

A PARADIGM SHIFT FROM QUALITY ASSURANCE TO QUALITY ENGINEERING

1. Introduction

Quality Assurance (QA) plays a key role in any industry that ensures customer expectations and more, in today's fast-moving technology transformation and disruptions, QA became vital and application development and business leaders positioning "Quality as first". Teams need to develop faster time to market, but never at the cost of low quality. So how can teams continue to push for faster development without hampering quality of products/ applications? The answer is a **PARADIGM SHIFT** of QA to Quality Engineering (QE)

Traditionally, there is a long transformation journey from Quality Control (QC) to QA and now the shift has moved to QE, let's see now the difference between them to understand the paradigm shift better

Quality Control (QC) - The operational techniques and activities that are used to fulfill requirements for quality

Source: Capability Maturity Model Integration (CMMI) Model

Essential for creating a product that is a need of the customers and QC is primarily done once a product is built, focus mainly on the techniques used, primarily done by an inspector or a tester

Quality Assurance (QA) - A planned and systematic means for assuring management that the defined standards, practices, procedures, and methods of the process are applied.

Source: Capability Maturity Model Integration (CMMI) Model

This mainly focuses on the methods (processes and procedures, check gates, etc.) which are used to ensure the quality of software that includes peer review, standard process, etc. primarily done by a Quality Analyst or SQA in short

Quality Engineering (QE) - Gartner's definition of "quality engineering" is "the application of lessons learned, and IP generated through QA to engineer better business, IT or OT processes, products, solutions, services and applications from the outset of a development project."

Gartner Report: Magic Quadrant for Application Testing Services, Worldwide

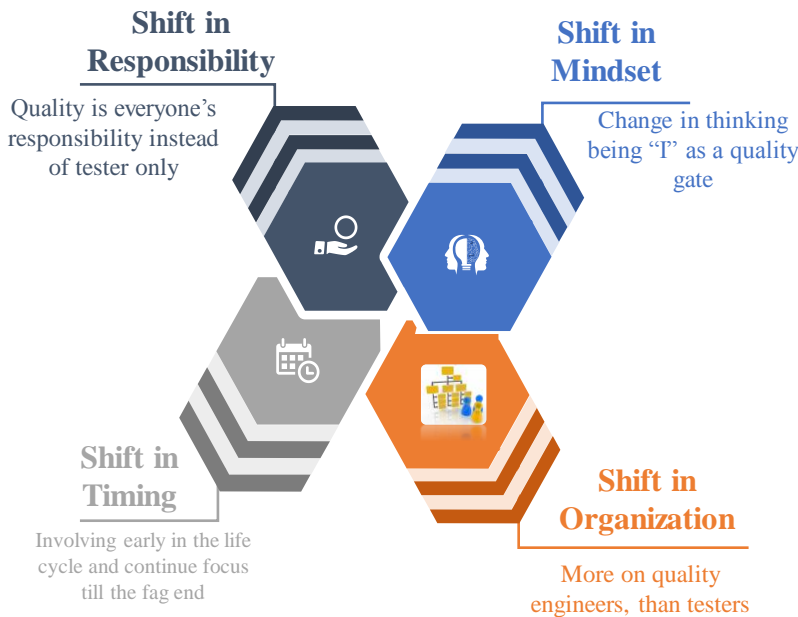
This shift is a radical way where focus on quality is embraced early on during the product life cycle, it is more of a cross functional culture change where multiple teams strive and drive impact towards building a high-quality product by innovation and continuous improvement.

2. Shift to Quality Engineering

The paradigm shift needs a focus on Quality@Speed, first time right, business agility, innovation, industry QA best practices and risk reduction that includes most viable product, smaller and faster development iterations, frequent potential shippable increments, effective collaboration and early validation.

What does this “SHIFT” mean and how does this add value?

This needs a shift in the following dimensions in an organization, leaders to provide sponsorship, commitment and support to the teams and thereby team can embrace



this cultural shift and mindset to achieve the enterprise goals

Also, as per one of the leaders speak in World Quality Report, eleventh edition says “Organization are seeking to right size their approach and possibly achieve Quality@speed this through a pure managed services delivery model. this means bringing together quality engineering and development teams to deliver work to

achieve cost effective results”

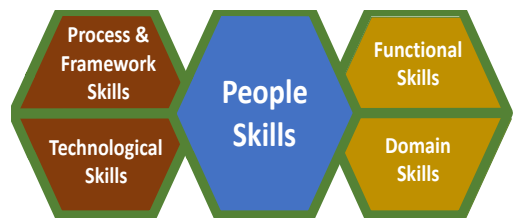
The paradigm shift impacts primarily the following areas, that needs to be embraced at all times:

- People – Build & acquire skills
- QE Practices

3. People – Build & acquire skills

The skills required for QA and testing have changed over the years with the adoption of new frameworks and technologies have broadened the skills required and also spilled over to domains and functions, with an advent of new technologies such as Artificial Intelligence (AI), Data Analytics, Block Chain and Internet of Things (IoT) there is an increase in demand of much more specialized skills, with more automation and integrated QA approach, this role is much more than an Software Development Engineer in Test (SDET)

A study from state of testing report – 2020, that clearly says knowledge needed and skills needed are primarily focused on Embedded systems testing, testing in cloud, AI testing, big data testing, performance testing and micro service testing

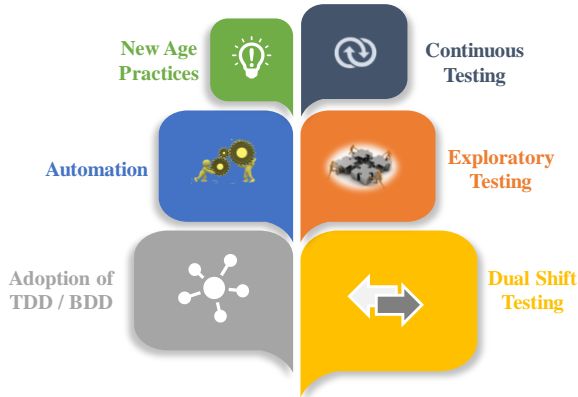


Certainly, acquiring these specialized skills will be bigger challenge and key recommendations from World Quality Report (WQR) tenth edition towards building up the required skills and strategy by enterprises are

- Attract / reskill agile test specialists with functional automation skills and domain testing skills
- Attract/ reskill SDETs, in advanced automation skills, and possess basic algorithmic application capabilities, and natural language processing
- Attract/ reskill niche non-functional testing skills
- Attract/ reskill on AI/ML, data analytics, neural networks, and augmented reality

4. QE Practices

Now let's understand how we can participate in the journey of QE transformation using some of the following QE practices, along with the skills we need to change our mindset and the approach. Following are widely used QE practices.



- **Adoption of TDD / BDD**

Adoption of Test-Driven Development (TDD) and Behavior Driven Development (BDD) have been in the industry since a decade, however these practices got more importance during last 1- 2 years, as most of the industry are striving for faster time to market with a focus on first time right.

TDD approach replaces the *inside-out (write code and then test)* to *outside-in (write test and then code)* and fundamental point to note that the goal is development based on testing, primarily in this technique there is change in the SDLC methodology, where team define the test first and then write the code to pass them. Mostly criteria specified by the customer are automated into acceptance tests.



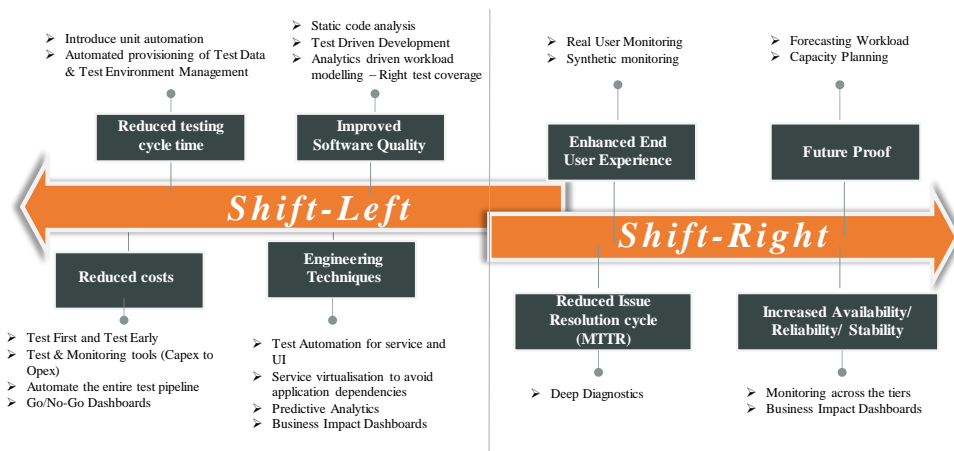
BDD mainly focuses on the expected behavior of the application and its components, User Stories created and maintained collaboratively by all stakeholders, this makes a business analyst, developers and tester a common language or platform to build an

acceptance criterion of the applications and in developing a detailed user story based on the application behavior. Gherkin is a widely used BDD language to write the user story and test cases.

The key difference between TDD and BDD are, TDD requires a shift of whole development approach where as in BDD team shifts the focus, depending on the appetite for change and risk involved, enterprises choses either a TDD or BDD.

• **Dual Shift Testing**

Let’s recall one of the concepts of eminent quality guru Philip B. Crosby, who introduced a concept of “Do It Right First Time” and that focus on Early Defect Detection and thereby improving the total Cost of Quality (CoQ), Dual shift testing is primarily focusing the team to shift “LEFT” and “RIGHT” and balance these dual shifts in testing.



Cost of correcting a defect increases as a project advance through the SDLC. “**Shift Left**” is a concept intended to find and prevent defects early in the SDLC, and thereby lower risks and costs where as “**Shift Right**” Technique focuses on “Test as an User instead of a Tester” - Focusing on end-to-end coverage and more of a testing in production understand application, gather data on customer preference and end user behavior.

• **Shift from Manual to Exploratory testing**

Manual testing won’t go away during the journey of QE transformation, but this will certainly change the way we do currently, the focus will shift to new features or functionality rather than full landscape of functionality or skip the retesting of components that have already undergone testing in previous sprints and working perfect, The goal will move to ensure the tests cover the critical paths, edge cases, that are not automatable and critical to business and technical functionalities. With the increase in automation and technological skills on coding, manual testing will shift to an exploratory testing that primarily focus more on domain workflows, non-automatable tests, and improve Customer Experience (CX). As per State of Testing report 2020, also says, 84% of respondent says they use exploratory testing as their testing approach

• **Automation**

With an increase in growth of Agile and DevOps SDLC models, fully integrated test automation became an essential part of the model, many QA organizations still have siloed the test automation to testing process, and now there has been a shift towards enterprise automation solutions, where automation is spread across the lifecycle that led to emerging of new technology or technique of Robotic Process Automation (RPA) that seeks to automate the manual business process, with an increase in complexity and frequent change in application, enterprises are exploring many such techniques like

- Model Based Testing (Automated Test Case Design)
- Cognitive Automation
- Robotics Process Automation (RPA)
- Test Data Automation
- Test Environment Virtualization
- Test Design Automation and Self-Remediation

- **Continuous Testing**

With a testing in production (Shift Right) approach enabling to implement updates faster, identify defect quickly and fix them while in the operations, which has helped enterprise to build a continuous testing and feedback loops from production back to development, and also with a greater usage of Continuous Integration (CI) / Continuous Deployment (CD) and Continuous Delivery the continuous testing also became prominent to align to the CI/CD pipeline, test automation and continuous testing goes hand-in-hand for enabling continuous delivery that includes functional test automation, testing across web browsers, automated function tests in CI/CD pipeline.

- **New age practices**

- Intelligent Automation

Test automation is been in the industry for more than two decades, where most of the automation frameworks were design to automate the manual test steps, there were not intelligent enough and unable to react when changes are frequent, this made a shift towards intelligent automation with giving more importance to automating steps related architecture which emerged with new techniques like Model Based Testing (MBT) / Natural Language Processing (NLP) and build a smart automation framework with some of key capabilities as follows:

- Defect prevention - Identifying defects early and incorporate algorithms to improve the accuracy of future defect classification and re-factor the test cases
- Smart framework that performs a speech recognition to automatically convert manual test cases to automated scripts
- Automatic test data generation using text-to-speech conversion technology
- Identifying of redundancies and similarities in test cases to optimize test case
- Testing Insights - AI-based bots to create actionable insights
- Performance testing analytics to refactor the test scripts

- **Artificial Intelligence and Machine Learning (ML) in Testing**

There are two facets of AI and ML for QE, one application of AI/ML in testing and other as testing of AI / ML products, due to COVID-19 impact, there are many applications emerged to track the pandemic in many ways that includes mobile app to track potential COVID patients, analytics that include potential effected zone, etc. Application of AI/ML in QE is primarily for

- Develop a smarter framework that adapts automatically with the application changes
- Smart analytics for building and optimizing the tests
- Presenting a real-time dashboards or progress with deep machine learning and analytics

With an increase usage of tools have historical data, using ML to predict the likely defects, and identify the right set of test cases and also build AI dashboards for improve decision making.

Second facet of AI, is testing AI products such chatbots, testing of functionality and security of these chatbots is new transformation to QE roles, these tests are primarily done using virtualization technologies that combines real device, simulators and emulators to test the functionality

- **Augmented Reality (AR) / Virtual Reality (VR)**

AR/VR is continuously evolving and getting incorporated in the digital platforms, testing leaders are striving to identify the best and optimal use case or approach to testing these applications or functionalities, AR/ VR fairly being fairly new, many enterprises are undergoing research to identify the best and optimal use cases and certainly this will change the world we see in the digital platforms with a new acronym of XR derived from AR, VR, and MR, collectively "extended reality" or "XR" and getting a right skills for testing is new challenge to the leaders today, but looking forward to explore the research and experience.

Here are definitions of AR/ VR from Forrester Report:

Augmented Reality (AR) - This is the virtual overlay of contextual digital information that a computer generates on a physical-world object and that a user sees in the display of a mobile device as its camera captures it in real time.

Virtual reality (VR) - An occluded-view, immersive digital experience is made to feel realistic by the addition of body cues like 360-degree views, 3D sound, and, increasingly, several degrees of physical freedom for movement.

As we see with the increase in digital footprint, cloud adoption and technology disruptions happening, there are new techniques and technologies emerging that is transforming the way we do QE such as Internet of Things (IoT), RPA, Block Chain and the convergence of analytics through AI and Machine Learning and more to come to see in the future.

5. Conclusion

The outlook for QE transformation will happen much faster considering the COVID-19 impact and demanding cloud hosting, secured remote operations and digital business models. Business resilience can be demonstrated efficiently by enabling the People and QE Practices effectively. Organizations found this transformation delivered Quick Wins and in the path of Continuous Growth. CXOs to re-consider investment in innovation and IP to be a reasonable percentile, these focused efforts always resulted in productivity improvements and differentiator with competitors. The next decade is going to witness a tectonic shift in the Quality Engineering.

References:

1. CMMI® for Services, Version 1.3 @ <http://www.sei.cmu.edu>
2. Gartner Report: Magic Quadrant for Application Testing Services, Worldwide, Published: 25 November 2019 ID: G00379884
3. World Quality Report, Eleventh edition
4. World Quality Report, Tenth edition
5. State of Testing Report -2020, by PractiTest
6. Augmented Reality, Virtual Reality, And Mixed Reality, Q1 2019, Forrester Report