Contents lists available http://www.kinnaird.edu.pk/

Journal of Natural and Applied Sciences Pakistan

Journal homepage: http://jnasp.kinnaird.edu.pk/

EVALUATING THE MEASURES TO IMPROVE THE QUALITY OF SOFTWARE SYSTEM BY APPLYING SCRUM

Zainab Muzaffar[1], Merry Daniel[1*], Saleem Zubair Ahmad[1]
[1]Department of Software Engineering, Superior University Lahore, Pakistan

Article Info

*Corresponding Author
Email: merrysardar95@gmail.com

Abstract

In Pakistan's IT business, there is a shift toward Agile Project Management in order to meet customer satisfaction and needs in software. Several quality assurance procedures are incorporated in the process itself in various agile approaches, with no specific QA roles. Transitioning from a traditional process to Agile Methodology is a difficult task. This will need a significant quantity of research in order to cope with the ongoing demand and changes. Scrum is the most widely used agile methodology in the IT industry for achieving product/system quality. The topics were investigated using both quantitative and qualitative methods. As a result of our research, various areas needed to be corrected or catered in order to effect change like Quality Assurance, customer collaboration, continuous integration, and sprint planning have all been discussed. Scrum is used with XP extreme Programming and Software Quality Assurance to address these difficulties.

Keywords
Software Quality Assurance, XP Extreme Programming, Scrum, Agile Methodologies, Customer Satisfaction

1. Introduction

Ever since the agile has hit the market it becomes the main stream how to measure the quality and effectiveness for software development. The agile was introduced to cater the constant changing requirements during the software development.

1.1 What Is Agile?

Agile is a time-boxed methodology. This iterative approach to software delivery is used to develop software from the beginning of a project. In the end, it does not provide everything at once. (Hoda *at el.,* 2018). Agile approach explain in Figure 1

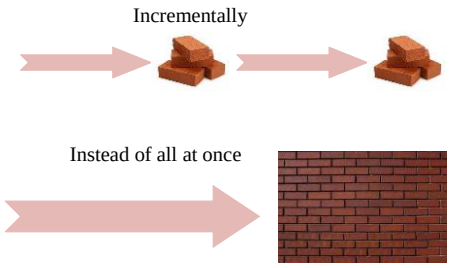


Figure 1: Agile Methodology

1.2 Software Development?

It is not a standalone practice, it consists of multiple frameworks such as scrum, XP or Feature-Driven-Development (FDD). (Serrador & Pinto, 2015).

As discussed above agile software development is an umbrella which is expressed in manifesto for agile software development. Along with this it has 12 principles behind it. (Sharp & Hall, 2016).

1. Customer satisfaction
2. Welcome changing requirements
3. Work delivery
4. Quality Product
5. Reporting
6. Sustainable development
7. Effective designs
8. Monitoring
9. Motivation
10. Self-organizing team
11. Face to face conversation
12. Self-efficiency of team

Following is the Figure 2 that will explain the agile software development

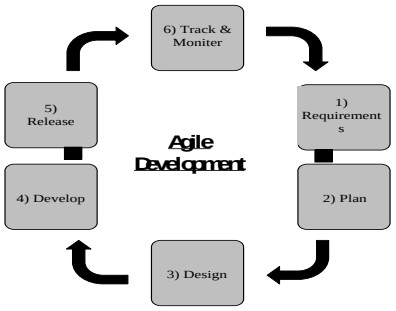
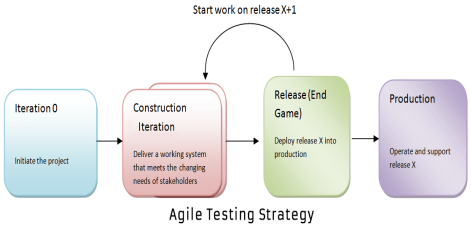


Figure 2: Agile Development

Following is the figure that will explain the agile testing strategy



Different agile approaches and techniques are utilised in software development all around the world. Scrum is the most widely used methodology in the IT sector. (Kuhrmann *et al.*, 2017).

Scrum is a software development methodology that aims to improve software quality. Scrum can build software in a fast-paced setting while maintaining a high level of customer satisfaction and delivering a high-quality output. (Pohl &. Hof, (n.d.).

1.3 What Is Scrum?

This is an agile framework or approach that is mostly used in software development to improve software quality. It has established objectives over the next two to four weeks. It is one of the most influential aspects of the agile manifesto. This also aids our understanding of how to produce high-quality software efficiently and effectively. Sprint system explain in Figure 3

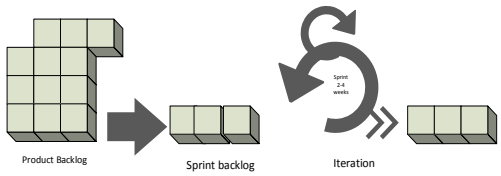


Figure 3: Sprint Working

In the development of any software product, Quality has always been a priority. Scrum enables complete independence in altering requirements throughout development, resulting in a high customer acceptance rate for scrum-developed products.

The iterative testing life cycle Scrum begins with a time of preparation for iterative development. Testing will focus on developing and running functional test cases throughout development. These can be conducted manually or in an automated test environment that can be run whenever necessary.

Scrum allows developers to develop a software in a rapid pace and in short sprint cycles. As developers are in high pressure to complete all the committed functional requirements within a given time frame, they usually ignore the non-functional requirements in the system. These requirements get piled up and can create a problem for both developers and the owner while developing software product. (Sharp & Hall, 2016). The objective of this study is to identify that how scrum can play an important role in delivering the quality products for the customer's satisfactions and to provide suggestions that will improve the process for betterment of using Scrum in Pakistan.

We have figured out the following variables

- Automation testing tool
- Skipping Unit testing
- Quality Sprints
- Checking the quality of product

1.4 Problem Statement

Scrum enables software engineers to work at a fast pace and in short sprint cycles. Because developers are under a lot of pressure to finish all of the committed functional needs within a certain amount of time, they often overlook the system's non-functional requirements. These requirements pile up, posing a dilemma for both developers and product owners as the software product is developed. Many scholars have tried to enhance the framework, but none have concentrated on enhancing the quality of Scrum products in Pakistan. The goal of the study is to identify activities that lead to a drop in quality and make recommendations for how to enhance the process.

1.5 Objectives and Aims

The aim of this study is to find out the quality of software using scrum practices which are being used in Pakistan IT sector. For this we have drafted 2 major research questions which are mentioned below:

Q1: What problems are faced by Scrum practitioners in Pakistan in achieving quality goals of the software development products?

Q2: What improvements can be done to overcome the problems in usage of Scrum methodology in Pakistan for providing quality product?

2. Literature Review

2.1 Overview

In early stages of software development simple process was used such as waterfall model.

In this model, some predefined steps are as follows:

1. Requirements gathering
2. Analysis
3. Design

4. Development
5. Testing
6. Deployment
7. Maintenance

This model contains pre-defined steps like (Requirement gathering, Design, Development, Testing, Deployment and Maintenance (Theocharis *et al.*, 2015). Waterfall model explain in Figure 4

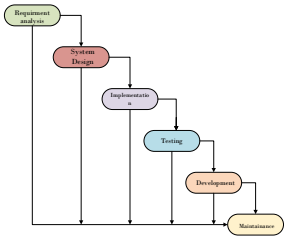


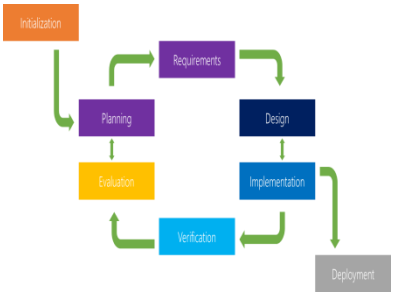
Figure 4: Waterfall Model

As this process moves downwards, one has to complete task so that it can be tested to check the quality before moving to the deployment, as there is no flexibility in this model, if any change occurs in requirements of software.

After water fall, Spiral model was introduced by Barry Boehm in 1988.

Risk assessment activity was added in each phase of waterfall but the process was very simple and there was still minimum customer interaction while the development is being done. (Boje *at el.*, 2017).

After these 2 models' iterative model was introduced in the IT industry. This was the model in which modules were developed and tested. After the complete quality assurance modules were sent to client for their approvals. Each module was using waterfall steps. (Alshamrani & Bahattab, 2015).



New methodology was introduced in the IT industry with the name of Agile in 2002. Some experts mentioned the key factors which practitioners were facing.

Agile is based on 5 key points (Cervone, 2011).

- Interactions with processes and tools.
- Technical documentation.
- Quality Assurance on each phase
- Customer Interaction.
- Cater Change.

Due to flexible nature of the agile multiple processes have been introduced in the IT industry like extreme Programming (XP), Lean Software Development, Crystal Clear methods, Adaptive Software Development (ASD), Kanban etc.

2.2 Description of Scrum

As scrum is one of the most used agile methodology in the IT industry (Cho, 2008). It has 3 main components Roles, Processes and Artifacts. (Cho, 2008).

a) Scrum Master

The Scrum Master is leader of the whole Scrum Team. The responsibility of a Scrum master is to promote and support Scrum as per Scrum Guide. She/he helps everyone in understanding Scrum theory, values and rules. (Singh *et al.*, 2018).

b) *Scrum Team*

It is self-organizing and adjusts them according to situation. Scrum team involves scrum master,

owner of the product and technical team. (Takpuie & Tanner, 2016).

c) Product Owner

Product owner has all the knowledge of the product. Product owner handles all the business needs of the clients and create a relation between stakeholders and the technical team. (Putra & Warnars, 2018).

d) Sprint Planning Meeting

Sprint planning is executed in the meeting where backlogs are created. These are the key points that are needed to be implemented for the systems and its quality delivery. These logs are then break down into several other tasks (Takpuie & Tanner, 2016).

e) Sprint

Sprint is a development phase in which multiple tasks are implemented from the print backlogs. While doing a sprint requirement are not allowed to be changed.

f) Daily Scrum Meeting

Scrum meeting are conducted on regular basis for 15 to 20 minutes in which the reports are provided to the PO (Product Owner). The key points of the meeting are as follow:

1. What was done?
2. What is the current status of the project?
3. What needs to be done?
4. What were the issues reported after quality assurance?

(Takpuie & Tanner, 2016).

g) Software Industry and Scrum implementation

Some researchers have conducted interviews and mentioned some main key points in scrum adoption as follow:

- No involvement with client. Due to the fear of changing the scope of the requirements.
- If unit testing is skipped from the development process then quality assurance (Q.A) will be in-effective.
- If the automation testing tool is used in a mannered way the quality assurance will be productive and effective.
- Decision making issues occurs.
- If the quality of the product is checked properly then overall quality assurance will meet the required standards.
- Teams are not empowered.
- Lack of risk management strategy.
- Less development times.
- If the training of personnel is conducted properly then there will be improvement in the quality of the product.
- If the goals are defined properly in each sprint then the quality of sprint can be improved. (Bachmann *et al.,* 2016).

3. Existing Solution to Improve the Quality of the Product through Scrum

Till now not a single development framework can be set as the ideal framework for all kinds of project and their quality. Many researchers had integrated different agile

Methodologies with the scrum to get the required quality results or improvements in the scrum. Following are the agile frameworks that were integrated with the scrum:

3.1 V Model

V model is considered as enhancement in waterfall model because in each step specific and predesigned step are being followed to complete a

module or a phase of a development and testing. These specific steps are same as the waterfall steps, which starts from the requirements gathering till the quality assurance and deployment. So, this means every phase is predefined and tested as well. This is also known as the hybrid model (Hayata & Han, 2011).

It was observed that there is a flaw in this hybrid framework which was, there is no customer interaction between the development phase/module. This causes the customer dissatisfaction of the product which results in low quality of the product.

3.2 Personal Software Process

Personal Software Process is designed in a way that it would increase the individual's development and testing productivity as there are already predefined steps in the personal software process and individuals has to stick to the script which are having predefined planning and work flows. Developer or an individual has to fix the issues and to create their logs within a specific time frame. When all of this development and testing is completed a summarized report is written in which the problems are identified and the submission of the project is defined. Also, this report is submitted to the client or customer. This personal software process hybrid plan was presented by (Rong *et al.*, 2010).

It was observed that personal software process model has same drawbacks like Vmodel. There is minimum client or customer interaction while the development and testing phase is conducted.

3.3 Research Variables

Some of the variables has been extracted from the questionnaire which are mentioned below:

1. Automation tool testing.
2. Skipping unit testing.
3. Training of personnel.
4. Defining quality goals for sprint.
5. Checking quality of product.

3.4 Hypothesis

1. Use of automated testing tools:

This variable is used to figure out if automated testing tools are being used for testing purposes or not?

2. Skipping unit testing:

This variable is used to figure out if the team members are skipping unit testing or not?

3. Training of personnel:

This variable is used to figure out if the individuals has conducted or received any training for working in the scrum environment.

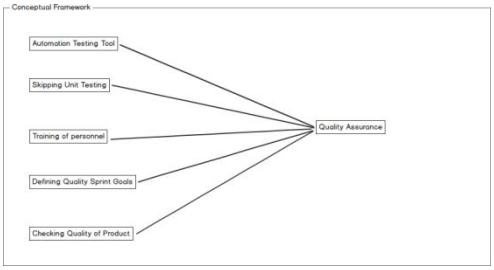
4. Defining quality goals for sprint:

This variable is used to figure out who is setting the quality goals for sprint.

5. Checking quality of product:

This variable is used to figure out who is checking the quality of the product

4. Conceptual Framework



5. Research Methodology

Quantitative and qualitative research are the two primary techniques to research. We utilized a survey to collect data for our exploratory inquiry. The purpose of this survey is to address the issues that practitioners who are adopting the scrum framework in quality assurance have encountered. Our questionnaire consists of 20 questions that were answered by five members of each organization's staff. As a result, we have 100 completed surveys from the following businesses:

1. Amco IT systems.
2. Expert flow.
3. Kwanso solutions.
4. iris communications.
5. Ebricks.

Out of those 100 filled questionnaires 75 questionnaires were considered correct or complete & were used in data analysis. Along with this we have also used quantitative research approach to back our survey. For this we have used 6 interview questions. Following are the list of practitioners how were interviewed:

1. Scrum masters.
2. Quality assurance engineers.
3. Software engineer.
4. Product owners.

These interview questions were developed to understand the development and quality assurance life cycle process in the organization so that we can figure out the problems which team members are facing issues in implementing scrum.

6. Data Collection Approach

- We'll be using questioners to get our data from the population. In order to back our questioners' results, we will be conducting informal interviews of the population.

6.1 Population

Following are the personnel's who will be filling our questioners

- Scrum Master
- Developers
- QA engineers
- Project Manager

6.2 Sample

We will use Non-Probability sample for the research. The reason for doing this type of sampling that we want to select the specific units for the IT industry to get our results

Our sample size will be 100 personnel's

7. Data Analysis Techniques

Analysis is the term that refers to the computation of certain measures and also searching for kind of relationship that exists among different data groups. (Mushtaq & Qureshi, 2012).

In case of survey, it involves the estimation of the value of unknown parameters of the population. Hypothesis testing is also included in it. Analysis can be categorized as descriptive and statistical. (Pandey & Pandey, 2021).

The research we are going to conduct will measure the relationship between the variables to identify those variables which are the cause of declining the quality of the product.

Since all the variables that we have used in our research are nominal variables, so only those tests will be performed that will work with nominal data. Chi-square test of independence is used to analyze nominal data (Wallis, 2003).

But if a sample size is less than 20 then the result will not valid (Agresti, 1990).

8. Results And Analysis

Table 1

Use Of Automated Testing Tool		
Organization Size	**Agree**	**Disagrees**
<50	9	3
>1000	5	0
101 – 500	6	1
501 – 1000	1	0
51 – 100	2	1

The p value that is calculated through Chi-square test for this table is p= 0.7806

Size of the organization is intendent of the use to automated tools for testing. As scrum framework

make the development fast and rapid, and increase the quality of the system. (Sumrell, 2007).

Table 2

Skipping Unit Testing		
Pressure During Sprint	**Yes**	**No**
Yes	2	10
No	10	6

The p value that is calculated through Chi-square test for this table is p= 0.02347

Team members do feel pressure will working in the sprint but they don't feel any pressure while doing the unit testing. Sprint planning should be done properly to incorporate sufficient time for development and testing after identifying the same issue is the survey (Cristal *et al.*, 2008). Continuous model according to this approach continues testing should be done during development since it reduces the development time by 15% and save more time for testing (Fitzgerald & Stol, 2014). Project planning should be done before project initiation as result of planning a quality assurance schedule (QSA) can be defined. It contains information about the quality aspects to be checked in the final product. It can help the team to estimate time for testing activities during sprint keeping it as a reference (Jakobsen & Sutherland, 2009).

Table 3

Feeling Pressure During Sprint		
Training Of Personnel	**No**	**Yes**
No	3	6
Yes	9	10

st for this table is p= 0.07161

The results show us that scrum master along with the team is defining goals for sprint. Customers should be involved from the begging of the project since customer is important for competitive quality (Lengnick-Hall, 1996). Agile emphases on customer involvement from the beginning till the end to ensure the success of the project (Saiedian & Dale, 2000). Conducted a survey and discussed the adverse effects of lack of customer involvement on the team and project (Hoda *et al.*, 2011).

Table 4

Frequency Of Reporting Quality Defects In The Product After Delivery			
Defining Quality Goals For Sprint.	**Never**	**Sometimes**	**Very Often**
All Of Them Together	1	11	1
Pm And Scrum Master	5	6	4

This table is p= 0.07161

Quality goals are set by the higher hierarchy in the initial planning phase (Moe & Dingsøyr, 2008). The set goals are then shared with everyone.

9. Conclusion

This research paper evaluate how to improve the quality of the system through scrum. We have conducted the research survey in the IT organizations. In our survey the questions was identify the problems in organization that faced while implementing the scrum methodology. Following are the results that have been gathered through surveys and interviews are listed below:

1. Ignorance of the clients from the start of the project.
2. Ignorance of the testing by the team while developing a project.
3. Training of personnel are not up to the standards. It was also noticed that few members are letting down other members within a team

The findings of the survey about the testing processes and development were used in the scrum methodology are reviewed in the study article. Create the questionnaires and resolved from the employees of different organizations, employees actively participate in this evaluation. However, the survey's importance was determined to be extremely important, since more than 80 percent of respondents held team leadership or management responsibilities. The report looked at the improvement of the software quality by using scrum in Pakistan's IT industry. The purpose of this study article is to define the optimal relationship between software quality and development, ensuring that techniques for testing software systems will yield the highest-quality software, since software has become an integral part of our daily lives.

Software companies in Pakistan must improve their software testing procedures in order to get a competitive advantage over their competitors in terms of software product quality. White-box and dynamic testing will increase coder productivity and output in agile development, allowing users to establish expectations for practitioners and academics to assess and implement software-testing frameworks in diverse Pakistani enterprises.

10. References

Agresti, A. (1990). 'Categorical Data Analysis Wiley: New York'.

Alshamrani A. & Bahattab, A. (2015). 'A comparison between three SDLC models waterfall model, spiral model, and Incremental/Iterative model', Int. J. Comput. Sci. Issues IJCSI, 12(1), 106.

Bachmann, J. Blöchlinger, P. Wellauer, M. Vassiliou, F. & Stojadinovic, B. (2016). 'Experimental investigation of the seismic response of a column rocking and rolling on a concave base', vol. 3, 5074–5097.

Boje, D. M. Baca-Greif, H. Intindola, M. & Elias, S. (2017). 'The episodic spiral model: a new approach to organizational processes', J. Organ. Change Manag.

Cervone, H. F. (2011). 'Understanding agile project management methods using Scrum', OCLC Syst. Serv. Int. Digit. Libr. Perspect.

Cho, J. (2008). 'Issues and Challenges of agile software development with SCRUM', Issues Inf. Syst., 9 (2), 188–195.

Cristal, M. Wildt, D. & Prikladnicki, R. (2008). 'Usage of Scrum practices within a global company', pp. 222–226.

Fitzgerald B. & Stol, K.-J. (2014). 'Continuous software engineering and beyond: trends and challenges', pp. 1–9.

Hayata T. & Han, J. (2011). 'A hybrid model for IT project with Scrum', pp. 285–290.

Hoda, R. Noble, J. &. Marshall, S. (2011). 'The impact of inadequate customer collaboration on self-organizing Agile teams', Inf. Softw. Technol., 53(5), 521–534.

Hoda, R. Salleh, N. & Grundy, J. (2018). 'The rise and evolution of agile software development', IEEE Softw.,35(5), 58–63.

Jakobsen C. R. & Sutherland, J. (2009). 'Mature scrum at systematic', Methods Tools, pp. 1–11.

Kuhrmann, M. Diebold, P. S. MacDonell, & Münch J., (2017). '2nd workshop on hybrid development approaches in software systems development', 397–403.

Lengnick-Hall, C. A. (1996). 'Customer contributions to quality: A different view of the customer-oriented firm', Acad. Manage. Rev., 21(3), 791–824.

Moe N. B. & Dingsøyr, T. (2008). 'Scrum and team effectiveness: Theory and practice', pp. 11–20.

Mushtaq Z. & Qureshi, M. R. J. (2012). 'Novel hybrid model: Integrating scrum and XP', Int. J. Inf. Technol. Comput. Sci. IJITCS, 4(6), p. 39.

Pandey P. & Pandey, M. M. (2021). Research methodology tools and techniques. Bridge Center.

Pohl C. &. Hof, H.-J (n.d) 'Secure Scrum and Open SAMM for Secure Software Development'.

Putra A. S. & Warnars, H. L. H. S. (2018). 'Intelligent Traffic Monitoring System (ITMS) for Smart City Based on IoT Monitoring', pp. 161–165.

Rong, G. Shao, D. & Zhang, H. (2010). 'Scrum-psp: Embracing process agility and discipline' pp. 316–325.

Saiedian H. & Dale, R. (2000). 'Requirements engineering: making the connection between the software developer and customer', Inf. Softw. Technol., 42(6), 419–428.

Serrador P. & Pinto, J. K. (2015). 'Does Agile work?—A quantitative analysis of agile project success', Int. J. Proj. Manag., 33 (5), 1040–1051.

Sharp H. & Hall, T. (2016). Agile Processes in Software Engineering and Extreme Programming: 17th International Conference, XP 2016, Edinburgh, UK, May 24-27, 2016, Proceedings. Springer Nature.

Singh, P. Farooq, S. U. & S. Tiwari, (2018). 'A report on the workshop on emerging software engineering education, pp. 1–2.

Sumrell, M. (2007). 'From waterfall to agile-how does a qa team transition?' pp. 291–295.

Takpuie D. & Tanner, M. (2016). 'Investigating the characteristics needed by scrum team members to successfully transfer tacit knowledge during agile software projects', Electron. J. Inf. Syst. Eval., 19(1), 36-54.

Theocharis, G. Kuhrmann, M. Münch, J. & Diebold, P. (2015). 'Is water-scrum-fall reality? on the use of agile and traditional development practices', 149–166.

Wallis, K. F. (2003). 'Chi-squared tests of interval and density forecasts, and the Bank of England's fan charts', Int. J. Forecast., 19(2), 165–175.