

# Innovative Learning Methodologies for enhancing Software Quality in DevOps: A Review

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**Abstract:** DevOps is evolved from agile methodology that integrates the operation and development teams to enhance the relationship and strategy between them. The motive is to improve the software quality, security and business strategies. According to literature review, the researcher improved software quality by testing techniques like Pearson correlation, linear regression analysis and CAMS (Culture, Automation, Measurement, Sharing) framework. We adopted BizDevOps for continuous innovation in business and DevSecOps for security purpose. ISO 9126-1 is the latest proposal used for software quality management. The main implication of this paper is to underline the security, business and quality strategies to achieve good quality software and deliver services rapidly.

**Index Terms---**DevOps, Agile, CAMS Framework, Quality, ISO 9126-1, BizDevOps, DevSecOps

## 1. INTRODUCTION

The idea began in 2008 with a discussion between Patrick Debois and Andrew Clay Shafer concerning the concept of agile infrastructure. However, the idea only started to spread in 2009 with the advent of the first DevOpsDays event held in Belgium. DevOps is lean thinking blended with agile philosophy merging software development with the environment in which it is developed. DevOps has been shaping the world for quick and continuous delivery to provide best quality of software as: Focus on CI pipeline to provide virtualization provides automation for efficient and faster delivery in 'Dev' and 'Ops' [1]. DevOps is continuous cycle of '6 C' which perform iterative model instead of waterfall model of SDLC.

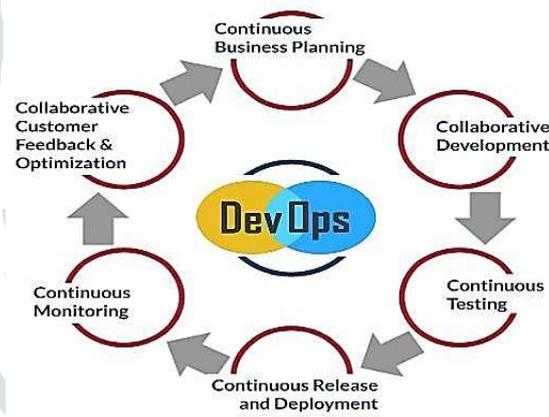


Fig 1. '6C' DevOps Cycle

## II. RELATED WORK

### A. Agile

In DevOps agile refers to an Iterative approach which focuses on collaboration, customer feedback and rapid increases. In large scale agile projects, product leader, manager and developers create better agile behavior. They choose most appropriate and successful coordinative practices from the large number of agile applications that are employed. Agile methodology is an approach that manage and used in software development. The agile methodology was introduced in response to drawback of the rigid plan driven process model (Waterfall) [5].

### B. CAMS Framework

CAMS model was introduced by John Willis and Demon Edward. It is an acronym describing DevOps as Culture, Automation, Measurement, Sharing. These four values bring to DevOps implementation [3].

#### *Culture*

DevOps is about breaking down the wall between teams. This wall is considered as wall of confusion. It can be vanished between the teams by creating a "Culture" in DevOps, where teams work together and share the responsibilities for the customer of their application. It creates friendly atmosphere to interact with each other [2].

#### *Automation*

It is a process in which automated script is generated to carry out the work easily. It is not just about saving the time but also prevent defects, creates consistency and enable self-services. Automation is not an easy task to perform. For example, Jenkins is a tool used for automation and maintaining the CI/CD pipeline across software development [2].

**Measurement**

Model data such as metrics and application behavior should be meaningful, accessible to all, able to visualize in ad hoc manner and transparent. Performance engineers in testing department have to focus on large scale environment. It helps us to know whether and automation task worthwhile or not [2].

**Sharing**

It means sharing the tools, discovery and lessons. Sharing the idea and problem is done to accomplish the collaboration and gives openness and transparency to our model. People with similar needs within an organization can help to eliminate duplicate work and new opportunity can be discovered for collaboration [2].

**C. Software Quality**

It describes the desirable attributes of software product. It is a degree to which a system or process meets the specified customer needs and expectations. Quality is not measurable but can be experienced. Software quality comprises the following metrics: functionality, reliability, portability, maintainability, efficiency and usability [2].

**ISO-9126**

It is the detail description of software quality model. It is an international standard for evaluation of software. The standard is divided in four parts that is quality model, external metrics, internal metrics and quality of used metrics. It also defines the quality characteristics of software model [2].

**D. Challenges**

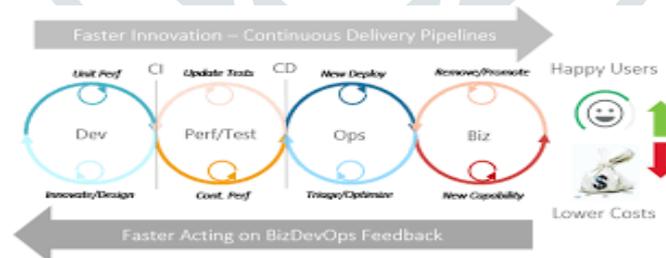
The working software was not delivered frequently (months rather than weeks) irregular adaption to changing circumstances. Even late changes in requirement were not welcomed moreover customer satisfaction lacked due to discontinuous delivery of software. There was no interaction between development and operation team which compromise the quality of software. Working hours increased due to manual work which affected the performance of workers. Different tools were used by the teams and was not shareable.

**III. LITERATURE SURVEY****A. BizDevOps**

BizDevOps is also known as DevOps 2.0. It is a approach to software development that encourages the developers, operations, staff and business teams to work together. So, they move quickly and be more responsive to user demand and ultimately maximize the revenue. A BizDevOps algorithm knocks down the walls and fundamentally changes the way of how the software is developed.

To achieve a higher success rate of software development projects, DevOps approach could be a suitable solution because project team members are responsible. It accepts new challenges for the organization.

Development and operation teams will become partner with the business to enlarge and work with manager to solve their problems and achieve business goals. Collaboration of short cycle feedback from customer with help of agile project gives quality. They also work directly with developers to set priorities for agile software development backlogs. By using performance monitoring tools or analytic tools, companies able to get data and end user behavior instantly and qualify business KPI's.



**Fig 2. BizDevOps**

In order to stay in competitive organization have to accept rapidly the new customer demands. It is necessary to fix errors quickly so that quality and resilience of software can be enhanced. This approach will lead to increased automation especially in testing.

The speed and flexibility that DevOps allow the teams to identify mistakes and fix them which is known as “fail fast”. A BizDevOps is used for faster and end to end continuous delivery of the software to the customer in a single stage pipeline which is virtualized.

**B. DevSecOps**

DevSecOps provides security within DevOps proces. It is all about embedding security in every part of development process. With the help of security functions, it aims to bring operation and development teams together. DevSecOps is healthy model which explains that security is not only the responsibility of the security team but is for everyone. Automation in DevSecOps not only reduce the mistakes but also reduce the security attributes to manually configure the security consoles.

There are some challenges in DevSecOps, people practicing it are still low says ‘Chris Carlson, V.P. of product management at Qualys’. Another big challenge is to train development team on secure coding. Sometimes the developers are not aware of the insure coding. It is still not discussed and not important for development team.



Fig 3. DevSecOps

The most important measure we can take for our application is that how much time it takes to fix a bug or vulnerability once found is effective or not. This shows how fast and agile the team practice and handles the issue.

$$\text{Automation} + \text{DevOps} + \text{Security} = \text{DevSecOps}$$

Moreover, security should be integrated at every level of the infrastructure and application life cycle. Due to this reason the cloud based technologies don't bring themselves to static security policies. O'Leary says that those customers who found vulnerability using dynamic analysis in production fixed it in 92 days instead of 174 days. And those who found defects in development using static analysis fixed it in 51 days rather than 113 days. It is a pretty drastic improvement said O'Leary.

**C. Testing Techniques**

- Pearson correlation(r) is a statistical measure that refers to a bilateral relation between related consignment of random variable.

Whereas Pearson correlation estimate the robustness of the linear relation between continuous variable. It always falls between -1 and 1 that is (-1,0,1). This concept sorts the correlation coefficient easily and define one variable perfectly to relate other by liner function.

If r= -1 i.e. negative relation that means increase one variable w.r.t decrease in other one.

If r= 0 i.e. No relation that means strong relation between two relation.

If r= 1 i.e. positive relation that means increase one variable w.r.t increase in other variable.

Whereas X and Y are independent to each other.

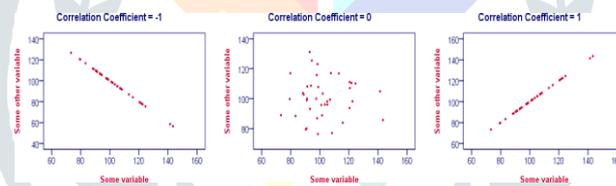


Fig 4. Pearson Correlation between X and Y

$$r = \frac{n(\sum xy) - (\sum x)(\sum y)}{\sqrt{[n\sum x^2 - (\sum x)^2][n\sum y^2 - (\sum y)^2]}}$$

Fig 5. Mathematical relation of Pearson Correlation

- Linear Regression Analysis(m) is a relation between Pearson correlation and slope of line. It is used to reduce the distance between estimated variable and actual variable.

b1 is slope of regression analysis.

X is dependent variable and Y is independent variable to calculate the actual and estimated result to minimize the result.

$$Y' = b_0 + b_1X \text{ (positive linear regression analysis)}$$

$$Y' = b_0 - b_1X \text{ (negative linear regression analysis)}$$

Linear regression equation (without error)

$$\hat{Y} = bX + a$$

predicted values of Y

b = slope = rate of predicted  $\hat{Y}$  for Y scores for each unit increase in X

Y-intercept = level of Y when X is 0

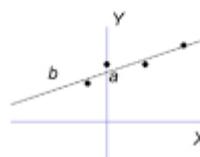


Fig 6. Linear Regression Equation

$$m = \frac{\sum_{i=1}^n (x_i - \bar{x})(y_i - \bar{y})}{\sum_{i=1}^n (x_i - \bar{x})^2}$$

Fig 7. Mathematical relation of regression analysis

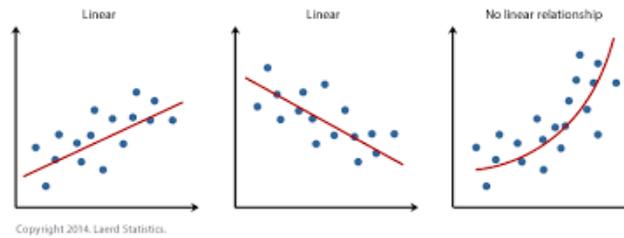


Fig 8. Regression analysis between X and Y

Linear Regression analysis, the parameter of linear equation that can be implied the value of one variable to other. According to literature survey, we found observation of software quality based on CAMS framework [1].

Software Quality=1.409 + 0.176C + 0.227A+0.096M + 0.172S [2]

In above equation software quality will upgrade when Automation(A), Measurement(M), Culture(C) and Sharing(S) will improve.

- TDD (Test Driven Development) is used for automated unit testing to give direction to the developer “How to deploy the software”. It follows set of algorithms to test. It first, create a test where code become fail. TDD is starts before writing code. It flows as desired outcome written as test.

According to ISTQB (International Software Testing Qualification Board) test automation engineering is desired promotion for enlargement. Duplication code is removed and refactored. It ensures that testing done in correct code but not works for accident. J unit tool is used in TDD in automation [2].

In a global standard testing software in DevOps is famous and fastest growing certification for the speed and software quality in the world. In ISTQ, it issued more than 570,000 certificates across 100+ countries. It provides automated software quality path to move the career higher, fast testing codes, improve communication between the teams and continuous delivery of software and product i.e. key factor of success.

- BDD (Behavioral Driven Development) helps to minimize issue created by TDD and induced by behavior and specification. BDD boosts the business associate to encourage and describe the functionality of application and test in DSL (Digital Subscribe Line). It focuses on actual design whereas TDD on testing. Unit testing allows you “what should be tested”, TDD allows you “when should be tested” and BDD allows you “how the code should be tested”. Utopia states that if we combine unit testing TDD and BDD to each other, it provides best result. Cucumber tool is used for BDD.
- ATDD (Acceptance Test Driven Development) created by TDD and BDD to find the scenario of end user vision for the purpose of automation testing.

In DevOps quality assurance plays a vital role in development team, operation team and testing team to yield fast delivery. Quality assurance detects bugs but in DevOps its primary responsibility to prevent the bugs occurred in code that speeds up the market and degrade the test cycle.

- Tools  
The best DevOps tools that are owned in 2019 are
  - Gradle
  - Git
  - Jenkins
  - Kubernetes
  - Puppet Enterprise
  - Docker

#### D. ISO-9126-1

It is the latest proposal for a useful quality model of software characteristics. It is unlikely to be the last. The operating environment in the software and requirements will be continuously changing is certain. And with this change will come the continuous search to find useful characteristics that facilitate control of the software production process and measurement. The characteristics and sub characteristics of ISO 9126-1 functionality, reliability, portability, maintainability, efficiency and usability.

#### IV. CONCLUSION

In this case study, we summarize that automation is the analytical factor that helps to upgrade the overall performance of the software. Through this paper we overcome the gap between development and operation team by enabling transparency, innovation, supporting, communication, shared resources and encourage collaboration [1].

DevOps supports fast delivery and provides good quality of the services to the customer. It manages dynamic adaptation of sharing law of change. Moreover, CAMS framework is the basic phenomenon to improve software quality in SDLC.

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