

Scrum Testing With Backlog Management in Agile Development Environment

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Abstract— Recent research report shows the wide acceptance of agile development methodology to create qualitative software in short development cycles. It encourages the early development of software with more promising quality. Early testing strategies with multiple test cycle decrease the number of defect in product. In each iteration automated testing minimize the test effort and cost of testing. Basic agile practices like pair programming, continuous integration, small release, simple design and re-factoring make the development procedure more promising. Scrum is most widely used agile framework for developing software within four weeks. It keeps the document light and manage requirements in the form of product backlog. Testing is performed on the features which are developed in scrum process. Tester are more integrated with development team and collaborate with customers for early feedback. Automated tools are used to enhance the communication in distributed team members. Planning and meetings are the heart of agile testing. Design is more flexible to accommodate change in requirements. Testing process includes unit, integration and regression testing with non functional testing. Automated tools are used for unit and regression testing in scrum process. These tools helped significantly to simplify and speed up the development cycle. In this paper the testing process performed in scrum environment is discussed through testing model. Test strategies like unit and regression testing method is adopted in the process. Management of user requirements through product backlog and sprint backlog is discussed with suitable example. Different methodology of backlog estimation i.e initial estimation technique and planning poker method is discussed in this paper.

Index Term— Agile Software Development, Scrum testing, Backlog management.

I. INTRODUCTION

Agile methods and methodologies are used to produce software product frequently and on time. Agile software development is used to develop software product with minimal documents within short period of time. Agile means swift i.e. changing of requirement occurs frequently in Agile Software Development (ASD) [3]. ASD is iterative and incremental approach towards the software development.

ASD consist of more number of methodologies having some common principles. Among all methodologies Extreme Programming(XP)and scrum are the most important and widely accepted methodology [3]. Scrum is one of the most important agile methodology, which produce the software early and continuously.

ASD methodology follows some values and principles which are based on agile manifesto [1]. Agile manifesto described the importance of : Individuals and interactions, working software, customer collaboration and responding to change, over processes and tools, comprehensive documentation, contract negotiation and following a plan respectively.

Testing activities performed in agile environment are called agile testing [6]. Information for scrum testing in agile environment is important now-a-days. Agile testing shows the testing work with combination of agile environment and grooming of product backlog and prioritising the backlog,

distributing the responsibility within the team members and over all scrum process with combination of test strategies is described in the paper. As there are many research is performed on agile software development but how testing is performed in agile environment is limited. As agile method is more accepted methodology which is described by Hayata et al. [9] in his paper described that 74 percent of IT professionals mix agile method with other software development methodology.

Outline of the Paper

The rest of the paper is organized as follows: Section II describes the basic concept. Related work is described in section III. The proposed methodology is elaborated with a case study in Section IV .Section V, discusses the comparison with related work and Section VI contains conclusion and future work is described in section VII.

Motivation

Product backlog management is a challenging task in scrum methodology. Generation of product backlog, prioritization of user requirements also another important aspect in scrum

II. BASIC CONCEPT

Scrum is a most common agile framework to develop software product. The word scrum comes from a British game rugby where two team push and pull the ball to achieve the goal, similarly in scrum stake holder and scrum team both are responsible for producing the product and maintaining the quality [12]. Scrum process represent two sides like stakeholder or product owner and team. Team is committed for all responsibilities and, stakeholders are involved in all activities of the process.

SCRUM ROLE: Three roles are performed by the Product Owner, the Scrum Master and the Team in the scrum process.

- **SCRUM MASTER:** Scrum master communicates with team for better development and also remove the obstacle that the team face [12].
- **PRODUCT OWNER:** product owner is one who owns the product. Product owner writes the user requirement in the form of user story in the product backlog. Product owner can prioritise the product backlog as his importance. Product owner should participate in the sprint review or sprint demo ceremony [12].
- **SCRUM TEAM:** Team members are cross functional, and multi skilled. Developer, tester, business analyst, and quality assurance team members are included in team for better performance of team work. The development task is performed by the team. In the period of sprint, which story is meant for development is decided by the team. Product backlog is estimated by the team members [12].
- **ARTEFACTS USED IN SCRUM:** In scrum process the requirements are placed in product backlog and sprint backlog. Quaglia et al. [3] and Gregorio et al. [7] explains about all artefacts in their paper which are used in the scrum process.
- **PRODUCT BACKLOG:** A collection of stories the Sprint team will work on at some point in the future. The product backlog is a set of functionality called stories or user stories. Stories are placed in product backlog according to its importance and business value.
- **SPRINT BACKLOG:** A scrum term for an iteration. Most important stories from product backlog are moved to sprint backlog for development in scrum process. Sprint backlog is a sub set of product backlog.
- **User story :** A requirement, feature and/or unit of business value that can be estimated and tested. User stories are the business requirements written in the small index card. User stories are written in the form: As a User, I want..., so that ... [7].

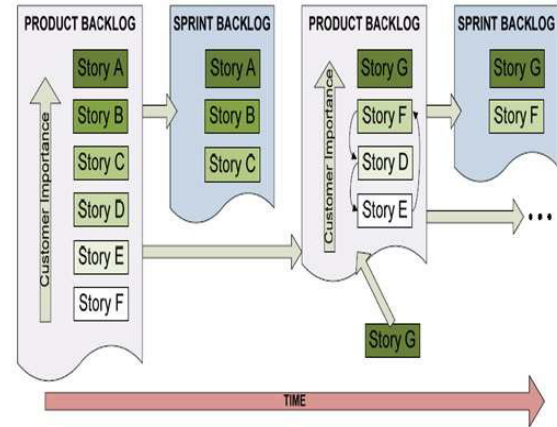


Figure 1: Product Backlog and Sprint Backlog

SCRUM MEETING: Scrum process enhance strong communication through meetings. Scrum meetings are essential components of scrum process.

Hayata et al. [9] described four type of four type of meeting in figure 2, which are :

Kick-off meeting : Kick-off meeting is performed at process starting time. Team member with product backlog is decided. Sprint planning meeting is performed after this meeting.

Sprint planning meeting: According to the customer priority most prioritised items are placed in sprint backlog. planning for development of sprint backlog items is performed in this meeting.

The daily-status meeting: Each day a short stand up meeting is performed for 15 minutes. Scrum master asks three questions to the team members to remove the obstacle.

Sprint review meeting: The developed feature is to the product owner by the team member [9].

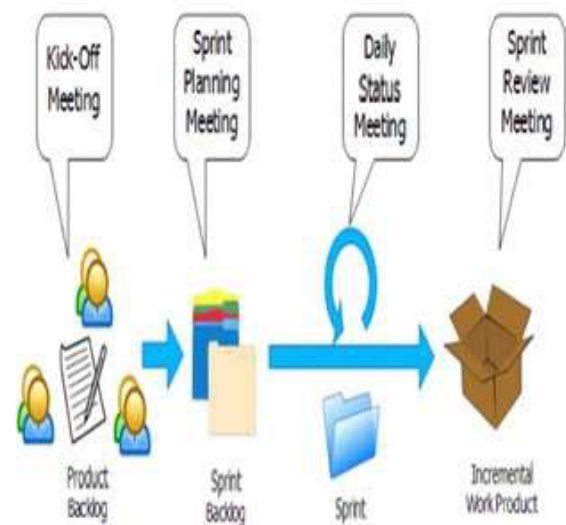


Figure 2: Scrum Meeting

III. RELATED WORK

Abrantes et al. [2] described all agile practices which are used in agile software development approach. These practices are: whole team approach, project visibility, Continuous integration, Test Driven Development, Refactoring, Pair programming, Planning Game, Small releases, Metaphor, Simple design, Collective Code Ownership, On-site customer, Sustainable Pace, Open workspace, Coding standards, Product Backlog, and Stand-up meetings. These 12 practices are described briefly by the author which are mostly used in agile process [2].

Ahmed et al. [3] suggested an agile model which can accommodate changing requirements in implementation phase. In suggested model after collecting requirements, analysis is performed on the requirement. High level design is performed then design is implemented in next phase. If user ask for any change then the change can done in implementation phase and the code is review in next phase. Then the output is implemented and testing is performed on released software. Implementation phase is composed up of four phases like iteration planning, coding, code refactoring, build/release. If testing is successful then it is deployed.

Aitken et al. [4] compared values and principles of traditional software engineering (TSE) and agile software development. TSE described different forms of SDLC, which are Waterfall, Iterative and Incremental, Evolutionary Prototyping, Iterative and Ad-hoc or Code-And-Fix SDLC. ASD methods are of different type like Extreme Programming Method, Scrum Method, Dynamic Systems Development Method, Adaptive Software Development Method, Feature Driven Development, and Personal and Team Software Development Process. These type of development models are described briefly in this paper. The comparison is performed between the values and principles of different software development methodologies of TSE and ASD [4]. Scrum testing is testing process within scrum development environment.

Scrum is most widely accepted development framework as it enhance early and continuous delivery of working software. High Collaboration and communication happen during the process among all team members. To minimise the time and cost of testing, automation technique is used in scrum. Test automation is described by Collins et al. [5] which prevent defects and increase testing effectiveness during software development. In agile methodologies, automation is considered as an important and key activity, of the agile testing.

Different type of testing is performed in scrum process which are described by Collins et al. [6] through testing quadrant. In first quadrant unit and component testing occur where the code is tested after development by the developer. After completion of all components the integration testing is done to see whether all interfaces work properly after integration. In scrum process we can automate the unit testing and component testing. In second quadrant, functional testing is performed through testing the user stories and prototypes which are the implementation of real model. We can test the story and prototypes in both ways

like manually or we can automate the testing. Testing performed in quadrant 1 and 2 supports the team as it early finds the defects in testing process in agile world. Testing performed manually in third quadrant. Type of testing which performed in third quadrant are performance testing, usability testing, and user acceptance testing like alpha and beta testing. Automated tools can be used to perform testing in fourth quadrant. Both third and fourth quadrant tests critique the product which is developed by agile methodology [6].

Hayata et al. [9] proposed a hybrid model which combines the agile methodology with traditional approach which reduce the risk of unstructured documentation. In the proposed hybrid model agile method doesn't replace the traditional software development methodology rather a mixed approach is developed from these two methodologies.

Kayes [10] proposed a test metric for scrum process through which quality of deliverables, test quality of sprint and quality of testing process can be measured. PRAT is the proposed metric which is calculated on two types of quantification like PCL and TAR. These quantifications are calculated on some factors of product backlog(PBL).

IV. ANALYSIS

The proposed model shows the backlog management with story estimation in scrum environment where , the product owner write technical or business requirements in the form of user story. User story is the collection of features which customer wants. User story is the primary input to the scrum process. According to the business value and estimation technique, most important features or stories are prioritised by the product owner. The prioritization is done through planning poker and initial estimate. In the process of sprint, iteration starts with development of story. Coding is performed for each feature by the team members. In sprint session feature is fully developed. Pair programming approach can be used in scrum where two programmer write the code alternatively and change the task between them. It will enhance the productivity of the process. After coding if we have any change in feature then we have to go for code review otherwise we can start test strategies for developed feature. Code review is the process of changing and verifying the source code. After review, type of testing based on feature to be tested is decided. During a Sprint, code is integrated and regression tested daily. Test strategies includes unit, integration and regression testing. Test cases are generated to pass all these tests. If test fails then we will go for debugging. Defect is corrected and planning for next sprint is performed. sprint review meeting perform product demo or functionality demo of the small application which is tested and satisfy the user acceptance criteria. End of iteration demonstrates the tested product. The proposed scrum testing model is shown in Fig.3. which describes the development and testing process of web application in scrum environment. Fully demonstrable, tested product is the output of whole process.

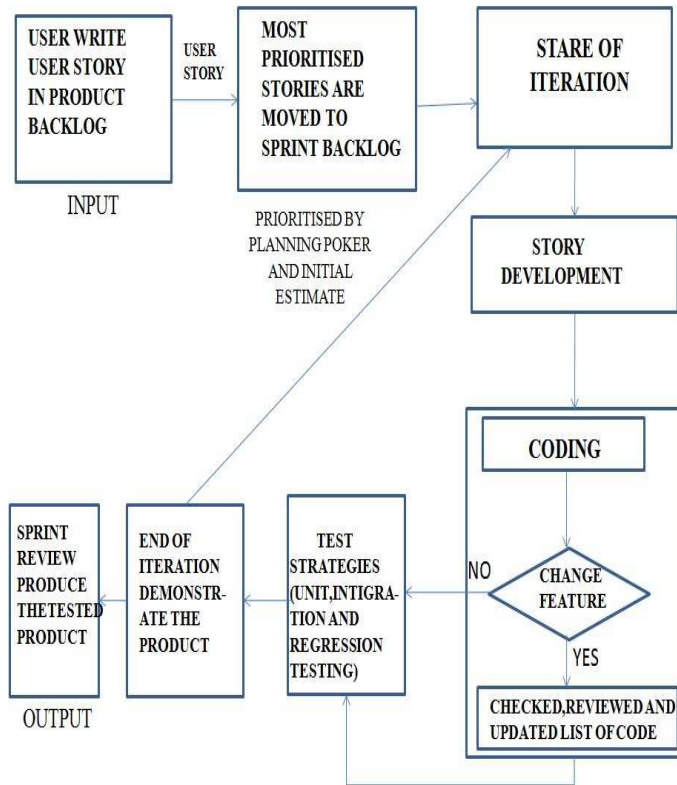


Figure 3: Proposed Testing Model in Scrum Environment

On Line Registration System : A Case Study

To develop a on-line registration system using the scrum process first user should write all his requirements in user story. All user stories should be shorted in product backlog. If any organization wants to develop an application for the purpose of registering students through the scrum process, then the application is used for registering new students by creating new accounts, update existing student detail. User can create log in page, can deposit money for registration, can register himself for on line exam. So according to the requirement, user can write user story in an index card or story card. Then the most important stories which are prioritised by the product owner should move to sprint backlog. If application demand first development of login page then developer perform their task and they estimate resource and time for that specific task. Velocity of the process is also calculated. Tester should understand the code because after development, testing will be performed on the developed feature or small application. Testing is performed on the developed code. Before testing a high level test planning is performed to set the environment, tool, budget, place, time and team members. So before delivering the product to the product owner, unit, integration, regression and all non functional testing are performed on the feature. Testing is performed in each iteration. Testers are more integrated to the development team. As Collins et al. [6] described all type of testing performed in agile environment through test quadrant to achieve the quality of product. Test automation is much important in

scrum process, as it demand early delivery of tested product. Selenium is a automated tool used for testing in web application [13]. It execute the test on multiple browser. Automated scripts are generated and executed by the tool which minimize the cost, and speed up the whole test execution process. Automated tests on code level run every night or after new code is added. New functional test cases are automated, and executed to find defects, bug found is fixed immediately.

Error found can be placed in bug repository and prioritised during next sprint planning. Before delivering the feature all non functional testing is performed like usability, load, and performance testing. Acceptance testing is also automated before delivering product to the customer to satisfy the acceptance criteria [8].

For on-line registration system the user stories of product backlog is given in Table .1.

ID	Description/Name	Importance	Sprint Session
1	As a student i want to create an online account for on line registration system	80	Sprint1
2	As a online user/student i want to create login page for registration of exam	60	Sprint1
3	As a student i want to update my detail	50	Sprint2
4	As an user i want to make payment for registration	40	Sprint2
5	As an user i want to check my account balance before registration	30	Sprint3
6	As a student i want to register in the registration form	20	Sprint3

Table 1: User Stories In Product Backlog For Online Registration system

PRODUCT BACKLOG: Product backlog is the list of all user stories which customer want to develop. A product backlog has the following fields which is described by Kniberg [11].

- ID: An unique identification number to make the track of user stories.
- NAME: A small description about the user story. It should not be too large.
- IMPORTANCE: Importance is given by product owner. According to business value product owner gives the importance to the user stories as 20 or 100. It means story having importance 100 is more required or demanding for product owner, and story having importance 20 can be developed later and which may be less important than other.
- ESTIMATION TECHNIQUE: To estimate the backlog items two methodology are used like planning poker and initial estimation method.
- PLANNING POKER: To estimate time for every story this technique is used. In this estimation technique 13 cards are used for time estimation. This time estimation technique in which 13 cards are used by the team members is coined by Mike Cohn [11].

Each member involved in the estimation technique for each story. They selects a card from the deck of 13 cards which represents their time estimates in the form of story point. According to his opinion the story will take how many days or hour it can be decided through his card. All member show their cards simultaneously, if the number differs from member to member then a common discussion is performed on what type of work the story contains. Again the selection of card is performed till all members have the same estimate.

Cards having special symbol like,

? = Having no idea about the task.

Coffee cup = symbol of break at work or tiredness.

0=Completed story, or have little work.

INITIAL ESTIMATE: Story point is the unit of initial estimate. The initial assessment for a story, that is how many people will work for how many days to complete the story is calculated through initial estimate. It represented as man per days. If 3 persons take 4 days to produce a finished, tested, releasable product, then initial estimate is 12 story points [11]. After estimation the most important story is transferred to sprint backlog.

Table-2 shows the example of sprint backlog for on line registration system .

ID	Description/Name	Importance	Sprint Session
1	As a student i want to create an online account for on line registration system	80	Sprint1
2	As a online user/student i want to create login page	60	Sprint1

	for registration of exam		
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Table 2: Sprint Backlog For On-line Registration System

V.COMPARISON WITH RELATED WORK

The proposed model shows the backlog management with backlog prioritization and estimation with appropriate example of product backlog and after estimation sprint backlog is given with example. Most common agile practices are described by Abrantes et al. [2] in his paper.

Aitken et al. [4] compared the values and principles of Agile Software Development(ASD)and Traditional Software Engineering(TSE).

Ahmed et al. [3] suggested an agile model which represents all phases of software development in agile environment, but the detail description of scrum testing is not described in that paper. Collins et al. [6] figured out all types of testing conducted in agile environment. Testing quadrant does not describe the scrum process and input to the testing process in scrum. Hayata et al. [9] combined both agile and traditional methodology and proposed the hybrid model, but no description about backlog management is given in their paper.

Kayes [10] proposed a test metric for scrum process through which quality of deliverables, test quality of sprint and quality of testing process can be measured. Automating regression testing with selenium is described by Razak et al. [13]. Haugset et al. [8] explains the automation of acceptance testing in agile world with suitable case study. The proposed scrum testing model show better understanding of scrum process with enhance communication as tester are early involved in the scrum process. Automated testing is adopted by the testers according to the feature which is to be implemented. Change in requirement is facilitated which reflects agility throughout the process. Automated regression testing decrease the defect rate as well as make the product more qualitative. Enhanced coordination among team and tester decrease the gap between developer and tester.

VI. CONCLUSION

To obtain software product early and continuously agile methodology is widely used. Agile method keeps the document. light and code is more flexible to accommodate change. Testing process has more value for demonstrating quality product in agile environment. Testing with automated tool enhance the efficiency of testing. Testing is a continuous process in scrum, where a code is tested daily. Scrum process encourage change in requirement so regression testing has to be done after any change in coding. Testing is done in each iteration. Scrum meeting enhance responsibility of all team members.

VII. SCOPE FOR FURTHER RESEARCH

Managing large product backlog having more user story in short development cycle is still challenging task. As code is modified for changing requirement so more number of regression testing is required. So more number of test cycle increase complexity in the scrum process. Enhancing quality of product with minimum documentation is also challenging. So more effect is needed towards these fields.

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