

# The Impact of Agile Software Development Process on the Quality of Software Product

Parita Jain<sup>1</sup>, Arun Sharma<sup>2</sup>, Laxmi Ahuja<sup>3</sup>

<sup>1,3</sup>AIIT, Amity University, Noida, India

<sup>2</sup>IT, IGDTUW, Delhi, India

<sup>1</sup>paritajain23@gmail.com; <sup>2</sup>arunsharma2303@gmail.com; <sup>3</sup>lahuja@amity.edu

**Abstract:** Developing a quality software product is an essential need for the software industry. Focusing on product's quality allows software users to adapt the product more easily and efficiently. Quality plays a vital role for the software users. It is a confirmation of all the requirements according to customer satisfaction. So, it's important to define a proper software development process that leads to a quality software product. Agile being one of the quickest methodologies for software development, allows the quality product to be delivered to the customer side. The objective of this paper is to discuss the impact of Agile Software Development Process (ASDP) on quality of software product by defining the mapping between agile software development process and various quality attributes. The paper presents an overall importance of software development process for a quality product.

**Keywords:** Agile Software Development Process, Software Quality, Software Requirement Analysis, Software Design, Software Implementation, Software Testing, Software Maintainability

## I. INTRODUCTION

From the past few years, many products fail to ever make it to the market, and for those that do, success is not guaranteed. The reason behind their failure is the software engineering process which is used to develop these products. Initially, the process used focuses on timely delivery of the product software engineering processes focus more on requirements specification, refactorization, delivery time, cost for development and minimization of efforts and many more factors on which software development depends upon. Overall, the focus is more on to improve software development practices by improving reusability, understandability of requirements, software delivery time and cost effectiveness and many other characteristics that leads to quality.

Quality being the most important aspect either in discrete production process or continuous production process, needs to be focused more to deliver a product that is acceptable by customers. According to International Standard Organization ISO 9000 quality is defined as the totality of characteristics of a product as a whole to satisfy the stated and implied needs in accordance with its capability. Here the stated needs means the requirements that are given by the customer at the time of an agreement and the implied needs are the needs that are

identified by the developers as the necessary needs to be included while developing the product.

Definition of quality has been perceived differently by different persons, but the one that has been given by customer is the definition that counts the most. Quality corresponds to standards, cost of the product, conformance to requirements and value for performance. Juran [1] defines quality as meeting the customer needs by providing satisfaction on valid requirements. Also he defines quality as freedom from defects. Weinberg [2] defines quality as "the value to some people". This can be stated in association with cost for development, efforts done by the developers to develop the product and customer needs.

Overall quality is much more complicated term than it appears. There are varieties of perspectives for consideration for example, customer's perspective, developer's perspective, tester's perspective, specification based perspective, manufacturing based perspective, and quality assurance based perspective and many more. Figure 1 describes different software quality perspectives. In each and every domain quality is one of the most important factor for a product to survive in the market. Many more definitions are given by different researchers from the perspective of manufacturing the product and engineering the product respectively. Definition of quality has a contextual bias towards these two industries.

The definition of quality is possible for all the areas, however when applying to IT software products the context is slightly different. The Pressman [3] states software quality as a "conformance to explicitly stated functional requirements, performance requirements standards and characteristics that are implicitly expected by all the professionally developed software's". Meyer [4] defines quality according to different quality factors given by McCall [6] on the basis of 3 major representations: product revision, product transition and product operations. Another definition of quality from the perspective of management given by Sommerville [5] stating software with less defects and conforming to required standards of reliability, portability and so on is quality software.

In general, software quality measures how well the software is designed, how well it is working without faults and conforming to that design. For the development of a software

quality plays a vital role, it is what the customer perceives. If your customer denies accepting the product, then that is the reality, whether or not the product conforms to the initially given specifications. This can be because the specifications do not relate with the customer desire. Hence it's important to focus on development of software more in comparison to end product delivery.



Fig. 1. Different Software Quality Perspectives

## II. ASPECTS OF SOFTWARE QUALITY

Software being important for each and every area in today's modern civilization, quality of that software really matters. Because of its usage and importance, low quality software is just not acceptable. Since the concept of quality means different things to different people, it's better to group its various components into different aspects. There are two aspects of software quality, process quality and product quality. These two aspects include all the perspectives illustrated in Figure 1, through which good quality software product can be achieved. Difference in both the aspects lies in understanding perspective behind quality.

A product quality refers to the overall quality of the product which make user ecstatic and hence results in more customer acquisition and satisfaction providing more customer retention and profits. A product is a quality product if it is accepted by the clients or customers and it fulfils all the requirements of the customer. The product quality always depends upon level of satisfaction of the customers. The higher the level of satisfaction, the higher will be the quality of the product. However, it has been observed by different developers that only if the process quality is as per the requirements the product quality will be as expected, "process with high quality standards yields products with high quality standards". One can define process quality as a process that conforms to defined process specifications to get good quality product [11].

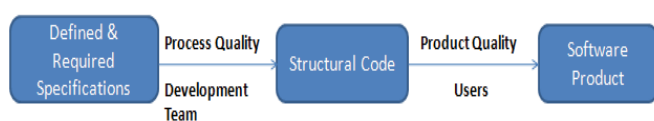


Fig. 2. Process Quality leads to Product Quality

The quality of the development process significantly affects the value received by customers and development teams [14] [15]. The flow from specifications to process quality and then to product quality can be understand through Figure 2. Hence, for high quality product it's important to concentrate more on development process as development of good quality software is usually an organizational effort, "something of higher quality has more value than of low quality". Without a process, software development is not possible.

Developers need some structure to follow, providing good understanding of overall requirements, high coupling between developers which leads to better, cheaper and faster delivery of quality products. Titansoft, one of the small scale software organization started adopting agile from 2015. In its Titan TPE branch all the projects were developed using the agile scrum method. Not only for software development, has the organization adopted the approach for doing its general purpose work also [23] [24]. This shows that not even small scale organizations are adopting agile methods for software development with limited resources available. But whether the quality has been maintained or not is a big question?

With the changing trends in software development, it still not reached with the level of producing software that is correct, easily usable, works reliably, maintainable, cost effective and on time [21]. Agile Software Development Process grown dramatically as a popular alternative for the development of software providing developers to streamline all the above factors in an efficient manner. Though the quality of the agile approach has been proved theoretically but not in a quantifiable manner [8] [10] [22].

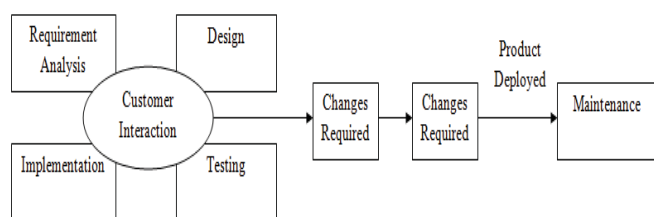
The objective of this paper is to discuss about the impact of Agile Software Development Process (ASDP) on quality of software product. The paper presents an overall importance of software development process for a quality product defining the mapping between agile software development process and various quality attributes.

## III. AGILE SOFTWARE DEVELOPMENT PROCESS

Unlike Agile software development process, the traditional software development process follows a strict phase concept in which every phase gets executed in a sequential organized manner, restricting on to the original requirements and the design developed at the beginning of the software project. The customers provide their requirements in requirement analysis phase and then based on the received requirements design gets created and then development starts. The project manager is the one who tracks every movement of the software project till the product gets delivered to the customer. In general, if no changes required and the customer accept the deployable product with the whole satisfaction then the traditional process leads to produce the software product on time and on budget release. The main drawback of the conventional software

development process is its non responsiveness towards requirement changes and it also takes longer time to deploy working software product to the customers.

As agile approach is an iterative and incremental method, every defined phase's gets executed within a series of small iterative cycles of the software development process known as sprints. While, in traditional process also known as light weight development process, every phase gets executed sequentially without defining any kind of iteration. The incremental cycles provides a deliverable product that can be deployed to the customer [20]. Besides that, other stages included in agile are concept, inception, release, production and retirement which are not included in traditional approaches. Agile development is more kind of quick and sustainable development in comparison with traditional development that allows customer interaction throughout the process with the adaptability of changes required. It is a customer centered methodology as shown in figure 3. Moreover, more importance is given to customer satisfaction, by interacting with them more frequently or almost in every phase of a sprint than in traditional one.



**Fig. 3. Customer Centered Agile Methodology**

Within traditional and agile methodologies various models are present for the development purpose. In traditional methodology, different models named as waterfall model, prototype model, spiral model, iterative enhancement model, evolutionary model and many more [12] [13]. In agile methodology, different models are kanban, scrum, extreme programming, feature driven development and many more. A model that is most suitable can be selected based on the requirements analysis of the software to be developed and availability of the resources. Scrum is one of the most popular models used in the industry to carry out agile software development for developing software systems [9]. The other name of Scrum is flexible as it focuses more on customer changing requirements. Other agile models including (FDD, XP, etc) are discussed by Pathak & Saha [7] in their review.

#### IV. MAPPING BETWEEN ASDP AND QUALITY ATTRIBUTES

The software development life cycle consist of mainly five development phases: software requirement, software design, software implementation and software testing, and software maintenance which have been used in various development models. Every phase individually plays an important role and

impact software product quality [16] [17]. An agile software development process differentiates with traditional development process in a way of engineering software. Both the development process consists of five phases but executed in much different manner. The five phases are described as follows:

**Phase 1. Requirement Analysis:** it's a requirement elicitation phase in which needs and requirements of the customers gets collected specifying functional and non-functional requirements [19].

**Phase 2. Software Design:** in this phase the complete architecture of the software to be developed gets created that specify how the software product is going to function and appear to the customer.

**Phase 3. Software Implementation:** this phase creates an executable version of the software product. The development of the software is based upon the programming language used for coding purpose.

**Phase 4. Software Testing:** after the executable product gets developed, testing phase comes into existence. Software testing is a process to find out errors, bugs, faults in the developed software and fix them before its get delivered to the customer. It basically verifies and validates all the functionalities of the software [18].

**Phase 5. Software Maintenance:** this leads to changes in the software product after it gets deployed to the customer side if any error or fault occurs. Also it provides the software product to be adaptable in the changing environment improving the performance of the software system.

All the above defined five phases affect the software quality and can be analysed to be mapped with various agile process quality attributes as shown in the below table 1:

**TABLE 1: Mapping Between ASDP and Software Quality Attributes**

Characteristics	Agile Attributes	Quality Attributes
Requirement Gathering	Total no. of user stories, Functional Completeness, Functional Correctness, Consistency	Functionality, Reliability, Maintainability, Scalability
Software Design	Release Date, Total no. of Sprints, User story planned, Story points planned	Functionality, Efficiency, Reusability, Reliability, Maintainability, Portability, Flexibility.

Characteristics	Agile Attributes	Quality Attributes
Software Implementation	Sprint Stretch Factor, Productivity	Reliability, Maintainability
Software Testing	User Story Accepted, Defect Density, Review effectiveness, Pre-delivery defects	Functionality, Reliability, Maintainability, Portability, Performance
Software Maintenance	Post-delivery defects, Defect removal efficiency	Efficiency, Reliability, Maintainability

## V. CONCLUSION

Software quality plays an important role while doing a software project. Various quality factors have to be satisfied onto some level to have a quality software product. The development of software consist of five phases that must catch up with the quality standards while development. Agile being a flexible approach for software development, allows quality product to be delivered to the customer side. Main aim of the paper is to analyse the impact of the Agile Software Development Process (ASDP) on the software quality. Through various studies it has been shown that every quality attribute is important in the perspective to have a quality product. And to incorporate each quality factor in the development of software, the quality attributes must be mapped with the agile software development process attributes and vice versa. Table 1 shows the mapping of agile attributes with the quality attributes included in each and every phase while software gets developed. The paper presents an overall importance of software development process for a quality product.

## REFERENCES

- [1] J.M. Juran and F.M. Gryna, "Juran's Quality Control Handbook", New York, McGraw-Hill, 2010.
- [2] G.M. Weinberg, "Quality Software Management Vol. 1: Systems Thinking", New York, Dorset House Publishing, 1992.
- [3] R.S. Pressman, "Software Engineering a Practitioner's Approach", New York, McGraw-Hill, 2011.
- [4] B. Meyer, "Object-Oriented Software Construction", New Jersey, Prentice Hall PTR, 2000.
- [5] I. Sommerville, "Software Engineering", California, Addison-Wesley, 2015.
- [6] J. A. McCall, P. K. Richards and G. F. Walters, "Factors in Software Quality", National Technical Information Service, Vol. 1, 2 and 3, 1977.
- [7] K. Pathak, A. Saha, "Review of Agile Software Development Methodologies", *IJARCSSE*, Vol. 3, pp. 270-276, 2013.
- [8] S. Bhasin, "Quality Assurance in Agile –A study towards achieving excellence", pp. 64-67, IEEE, 2012.
- [9] G. S. Matharu, A. Mishra, H. Singh and P .Upadhyay, "Empirical Study of Agile Software Development Methodologies: A Comparative Analysis", *ACM SIGSOFT Software Engineering Notes*, Vol. 40, pp. 1-6, 2015.
- [10] P. Jain, L. Ahuja and A. Sharma, "Current State of the Research in Agile Quality Development", in *Proceedings of the International Conference on Computing for Sustainable Global Development*, pp. 1877-1879, 2016.
- [11] C. Paulk, C. Weber, B. Curtis, and M. B. Chrissis, "The Capability Maturity Model: Guidelines for Improving the Software Process", Addison Wesley, 1994.
- [12] B. Singh and S. P. Kannoja, "A model for software product quality prediction", *Journal of Software Engineering and Applications*, Vol. 5, pp. 395-401, 2012.
- [13] B. Singh and S. Gautam, "Hybrid Spiral Model to Improve Software Quality Using Knowledge Management", *International Journal of Performability Engineering*, Vol. 12, Issue 4, pp. 341-352, 2016.
- [14] P. Isaias and T. Issa, "High level models and methodologies for information systems", *Springer*, 2015.
- [15] P. Sujatha, G. V. Sankar, A. S. Rao and T. Satyanarayana, "The Role of Software Verification and Validation in Software Development Process", *IETE Technical Review*, Vol. 18, Issue 1, pp. 23-26, 2001.
- [16] N. S. Godbole, "Software quality assurance: Principles and practice", Alpha Science Int'l Ltd., 2004.
- [17] B. Singh, "Quality Control and Reliability Analysis", Khanna Publishers, 2011.
- [18] F. L. Butt, S. N. Bhatti, S. Sarwar, A. M. Jadi and A. Saboor, "Optimized Order of Software Testing Techniques in Agile Process – A Systematic Approach", *International Journal of Advanced Computer Science and Applications (IJACSA)*, Vol. 8, Issue 1, 2017.
- [19] S. N. Bhatti and A. Tabassum, "The Impact of Analytical Assessment of Requirements Prioritization Models: An Empirical Study", *International Journal of Advanced Computer Science and Applications(IJACSA)*, Vol. 8, Issue 2, 2017.
- [20] T. Dingsøyr, C. Lassenius, "Emerging themes in agile software development: Introduction to the special section on continuous value delivery" Introduction and Software Technology, Elsevier, 2016.
- [21] L. L. Lacerda and Felipe Furtado, "Factors that help in the implantation of agile methods: A systematic mapping of the literature", In *Proceedings of 13th Iberian Conference on Information Systems and Technologies (CISTI)*, pp. 1-6, 2018.
- [22] H. J. Hsu and Y. Lin, "How Agile Impacts a Software Corporation: An Empirical Study", In *Proceedings of 42nd Annual Computer Software and Applications Conference (COMPSAC)*, pp. 20-25, 2018.
- [23] Y. Lin and Titansoft, "From chaos to control, from control to freedom - 5 lessons learned on our agile journey, <https://www.slideshare.net/yveslin888/fromchaos-to-control-from-control-to-freedom-5-lessonslearned-on-our-agile-journey>, 2016.
- [24] Titansoft, "Our history and timeline," <http://www.titansoft.com/en/About-Us/Our-History-Timeline>, 2016.