Software Quality Assurance in SCRUM: Implementing SQA strategies in meeting user expectations

Mehreen Sirshar
Faculty of Software Engineering
Fatima Jinnah Women University
Rawalpindi, Pakistan
mehreensirshar@fjwu.edu.pk

Tamsal Nadeem
Department of Software Engineering
Fatima Jinnah Women Univeristy
Rawalpindi. Pakistan
tamsalnadeeem@gmail.com

Um-e-Abiha
Department of Software Engineering
Fatima Jinnah Women University
Rawalpindi, Pakistan
abiehajaphrie88@gmail.com

***Abstract*—The main motto of this study is to examine and and study on behavior of Software Quality Assurance (SQA) issues of project stakeholders in a Scrum environment and their consequences . This inductive case study identifies SQA principles relevant to Meeting User Expectations. The Stakeholders in the Scrum project having lack of Concrete Guidance on Scrum's SQA approaches, methods, and techniques. The insufficiency of concrete guidelines in Scrum needs a management squad to develop concepts that can include implementing practices from other methodologies and wisely modifying the system structure to incorporate the practices adopted, ensuring improvement in the processes, and creating a shared ownership environment. Through explaining the incompleteness of Agile approaches with special attention to the lack of concrete instructions in Scrum, the study uses techniques to customize literature and advocate for Scrum's versatility. The study uses strategies to adapt literature and argue for Scrum's simplicity by illustrating the incompleteness of Agile approaches with special attention to the lack of concrete instructions in Scrum methodology.**

I. Introduction

Design of software has become one of the most important activities in the environment. Today's software is fast becoming the embodiment of much of the world's intellectual property. In the scope of this article, Scrum refers to an Agile approach which focuses on new strategies to handle project management structure which interact between all participants, including clients and business representatives, sets daily sprint deadlines for code delivery, reviews improvements and retrospect's before focusing on the next criteria for product backlog. It is used to deliver effective IT programs that is vital and strategic requirement for today's organizations but developers faced high cost overruns, limited range, termination, quality problems and concerns from customers.

Performance refers to a technology project's ability to meet industry requirements and add value to the consumer for the purposes of this analysis. Scrum is a lightweight model for software development that embodies characteristics that are flexible, competitive and cooperative. The technique used to adapt the approach to accommodate the creation of large and critical and difficult projects. Scaling scrum members' positions, however, this methodology brought advance challenges, especially in large decentralized software projects. Resolving a wide range of problems and giving software technology a number of benefits makes the Agile system models appealing to researchers. Scrum is also known in the software industry as one of the most influential and widely implemented agile process models. It was described by Abraham son as a validated project management method for co-located and small development teams. This approach is familiar with the concept of quantitative process control for handling complex and dynamic software projects.

II. Literature Review

There are many organizations who are giving confidence and assurance to the management experts for the searching of highly reliable tools for project management in order to manage the challenges faced by mangers in managing the complex projects. Literature review deals with various Project Quality methodologies in SCRUM. Chitra A. Dhawale proposed that the Scrum is the software industry's most common agile methodology. Many companies have increased their efficiency and profitability by using scrum techniques. Practical view of Scrum practices are showed in this paper [1], in particular the size of the team, the team structure and the description of the roles in Scrum teams. This paper is grounded on their experience in a variety of projects. The Scrum is most common agile methodology. Many companies have increased their efficiency and profitability by using scrum techniques. Scrum is best suited for 3-9-member team-sized items. SOS (scrum of scrum) distributes the broad work project into multiple teams and regular meetings are arranged among the members of each group to track the quality and speed of each team. They also presents the working delivery strategies for the SOS. In their research they plan to examine the practical aspect of GSD projects as a future work with (SoS) activities.

Indika Perera stated that quality related issues and challenges must be resolved in order to be successful [2]. Due to its flexible approach to managing requirement volatility and emphasis on extensive customer and development team collaboration,

Scrum has gained considerable attention. Offshore teams ' geographical and cultural isolation poses obstacles for using OSD Scrum. The research's aims were therefore to identify issues and challenges relevant to OSD in the context of Sri Lanka and how Scrum can be used to address these issues and challenges. Their Study results show that key Scrum factors such as interaction, individuals, procedures, and organizational factors contribute positively to OSD performance.

According to RiffatNaz, M. N. A. Khan, Muhammad , Aamir [3] Scrum is now being used as a fast, flexible and holistic software development methodology having great deal of customer engagement in Scrum projects that helps toward creating user-oriented product. In this approach many techniques for product maintenance and support have been suggested. This maintenance model is based on designed type and severity (priority) analysis of customer requests and users can change their requirements according to their need In their methodology, the Conference attendees "Scrum Master, Product Owner and Team" first select that error, issue or upgrade that has an urgent type or higher priority request and then select low priority or non-urgent requests and give ease to the customers. The proposed model works effectively and challenging in order to meet the demand of the consumer. This complete worldwide study has been performed on consumer support and maintenance which contributes to existing scrum activities. We found that less attention was given to the scrum's maintenance phase in the existing literature. With this in mind, we have tried to propose a new model.

Sara Ashraf, Shabib Aftab [4] describes a customized version of Scrum that aims to improve communication, team performance, test, and maintenance visibility. The proposed model includes modifying and innovating the current Scrum methods and functions to solve the issues while preserving the model's authenticity and simplicity.

Syed Mehmood Raza Naqvi [5], in his paper stated that the Performance metrics play a progressively more important role in project management of software development, with the need to effectively control the paramount apprehension's exclusive investment in software development. The purpose behind picking the most revealing separation of features from a pool of accessible, cost that reduce the dimensionality of the data sets which will significantly lessen the complexity and time duration needed to reach for estimation using specific modeling process. Regression analysis was used almost exclusively in this work to derive computer system effort prediction equations. In this paper, the use of neural networks and fuzzy models is given some consideration in terms of their suitability for the task of estimating effort. There is also a comparison of Software Quality Assurance with specific reference to statistical modeling and point analysis, a common formal approach for estimating size and development exertion.

Abeer M.AlMutairi, M. Rizwan Qureshi [6] discussed the technique of Scrum of scrums to scale the traditional scrum methodology for huge and composite difficult projects. This paper describes in detail of every scrum member functions in SOS to propose a solution for using a devoted brand owner for a group and sub-backlog presence. The major purpose of the suggested solution is to enhance the role of product owner for the distribution of large projects. The projected changes will be increases cohesiveness between scrum groups and exclude repetition of work as well. So, the assessment is used to test the proposed solution as a research design.

Eduard, Yusuf, Suharjito presented a correlation between the agile method and the waterfall is discussed in this article [8]. The quality of Scrum is also checked in various ways. In the paper, "Scrum of Scrums" is a structure that can solve difficult dynamic problems. Software development is carried out sequentially in the waterfall model. Yet software development is broken into small pieces in the Scrum template. Developers concentrate on one piece of cross-function in one unit of time. Once these small pieces have been completed, users can use them directly. Scrum is used now a days to make sure its possibility to deliver all pieces of the code on time. The other advantages, this methodology make the workplace innovative and efficient, and scrum can also improve the value of the business. This paper explores Scrum's current state, popularity, and evolution over the past five years [8]. They take published literature and business survey into account. Their end results shown that Scrum is a popular software development approach used by industries among various agile methodologies and it also the cover the area of interest to the research community. Similar to the other agile methodologies, they believe that Scrum approach is commonly used strategy.

Breno Lisi Romano, Alan Delgado da Silva [9] proposed a study based on discussion of use of the agile Scrum model within a small business .It provides software project management monitoring activities. This includes using human, economic, and temporary resources during the construction of a plan, increasing the rate of effective deliveries. Following four separate steps were defined to enable Scrum adoption: infrastructure set-up, team training, agile deployment of Scrum, and deployment refinement. During that particular case study within a small business, their major improvements have been found since the first sprints, primarily concerning coordination, team morale, and adaptation agility.

"Geir K. Hanssen," "Børge Haugset,Tor Stalhane" [10], suggested that during sprints, sprint reviews and retrospectives, the team takes special care of QA. They defined Safe Scrum, a Scrum variant with some supplementary XP methods that can be used to develop safety- critical software and IEC 61508 certified software. This puts the system under a lot of additional conditions. The quality reassurance processes in Scrum are found to become in- adequate. Consequently, they examined the standard, look up an independent evaluator and worked with the Scrum squad to identify the necessary additional tasks to be added to the Safe Scrum process for a team-internal Quality assurance part.

Christelle Scharff [11] stated that the developers uses Scrum and Agile methods to improve mobile applications to support different end-to- end tooling infrastructures for different mobile platform. Their study isolates the position of auditors and focus on it. This explains the partnership model, the

role of auditing in adherence to Agile and Scrum, and the value of resources to maintenance quality assurance activities. Recommendations for greater participation of auditors in Agile and Scrum programs and their contribution.

Riwaande Hanslo, Professor Ernest Mnkandla, [12] discussed that although Scrum plays a key role in Agile growth success, it does come up with its own challenges. Challenges are analyzed at the organizational and team level in previous research, mainly through case studies. Basically, it is necessary to adopt Scrum at the individual level.In addition, difficulties such as inexperience, poor communication, expertise, lack of coordination, low quality, organizational culture and alignment with Scrum have been described as contributors. The Scrum Adoption Challenges Detection Model (SACDM) design model consists of four constructs: human factors, group factors, organizational factors, and engineering (technology) factors. The constructs consist of nineteen independent variables that help in understanding which factors contribute to either adopting or rejecting Scrum within a software organization by an individual.Therefore, SACDM is used to detect Scrum acceptance or rejection as the dependent variable depending on the independent variables evaluated in the four constructs.

Tiisetso Khalane put forth his study, [13] The purpose of their study is to define and present the Software Quality Assurance (SQA) issues of project stakeholders in environment of scrum. This exploratory and inductive case study, led by the principles of Classic Grounded Theory Methodology, discusses SQA concepts relevant to the main concern of Meeting User Expectations. The lack of concrete guidelines in Scrum needs a management team to develop concepts that includes incorporating practices from other methodologies and carefully adapting the system structure to incorporate the adopted practices which ensures continuous process change and establishing a shared ownership environment. The study further indicates that Scrum should be regarded as 'blank bucket' system that needs to be filled with situation-specific SQA activities and processes to fulfill user expectations.

The research work presented in this paper by Anum Ali, [14] has proposed a framework.Their structure is constructed on four elements, namely technological, human, environmental and organizational elements.Through statistical analysis, i.e.,the suggested model is validated.Structural Equation Modeling (SEM) while gathering data from people working on agile methodologies from the software industry. Their proposed model study results concluded that 15 out of 18 theories have been found to be important, including Training and Education, Social Culture, Communication and Negotiation, Customer Engagement, Decision Time, Team Size, Corporate Culture, Planning, Control, Growth, Information Management, Working Environment.Personal Characteristics and Customer Collaboration.

Janeth Lopez-Martnez, Reyes Juarez-Ramrez, Carlos Huertas, Samantha Jimenez highlighted the problems in the adoption of Agile-Scrum Methodologies [15]. Scrum is an agile, iterative, gradual, and quantitative approach. It is also intended to add quality, emphasis, clarification and visibility to a project's activities and goods.Although Scrum is a process of nimble and easiest way to understand software,but sometimes it is difficult to adopt.The Agile practices are not self-evident, so they are difficult to introduce into a company's culture. The several issues were found which are categorized into a set consisting of 4 aspects: people, process, project, and (organization) company and the results supported the agile approach.

Scott Underwood, undergone multiple case studies [16]. The main purpose of this case study was to examine the methodologies used for successful software quality assurance (SQA) processes by quality assurance (QA) leaders in small software development organizations. A case study provided the best research design to examine organizational and management processes. This study's analysis leads to recommendations for action in categories that apply to all software development organizations ' QA leaders. The main and top aspect of Softwre QA is Statistical process control.

Deepti Mishra, Samia Abdalhamid [17] proposed a structured mapping approach to address specific research questions is introduced in this paper through an analytical method to determine the essence of quality issues in Scrum studies. A variety of research studies in online archives were checked for this purpose in order to find out about different quality issues related to Scrum.The results show that work on people-related quality issues such as employee skills, productivity etc. is very minimal. Nonetheless, process quality such as system reliability, consistency, visibility, acceptance, etc. has received much attention among researchers, although researchers are also interested in product quality and quality issues related to the project such as team performance, collaboration, etc.

Saja Al Qurashi, M. Rizwan Jameel Qureshi, [18] presented solution called Scrum of Scrums to address the challenges of SCRUM methodologies. The main objectives of the proposed solution are to improve interaction between Scrum of Scrums teams; to make the system work after all parts have been integrated; to reduce the dependencies between system components; and to prevent duplication of system parts.

Hu Guang-yong [19] states that growing the number of engineering teams are using agile software design methods. Throughout recent years, Scrum as Agile Software Development has become an important member of the software industry application process control system. To further boost performance and application reliability, the project team in the Vehicle Spare Parts Management System Implementation Try to integrate Scrum agile software development, Scrum implementation adheres to its values, as Scrum's deeper understanding, extension and enhancement. Team has a better development by introducing Scrum agile software development, through team performance, product quality and the project's ultimate success.

Ashish Mundra,Sanjay Misra, Chitra A. Dhawale [20], The paper provides a practical view of the Scrum methods, in particular the size of the team, the team structure and the overview of the positions in Scrum teams.The paper is based

on our understanding with multiple projects carried out in the framework of Scrum Agile. Scrum provides a mechanism for larger items called SOS. That distributes the broad work and project into multiple groups and regular meetings are arranged among the members of each group to track the quality and speed of each team. They also provided the method of dividing work among SOS teams.

III. Analysis

A. Research Methodology

That following work was in the field of perception and exploration. The approach used in it is case study approach which is highly motivated by Classic GMT's concepts. The data collection consisted of three levels:

- Initial exploratory (Stage 1: Innovation)
- Systematic (stage2: Meeting user expectation)
- Limited (stage 3: challenges)

These stages were not pre-designed but guided by the theory called grounded theory (constant comparative theory) which is used to generate comparative analytical method for quality assurance in scrum. Data is gathered through daily Scrum meetings. The research used GTM's procedures as a methodological whole to achieve consistency and validity, as suggested by Glaser and Holton. The Classic GTM investigator has a continuous comparative analysis of a number of theoretical coding families to use to conceptualize how classes found from the data contribute to each other. These coding groups consists of 6 C's which are (causes, circumstances, contingencies, co variances, and conditions), the system (stages, phases, passages, etc.),the grades family (limit, distance, frequency, etc.), the dimensions family (dimensions, components, divisions) and much other.

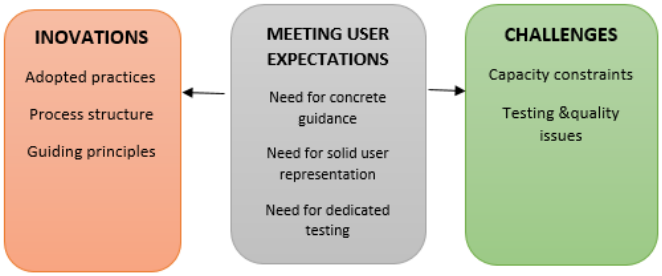

Fig. 1. Aspects of quality assurance in scrum environment

B. Implementing SQA in scrum methodology

- INNOVATIONS

The innovations in a project that team had to develop is consisting on design of process structure, implementation of Software QA methodologies from other practices, and the use of combined ownership guiding principles it also included constant feedback and continuous advancement.

1) Process structure: The class Process Structure describes the phases, procedures, strategies, results and roles of project team leaders to turn product backlog specifications such as list of requirements relevant to that project into a possibly ship able part of software system. The system architecture or process is structured to integrate methods and strategies from other methodologies. The principles in the classification of System Architecture such as

- Task Coordination
- Process Workflow
- Appropriateness of Situation

The class "Process Workflow" is a key factor that defines the design of the process.

2) Adopted practices: The research conclude the result that the structure of software had to be developed in a way on which the other methods of software development methodologies can easily applicable.

3) Guiding principles: The close examination of the facts shown that the process structure design and practice adoption have following principles which are: Collective Property, Continuous Feedback, and Constant Improvement. Collocation and facial interaction have made possible a cooperative approach to development. This study describe the fact that all the developers who are working on same project need to be in touching distance of each other. Quality defined on the basis continuous discussions between developers.

- CHALLENGES

There are following challenges faced by developers to meet software quality assurance:

- ☐ Lack of knowledge /training/skills
- ☐ Organizational structure /mindset
- ☐ Team work /communication issues
- ☐ Lack of documentation
- ☐ Budget and constraints
- ☐ Hard to scale lack of senior support
- ☐ High management overhead
- ☐ Work specialization
- ☐ Cross functional generalist terms
- ☐ Increase stress and work load
- ☐ Lack of quality
- ☐ Lack of top management support
- ☐ Long time to market
- ☐ Low user satisfaction
- ☐ Over engineered solutions
- ☐ Over optimistic task estimates
- ☐ Project team size
- ☐ Requirement creep
- ☐ Too many meetings

IV. Framework for of Agile and Scrum's Approach Applicability

Next step is to build structure after defining complex factors extracting key factors as described in the previous section. The main features that have been analyzed in detail . Four factors have been selected for framework development. Lastly, the

identified factors are categorized inteam of four features such as: (organizational, people, environmental and technical) in this proposed structure showed in fig 1:

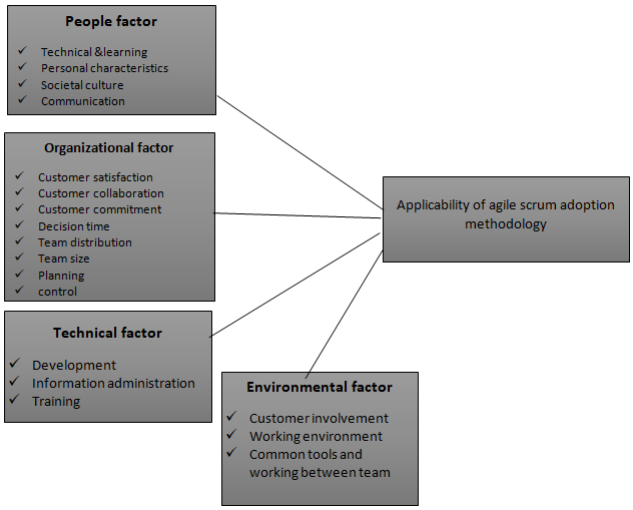

Fig. 2. Key Factors

V. SCRUM ADOPTION CHALLENGES DETECTION MODEL (SACDM)

This is the theoretical model covers both the individual and organizational aspects of IT adoption studies. It is not enough though for complex methodologies within Agile, such as Scrum. The final list of independent variables is displayed below: Change Resistant, Organizational Structure, Collaboration, Over Engineering, Communication, Quality Compatibility, Recognition Complexity, Relative Advantage, Escalation of Commitment, Resources, Management Support, Specialization, Organizational Culture, Sprint Management, Teamwork, Training. It is suggested that a practically applied Scrum adoption challenge detection model such (SACDM) will help to raise awareness of the challenges tackled by software organizations and hence potentially limit the negative effects that these adoption challenges could have on individuals and organizations using Scrum.The existing challenges of Scrum adoption were acquired through a narrative review of the challenges of Scrum adoption, both in the global and SA context.The SACDM was developed to identify Scrum adoption challenges with the goal of providing adopters with the knowledge and awareness they need to overcome.

VI. CONCLUSION

The main conclusion of this study revealed that an extensive range of characteristics of SQA is compulsory to Meeting User Expectations in a good software development. The need for clear flawless feed- back on Software QA approaches, procedures and methods emerged as one of the key factors needed to meet client standards. Scrum does not provide clear image of guidelines on how we can achieve and meet quality requirements in technical aspects because of the lack of accurate guidelines in Scrum. A development team needs to develop ideas that could include implementing techniques from other organizational approaches on the same domain. The Improvements may also include updating the System Structure in a way which is suitable for further Adopted Procedures, making dependency resolution faster and easier, and ensuring the basic system structure is continually strengthened. Accordingly, the implementation of SQA practices and the development of the system structure must be driven by principles such as collective ownership and constant advancement in field promote the performance. Through presenting an overall description overview of how Scrum works in practice in Software QA, the analysis contributes to the research community for further enhancements and for better results. The Model used in this paper is Scrum Adoption Challenges Detection Model SACDM. Although adopters can clearly see the advantages of using this approach. SACDM was created to recognize Scrum adoption issues with the goal of providing adopters with the knowledge and awareness they need to resolve. It is suggested that a technically implemented Scrum adoption challenge identification model such as SACDM would help to raise awareness of the challenges faced by technology organizations and thus potentially limit the negative effects that these implementation challenges could have on individuals and organizations using Scrum.

VII. FUTURE WORK

Future research will strive to improve the SACDM by developing a self-evaluation questionnaire for automated Scrum implementation challenges.This questionnaire will allow authors to collect and analyze the answer information that will be used to generalize findings for the benefit of potential adopters to enhance their understanding of the complexities of Scrum adoption and the connection with Scrum adoption. The research revealed the huge number of ideas that could be explored further. Therefore, this research contributes to the community of research area in this field by highlighting the gaps in Scrum studies. So, The presented model is expected to improve the team performance by retaining its simplicity and produce the quality product.

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