software engineering methodology for constructing web-based applications. Consequently, much of the development is carried out without a true understanding of analysis and design issue.

The development of Internet-based applications (E-commerce systems, web portals, etc.) is subject to different conditions than that of conventional software systems [2]. Such idiosyncrasies include: usability, rapid development lifecycle and short time to market.

Web based systems and applications deliver a complex array of content and functionality to a broad population of end users. They require new approaches to design and development but present the same issues and challenges as traditional information systems. Therefore, the same software engineering techniques are still necessary but the process should take these differences into account.

Web-based applications differ from other applications from both the product and process point of view.

As products, they differ from traditional systems in the following ways:

1-Web based applications are distributed and component based.

2- High reliability

3- High Usability

4- Security

Web applications also differ from traditional applications from the process point of view: there are more Technologies (HTML, XML, network protocols, multimedia, Java and script languages) and thus, many Roles (authors, developers, graphic designers, legal issues etc.) that have to be managed. In addition, the shorter time to market, shorter product life cycles and continuous maintenance are much more pronounced in the case of Web applications as compared to traditional ones[3]

Part of the problem is the business context: Web-based applications demand faster time-to-market and the continual integration of new requirements [4].

A number of SP frameworks for web application development have been introduced to solve various problems associated with the development of web applications, but they all need a lot of resources like Number of developers available, the quality of tools and equipments, and Quality assurance (QA) team [5], which are limited in Small-size software companies.

The software process is becoming a major concern in most software development organizations as one of ways to assure the software quality While developing software system with the software process[6], there are still questions on whether we perform the process in a right way and how we

evaluate the level of conformance of the process.

There are two battles over process that every small software company must win to be successful. The first is the battle to convince the company to adopt reasonable development processes. Discussion of what makes up a good process may be an interesting meditation, but is entirely moot until the company commits to a policy of process improvement. The second battle is never over. It is to change existing processes to match changing circumstance [7].

So in this paper we proposed a five-step model that helps Software engineering in design and constructing web-based application in small software firms.

2 web-based Application Development

 The brief history of systems development methodologies identifies and explores eras of development and speculates on their future. Today's "post methodology" era involves methodologies that can be viewed by developers as outdated and inappropriate for rapid development, Web applications, and other current requirements. Perhaps we are in danger of returning to the bad old days of the pre methodology era and its lack of control, standards, and training [8].

Yogesh[9] mentioned that "There are very few standard methods for the Web developers to use. Hence, there is a strong need to understand and undertake Web Engineering".

Ad-hoc development of WBA has brought disasters to many organizations. A survey on Web based project development by the Cutter Consortium [10] highlighted problems for Web-based projects:

* Delivered systems didn't meet business needs 84 percent of the time.

* Schedule delays plagued the projects 79 percent of the time.

* Projects exceeded the budget 63 percent of the time.

* Delivered systems didn't have the required functionality 53 percent of the time.

* Deliverables were of poor quality 52 percent of time.

Difference between Web Engineering and Software Engineering received much debate from the researchers [11], [12], [13], [14] in the last few years. Many researchers have identified very interesting differences:

- WBA have increased emphasis on user interface
- Open modularized architectures
- Link between business model and architecture
- Rapidly changing technologies
- More content-driven than software engineering.
- Increased importance of quality attributes
- Client uncertainty
- Changing business requirements
- Short time frames for initial delivery
- Fine-grained evolution and maintenance
- Highly competitive

In case of conventional software system for Quality the Developer has to satisfy Client and a known number of Users only. Whereas incase of WBA other than these two (client, user), the system must serve the Quality needs of a diverse community of Customers which can grow enormously with a varying intellectual level.

In case of conventional software system "security" is the issue with in organization but WBA being network intensive (i.e. resides on the network/Internet) are prone to attacks by hackers who are not even Customers.

The web-technology is going through major changes in these years, both with respect to types of systems based on web-technology, organization of the development work, required approaches and competencies, etc. We must rethink development methodologies, the ways of organizing the development work, and the tools to support the development. [15].

3 Software process improvement

The growth of the software industry has produced many small companies that do not do contract software, but rather compete in other areas. This gives rise to at least four significant development issues that have not been adequately addressed in software engineering literature: company size, development mode, development size, and development speed. . Definitions of "small" businesses vary by industry and by government agency from 100 to 500 employees or more. These bounds are somewhat broad for our purposes. Based on census data, we define companies of 50 or fewer employees as small [16].

First step toward process improvement is identifying the strengths and weaknesses of an organization's software processes to determine effective improvement actions. An assessment can help an organization examine its processes against a reference model to determine the processes'

capability or the organization's maturity, to meet quality, cost, and schedule goals [17].

A study [18] showed that software process improvements are required to increase the productivity of software companies. Generally, it is the aim to increase the quality of the produced software and to keep budget and time. Quality models for software process improvements were developed in context of large organizations and multi-national companies.

This study investigated how software process improvements are done in a small software company.

Based on the field experiences and the analyzed field notes, the following results were identified: In the studied small software organization, software process improvement efforts were pushed by the initiative of single employees. The studied company did not have enough resources to implement a complete quality Model. In addition, management was heavily involved in daily work and therefore had not enough time to initiate and lead software process improvement efforts .

A study of managing risk in software process improvement [19] showed that many software organizations engage in software process improvement (SPI) initiatives to increase their capability to develop quality solutions at a competitive level. Such efforts, however, are complex and very demanding. A variety of risks makes it difficult to develop and implement new processes.

Another study examined [20] whether an organization's size affects its SPI implementation strategy and the degree of SPI success. organizations.

Based on the results from this study, it is reasonable to conclude that there exist a few factors that have a significant and positive effect on software business performance in both large and small organizations

Several specific approaches to process improvement have become popular in the software industry. These include the following:
• Capability Maturity Model – Integrated
• Six Sigma
• Lean Development and
• ISO Standard 9001.

A common weakness of all of the SPI methods identified earlier is that they do not identify specific best practices within the software domain [21].

4 Web-Based Application Development Methodologies

A Proposed Methodology for Web Development was suggested by Debra Howcroft and John Carroll [22] at the University of Salford, the aim of this study is to examine the domain of World Wide Web site development and propose a methodology to assist with this process. Methodologies have both their proselytizers and those who decry the constraints and rigidity of prescriptive frameworks.

The study concludes that Methodologies, whether used for traditional systems development or web development, have their uses and also their limitations. On the positive side they provide a useful crux for the novice developer , they act as a comfort factor to reassure participants that 'proper' practices are being followed and the project management facility provides an audit trail, that helps ensure management viability of the development progress . On the more negative side, they are often far too prescriptive and can actually constrain the developer while attempting to successfully complete a project in what is often a highly stressful and complex environment.WARP (Web Application Rapid Prototyping)[23] is another methodology, offers a set of online software tools, which assist the designer and the user browsing of a Web application, in all its different aspects. The environment is based upon models and techniques already used in the hypermedia, information systems, and software engineering fields, adapted and blended in an original mix. The foundation of the proposal is the conceptual design of Web applications, starting from HDM, a notation for the specification of structure navigation, and presentation semantics. Surveys of Web engineering in practice[24] have identified seven characteristics of Web engineering that must be addressed by a Web engineering processes. These are support for:
1. Short development life-cycle times
2. Different business models (Business Process Re-engineering)
3. Multidisciplinary development teams
4. Small development teams working in parallel on similar tasks
5. Business Analysis and Evaluation with End-Users
6. Explicit Requirements and rigorous Testing against requirements
7. Maintenance

An agile approach for web application development [25]have been proposed that applies the concept of agile modeling, adopts a standard software architecture and is heavily based on frameworks, speeding up system analysis, design and implementation.

Most of today's Web application development processes are extensions of standard software

engineering processes. The usual iterated waterfall model is too rigid an approach to developing Web Applications .The waterfall model process was perfect for developing a file maintenance program for mainframes, but far too restrictive a process for building a Web application. Web application development needs to be an iterative process and most agree that a spiral approach is best.

A more extensive use of the UML is seen in the Web Application Extensions (WAE) of Conallen [26].

A few of today's Web application development processes have been derived froma business-oriented approach to applications development [27].

5 Software Process in Small Firms

Small firms do not have the managerial experience, the financial resources and the methodological know-how to manage web-based applications projects the way large firms do. Yet despite this, some small firms are satisfying their software development needs offshore[28]

There are two battles over process that every small software company must win to be successful. The first is the battle to convince the company to adopt reasonable development processes. Discussion of what makes up a good process may be an interesting meditation, but is entirely moot until the company commits to a policy of process improvement. The second battle is never over. It is to change existing processes to match changing circumstance.[29]

A first step toward process improvement is identifying the strengths and weaknesses of an organization's software processes to determine effective improvement actions. An assessment can help an organization examine its processes against a reference model to determine the processes' capability or the organization's maturity, to meet quality, cost, and schedule goals. Several software process assessment models have been developed, such as CMM/CMMI, ISO 9001 Quality Management (including 9000-3), and ISO/IEC 15504—sometimes called SPICE.

However, small companies (1–49 employees) find it difficult to run assessments .

5.1 Challenges Facing Small firms

Many small firms are unaware of existing software process assessment models and standards. There's often the assumption that assessments conformant to these models and standards can be expensive and time consuming, and therefore difficult to perform in small companies. Small organizations also perceive assessment models and standards—including

documentation and process-formalization practices—as targeting large organizations.

Such procedures have been criticized as inappropriate for small companies, which generally have informal processes and organizational structures focused primarily on getting the product out to stay in business. [30]

This reveals a serious situation, because in many countries, the majority of software companies are small (with 3–20 employees), which indicates their great economic importance. This is true in Brazil, where about 70 percent of software companies are small.

6 Guidelines for Development in Small Firms

Web-based companies have very stiff and stringent conditions. They have limited resources. This will hinder the quality of the product and ultimately the success of these companies. It is usually the case that the few people, who carried out the development, will also perform the testing of the end product. This is a poor practice, as it does not allow the test to be carried out rigorously and it will be certainly biased[31].

We proposed a model for web development in small firms based on a set of development methods and a set of quality standards and we call it the five – steps model for web development (see Fig 1)

Step 1: Evaluating the current software processes, by using the MARES[32] which is an ISO/IEC 15504-conformant assessment method for small software companies .

Step 2: adopting a software process model that identify specific best practices within the software domain and we recommended agile development as we comment in the previous sections. The success of a software project is generally judged on its ability to meet users' expectations, be delivered on time and adhere to original budget.

Step 3: apply the seven-rule method for development [31].

The seven-rule method suggests 7 rules for development as follows:

RULE 1: Collect the requirements from users and/or management.

RULE 2: Translate informal requirements to a formal or semi-formal specification using any formal notation, which both teams are familiar with, like DSL.

RULE 3: Generate, as much as you can, test cases from the formal specification. It should be complete in the sense that it would not leave any component

without a proper test case.

RULE 4: Each team will carry their share of the development. The HTML group will work on their parts and the programmers will do so on their parts.RULE 5: Each team will do their testing according to RULE 3.

RULE 6: The integrated application, HTML and server side generated pages, is tested by each team in full against RULE 3.

RULE 7: Iterate on RULE 6 until the log is clear of any bugs.

Step 4: choosing a suitable web testing and quality assurance approaches, Software QA involves the entire software development PROCESS - monitoring and improving the process, making sure that any agreed-upon standards and procedures are followed, and ensuring that problems are found and dealt with. It is oriented to 'prevention'

Step 5: focus on project management issues specific to web development; In order to organize and manage a web development project successfully, one must combine specific knowledge, skills, efforts, experience, capabilities, and even intuition.
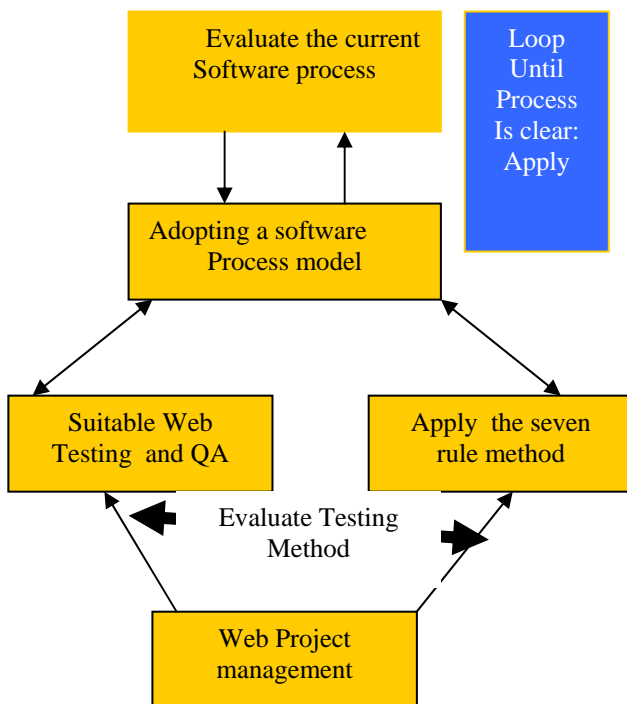

Fig 1: the five-step-model

7 Conclusion

In this paper, we provided some guidelines, which are being investigated and it turns out to be very convenient and helpful, where Web-based companies have very stiff and stringent conditions. They have limited resources. This will hinder the quality of the product and ultimately the success of these companies.So we suggest a five steps model for the web development in small firms based on a set of development methods and a set of quality standards.

And we hope to improve our work later and enhance this model by more case studies from Jordan.

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