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REVIEW ON ROLE OF QUALITY ASSURANCE IN WATERFALL AND AGILE SOFTWARE DEVELOPMENT

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ABSTRACT

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Quality assurance is one of the important issues for software companies because the delivery of high-quality software for customer satisfaction is much needed. Software quality is a relatively complex concept, but many companies have standards for quality assurance. In agile methods, developers are responsible for quality assurance. Agile methods involve many practices for quality assurance. Moreover, quality assurance in the waterfall model in each stage by using different practices is done for validation. Quality assurance has many parameters, to control software quality, that are also discussed. The traditional quality assurance is carried out periodically at various stages, but the agile quality assurance is constantly being carried out by the team on daily basis. In this paper, we mentioned ways to improve quality assurance in agile development.

Keywords: software quality assurance; agile software development; software validation; agile development methods; customer satisfaction; agile development teams;

1. INTRODUCTION

Quality assurance in software engineering (QA) is a set of activities for a suitable monitoring the software engineering processes and methods used to certify appropriate quality. Also (QA) perform with different ways. Quality assurance activities can be split into two parts. First goal to prevent the defect that would happen before the development cycle final and the second part focuses on defect detection into the completed product and is better known as Quality Control. Quality Assurance in software development is a type of an Umbrella activity that is applied throughout the software process. According to International Standard Organization ISO 9000 or a model such as CMMI, quality is specified as the important of characteristics products [1] Quality of product is directly related to customer's satisfaction [2, 3].To obtain the necessary level of quality, the standards for product or service must be determined [4].

The concept of quality is suitable for agile methodologies. Quality assurance is the all of operations to ensure software product quality as a part of the development process [5]. Quality assurance practices need to increase confidence that implemented software has enough quality before delivery [6]. Quality Assurance (QA) is an important part of the software development process [4, 7]. So quality assurance and testing are very important to high quality software on time delivery [8-10]. Successful software depends to release of high quality. Quality assurance of the software product has always been the final purpose of every company. Many companies have standards for quality control in their organizations. Software Quality Assurance is defined as continuous quality validation. Quality Assurance contains the verification processes within the software development lifecycle. Quality Assurance mentions to the validation and verification of quality in different dimensions that the end product is meeting the needs of the customer [11].

2. CONCEPT OF QUALITY ASSURANCE

Software quality is a rather complex concept. With the advent of new technologies such as virtualization and cloud computing, caused many challenges in software development. These challenges include various dimensions of quality, such as availability, reliability, security, performance, and scalability, which affects the success or failure rate of the project [12, 13]. There are very definite about quality Assurance which is indicated in Table 1[14].

Table. 1 Different definitions of quality Assurance

Quality Assurance	**Description**
Weinberg, G.M., (1991)	The author defines quality assurance as the association of quality with human assessment, and cost and benefit.
Juran, J& Gryna, F. M., (1988)	Juran defines quality as consist two things; "1) the products that obviate the needs of the customers and provide the customers satisfaction. 2) Quality contain of release from fault."
Software quality Assurance	
Meyer, B., (2000)	Software quality defines with according to several of quality factors: validity, reusability, compatibility, performance, portability, integrity, and facility of use."
Bass, L. (2006)	Bass believes that the common methods of defining software quality don't work. He believes that we must use a classification; a special requirement must be put into a class.
Software quality Assurance in agile	
McBreen, P.,(2006)	McBreen believes that agile quality assurance is one of the methods of software that can respond to change of the customer requirements. The frequent delivery of testing software at the end of each iteration is one of the important parameters in agile quality assurance.
Ambler, S., (2005)	Agile quality Assurance consist processes such as valuable collaborative work and incremental development to implement.

Stamelos (2007) has assessed the quality assurance in agile development from various aspects. The results indicate that many parameters affect the quality assurance [15]. Also The software quality assurance processes provide the different type of requirements of customers [16]. Quality Assurance in software development have a many parameters that is consist: A quality management approach, formal technical reviews, multi testing strategy, effective software engineering technology, measurement and reporting mechanism. Also may be, Quality control (QC) is mistake with the QA. Quality control is to inquire the product or service and check for the final result. Quality assurance is to inquire the processes and make changes to the processes which led to the end-software. There are many disadvantages in quality assurance software. For example, it is include allocation more resources, employing more workers to keep quality more in software development. Also there are many Benefits for Software Quality Assurance (SQA) that is Consist: SQA generate high quality software, High quality application hold time and cost. SQA is useful for better reliability. SQA is beneficial in the condition of no maintenance for long time, High quality commercial software increase market share of company, Improving the process of creating software, Improves the quality of the software.

3. QUALITY ASSURANCE IN AGILE AND TRADITIONAL DEVELOPMENT

Agile Quality Assurance activities are do daily, but in traditional methods, Quality Assurance activities are based on heavy-weight method [17-19]. Agile QA processes perform soon than waterfall methods. The iteration of QA processes in agile methods is very higher than waterfall methods [1, 20, 21]. In other words, in Traditional Quality Assurance methods are reporting based on the end steps and rely on heavy weight inspection methods whereas Agile Quality Assurance methods are built-in daily activities and daily sprints rely by the teams. One of the important perspectives of the quality assurance activity is risk analysis. This activity aids teams' developments to eschew of the risks. Moreover, QA aids to resolve periodical issues and potential bugs within software during the life cycle of development.

Software quality assurance is a concept term in life cycle of the development of software engineering in the project. in Table 2, the best methods must be used with tester person for high quality assurance. The best quality assurance should be including all processes in Table 2.

Table. 2 Best methods for quality assurance

Risk Management with QA	Risk management processes, must be include a part of quality assurance of software.
Cover all processes of SDLC	Software Quality Assurance are activities that must cover the all lifecycle of software development.
Focus on improvement in quality	The QA testing must focus on complete the process of development of software to optimize the end products' quality.
Continuous monitoring	Continuous monitoring of the process and making safe the development software process.
impartial method	Software QA development needs to be unbiased and the Quality Assurance team must be given some release and authority for the activity to work correctly.
Apply effective methodologies	With an effective QA testing method, the cost of the overall lifecycle of the software development can be reduced because QA testing ensures that software is matching to requirements and standards.
Reduce maintenance cost	QA steps would recognize errors and bugs sooner before the software get published therefore resulting in the overall reduction of the entire lifecycle cost.
Transform entire organizational culture	The Quality Assurance and testing process should spend the all lifecycle of the software and every step of the process of delivery software or maintenance should be covered by QA.
Follow two basic principles	There are two principles in the Quality Assurance follows: These are "fit for purpose" and "right first time".
Apply Fit for Purpose	The "fit for purpose" means that the software do and is suitable for its intended purpose.
Practice Right First time	"Right first time" means that all errors and bugs should be omit.
Formulate requirements concisely	Suitable Quality Assurance begins with requirements. Prioritized and managed of requirements greatly affects the quality of the end software.
Use of Mature **activities**	Ensure that activities are used as planned with no deviations from fixed activities.
Perform QA after the release of the product	When the testing is completed, the work of the QA team is still not over because there's virtually no software that gets released without bugs and errors.
Close Collaboration with Development team	The term "DevOps" is increasingly used which refers to the close collaboration of development and operations teams in an agile environment.
Consider End user's mindset	QA and testing try to make sure that what you're actually development is also correct. This means that the tester mindset focuses more on the end user.
bug-free software is not possible	The goal objective of the QA is not to fully test everything and fix every bugs and errors but release working software that suitable their intended purposes.
Black-Box testing or white-box testing	In quality assurance should be consider Black-Box testing or white-box testing.
Ensure the most suitable method for software development	Quality Assurance depends on what method used for your software development.

3.1 Agile methods and quality assurance

Software development agile has now with growing in the many teams everywhere in order to reply quickly to the changing requirements of their customers while developing good quality software at a faster rate. Another perspective of agile software development that is essential to improving software quality is the use of scrum teams. Software quality assurance (QA) is the fundamental component of agile software development [1]. Quality Assurance in agile software development will perform each phase of development process with less errors and delay. In agile software development testers and developers have to work together and the tasks could be replaceable. Development processes in the agile method are similar to Waterfall model [15, 18, 22]. In agile methods the stages are complete, with together. Agile methods consist many practices for quality assurance [19]. In agile methods, developers are responsible for quality assurance, and this process frequently is completed. One of the important techniques for assurance quality is continuous integration (CI) that by using continuous measurement, can be increased the quality of software [2, 23, 24]. Quality assurance in agile development is process-oriented and is not product-oriented. the process-oriented include activities for preventing defects while product-oriented include activities to identifying defects [25]. Figure 1 shows agile methods with Quality assurance process.

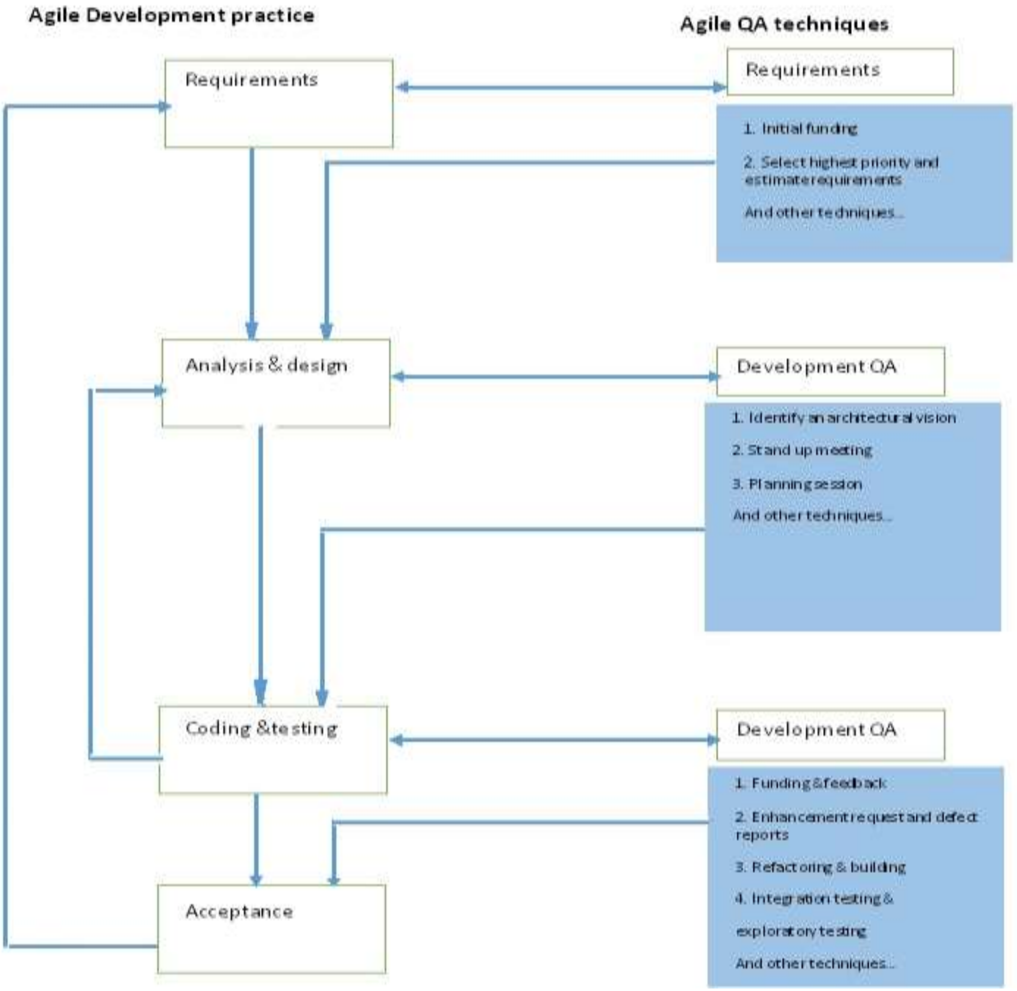

Figure. 1 Agile method and quality assurance

In agile development, the testing in any iteration provides the best quality because the testing in each iteration cause to shorten the release time of the product [21]. In agile development, there are a few metrics to follow the measurement of quality that these metrics are related to sprints [20, 26]. According to new requirements of the customers, frequent delivery, and problem understanding develop on time, causing increase the product quality in agile development [27]. Agile methods have a powerful connection between developers and testers.

3.2 Traditional methods and quality assurance

Quality Assurance activities are not defined correctly in the waterfall process, also can be applied between the steps. For example, part of the criteria for change from one step to another is the quality that usually takes the form of testing. About Quality Assurance (QA) techniques, Black Box test is the most frequently applied in the traditional models. In the traditional model, the software development processes are divided into different steps and each step Consists the chain of tasks and has different objectives that consist: 1) Requirement Analysis 2) System Design 3) Implementation 4) System Testing 5) System Deployment 6) System maintenance. In this model, the activities of each phase are as input for next steps. Figure 2 shows the waterfall model with the Quality assurance process [2, 18, 19].

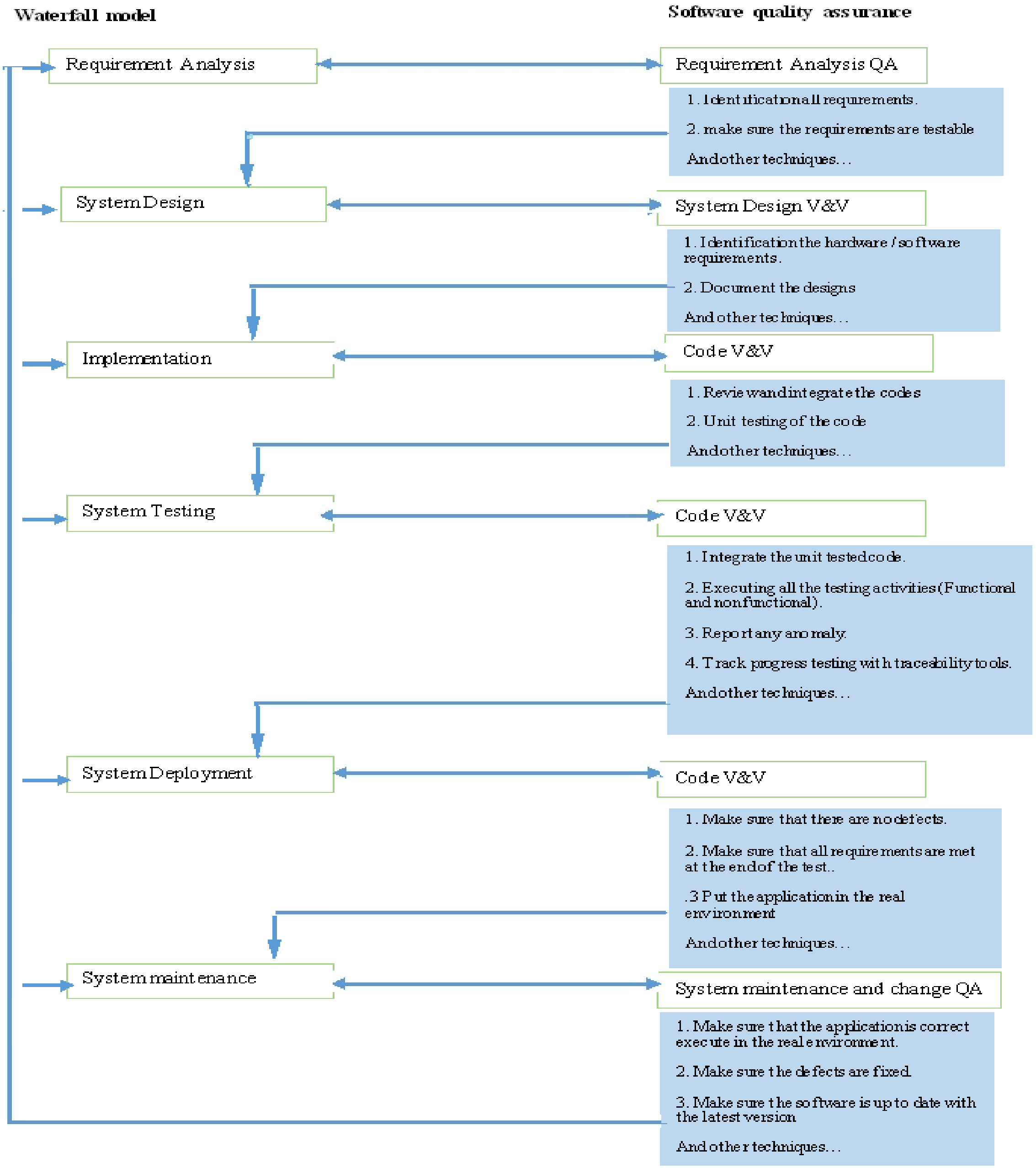
Waterfall model
Software quality assurance
Requirement Analysis
Requirement Analysis QA
1. Identification all requirements.
2. make sure the requirements are testable
And other techniques…
System Design
System Design V&V
1. Identification the hardware / software requirements.
2. Document the designs
And other techniques…
Implementation
Code V&V
1. Review and integrate the codes
2. Unit testing of the code
And other techniques…
System Testing
Code V&V
1. Integrate the unit tested code.
2. Executing all the testing activities (Functional and nonfunctional).
3. Report any anomaly.
4. Track progress testing with traceability tools.
And other techniques…
System Deployment
Code V&V
1. Make sure that there are no defects.
2. Make sure that all requirements are met at the end of the test..
.3 Put the application in the real environment
And other techniques…
System maintenance
System maintenance and change QA
1. Make sure that the application is correct execute in the real environment.
2. Make sure the defects are fixed
3. Make sure the software is up to date with the latest version
And other techniques…

Figure. 2 Waterfall method and quality assurance

Quality assurance in the waterfall model in each stage by using different practices done and then will be validated the tasks. Methods quality assurance in traditional methods is very complex [1].

4. AGILE DEVELOPMENT AND QUALITY ASSURANCE FACTORS

There are many parameters in agile methods that, if properly implemented can be guaranteed quality in the product. In summary, some of these parameters are shown in Table 3 [2, 14, 28, 29].

Table. 3 Software quality assurance factors

Compatibility	Compatible software is the ability to live and work together without any discrepancy. Elements of Compatible software can be easily combined with other elements.
Cost-effectiveness	Cost-effectiveness is the ability of a system to be completed with a given budget.
Correctness	The ability of a system to perform according to the defined specification.
Ease of use	In agile methods, the customer is involved in the development of the product during the development and continuously provides feedback, it makes it much easier to use the product.
Efficiency	Efficiency is the ability to maximize the usability of all system resources.
Extendibility	Flexibility is to adapt to new conditions and changes in a system.
Integrity	Ability to prevent unauthorized access to data.
Maintainability	Software must be able to evolve and change to improve the new user's needs.
Portability	Ability to move and install software on various hardware and software.
Reusability	Software components must be designed in such a way that they can be reused in other software.
Verifiability and Validation	Verifiability and Validation mean to ensure the correctness and efficiency of the produced system.
Rate of Delivery	High rates of delivery for customers and feedback of software cause to better quality of software
Testability	Quality software needs a high degree of testability. Finding faults and errors in software with high testability is easier, making such systems less likely to contain errors when delivery to end users.
Usability	Usability is fundamental to have a good UI. Simplicity and task execution speed are two factors that cause to a better UI. Functional and non-functional requirements that affect software quality, usability are a non-functional requirement.
Security	The quantity and intensity of vulnerabilities found in a software system are indicators of its security level. Poor coding and architectural weaknesses often cause to software vulnerabilities.
Functional stability	A software is Functional stability that when it meets the implied needs when used under certain given conditions.
scalability	The capability of hardware to continue performance when changes are done in volume or size of the system.

Some agile methods may not cover all quality assurance factors. But by analysing these parameters quality assurance can be obtained.

5. METHODS TO IMPROE QUALITY ASSURANCE IN AGILE DEVELOPMENT

Results of prioritization as result of prioritization are shown in Table 4 below in descending order or priority. Any number of priority groups can be constructed using NA. Top priority requirements will be assigned to high priority group will low priority requirements will be assigned to low priority groups.

Testing in agile development is one of the important QA processes [3, 30-32]. In order to obtain the high quality in agile development, testing, and software development process should be implemented in parallel. In agile development, bugs and errors are discovered in initial stages. Discovering bugs and errors in initial stages causing decrease the use of time, cost, resources and improve the quality of product [4, 33]. By performing various tests, product quality can be increased in the software development, such as conversational test creation, coaching tests, providing test interfaces, exploratory learning, and test interaction models [34]. Also, many number of QA experts believe that QA testing must be done from the very inception, even when all of the requirements have not been terminated. Even QA experts should be start testing before the code writing. identify and take of bugs at the initial steps of the software development have costs substantially less than doing so toward the end of the software development lifecycle. This activity has become one of the marks of a smart and efficient QA flow. QA expert's ability to write test cases depends on clear requirement documentation. There are kinds of aspect for consideration, for example, customer's aspect, developer's aspect, tester's aspect, specification based aspect, manufacturing based aspect, and quality assurance based aspect and many more [3]. with more collaborative environment, QA testers are able to work more efficiently. They are able to identify more risks. The QA activity can be easy with creating independent reporting channels. Instead of the QA team reporting to the developer team, suitable channels of reporting must be established. Research shows that the usage of agile methodologies with using quality assurance practices cause to a high success rate in software projects [6, 29]. Also, software security is the one important parameters software development. Quality assurance cause a key process to certify software robustness, effectiveness and usability, security assurance cause the development and implement of software components and systems that protect of the information [1].

6. CONCLUSION

In this research, to the importance of quality assurance in software engineering examined. Also, quality assurance is defined in various dimensions. After that, the quality assurance process in agile and waterfall methods has been investigated. Also, differences in quality assurance process in agile and waterfall methods were investigated. If many parameters in agile methods correctly implemented can increase the quality of the software. In this study, these parameters are mentioned. Agile methods provide a quality software product by delivering quickly and increase the customer satisfaction.

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