Bots for Quality: Augmenting QA’s Scope in the Digital Age

To excel with digital, software quality assurance must move beyond mere automation toward a system of intelligence that powers software quality at speed through machine learning and predictive analytics. An insight-driven approach, built around smart next-generation automation, enables testing to be conducted early and often.

Executive Summary

Digital technology has empowered customers to demand high-value services and products that are available from nearly any device at all times. Moreover, the stiff competition presented by digitally-native enterprises further raises the stakes for established businesses that live in a hybrid digital/analogue world.

Regardless of their starting point, most businesses in today’s hyperconnected digital world cannot afford any slippage in quality, since one bad experience can snowball into a reputation-wrecking incident. Several cautionary tales, like the United Airlines’ computer glitch earlier this year, demonstrate how compromised quality can be detrimental to business.

This has triggered an industry-wide change in the way software is developed. And to move at the speed of digital, organizations must find ways to develop better software faster and ensure it is bug-free at release. As a result, quality assurance (QA) becomes a pivot for business success.
Traditional QA practices were focused on defect detection, an inherently reactive process. Testing was an afterthought, the penultimate phase of software development, where it was all too common to see teams scramble to resolve a barrage of defects, days before a software release was scheduled to go live. With DevOps and Agile methodologies, however, QA has remodeled itself for early defect prevention to reduce disruption in the release cycle.

In today’s digital age, the focus of quality has shifted from requirements validation to ensuring positive customer experiences. To effectively navigate this shift, QA needs to be proactive, using algorithm-driven intelligent systems (aka, bots) and machine learning to predict defects. This white paper focuses on how enterprises can glean insights from data collected at every stage of the software development lifecycle (SDLC).

**MAPPING THE SHIFTS IN QA**

With changing priorities, traditional QA techniques are giving way to an expanded quality function with touchpoints across the SDLC. This encourages business analysts and developers to prevent defects much earlier in the lifecycle, thereby ensuring proactive, preemptive quality even before the traditional QA phase. As an enabler of business assurance, the focus of QA moves from mere automation to a combination of automation and a system of intelligence to boost quality efficiency.

The following sections reveal ways in which a system of intelligence can be used to achieve new quality objectives.

**Shift Up: Bridging the Divide Between Business and QA**

The unstructured format of business requirements and user stories make them difficult to analyze. However, they can be an important source of intelligence to improve downstream quality. Unstructured, free-text data can be processed using machine learning techniques that break down inputs into statistically significant keyword combinations. This can be correlated with test cases and test results to predict system failure.

- **Defect prediction based on user stories:** The success of every development Sprint is influenced by a number of different factors that are ideally suited for pattern analysis and prediction using machine learning. Factors can vary, but often include the number of user stories, developers involved, number of release cycles, development technology and the content of user stories. By identifying historical trends from prior Sprints, it is possible to predict the type and occurrence of defects, which are a useful barometer of risk during project planning and development.

- **Test case failure prediction based on user stories:** The concept outlined above can be extended to traceability between requirements, test cases and defects to arrive at a subset of defect-prone test cases. Based on an assessment of the probability and impact of failure, QA professionals can make better decisions concerning test suite optimization, thereby effectively focusing testing on the areas that matter most. This can be used to optimize the manual test suite and maintain the automated test suite at the start of every Sprint, thereby maximizing QA ROI.
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The Changing Role of QA

Shift Left: Bridging the Divide between Development and Quality

When it comes to predictive quality, development data is one of the best places to start, since it is possible to root out defects right at the source. Development data sources are numerous and varied like application binaries, continuous integration (CI) data, security and vulnerability analysis data, etc. By correlating this with data from test systems, QA organizations can extract actionable insights to optimize test cases, predict defects and reduce technical debt, as described below.

- **Change impact-based testing**: Application binary scans can identify changes down to a single line of code. By correlating code with test cases, QA organization can optimize and focus testing on areas affected by code changes, thereby saving effort while ensuring application reliability.

- **Reduce technical debt**: Data from code quality tools such as SonarQube provides valuable insight into technical debt that can be used to improve programming practices. By correlating factors such as technical debt, code complexity and developer data with keyword combinations from user stories, it is possible to predict technical debt before development formally starts. This helps in proactive planning for code quality and improves upstream quality.

- **Deliver on time with minimal risk**: Rushing a project to meet deadlines always incurs the risk of quality shortfalls - and the associated rework. However, it is possible to predict and plan for defects while deciding to rush a project, by using data such as user story completion, schedule, technology involved, team performance, code freeze and software configuration management (SCM) logs from previous Sprints correlated with defect histories. This can
also help balance schedule and risk, thereby improving managerial decision-making.

- **Predict build failure:** Smoke test data from prior Sprints can be used as a solid predictor of build failure based on various factors such as SCM log data, application integration details and functional changes. These inferences can be fed back to the development team to manage failure before a new build is released.

**DELIVERING ON THE NEW QA MANDATE**

Here is a look at how some of the concepts put forward have been used by our clients to achieve quality at speed.

**Test Suite Optimization for a Leading Healthcare Solutions Provider**

This client followed a biweekly release cycle for major applications, which involved the execution of hundreds of functional tests. Faced with severe time constraints, the company sought to reduce cycle time by testing more intelligently.

Deploying code change impact-based testing considerably reduced the effort to execute test cases that were either directly or indirectly impacted by changes to the build. This not only delivered a 90% reduction in the size of the test set but also improved test coverage, resulting in better quality at a fraction of the cost.

**Build Failure Prediction for a Major Retailer**

This client’s release process spanned more than a month, incorporating multiple Sprint cycles. As the team raced against the clock for every Sprint, managing rework through successive builds became a major challenge.

By analyzing patterns from historical SCM and build tracker logs, bots proactively predicted build failure, which helped focus testing on risk-prone areas. This reduced rework by almost 15% within the first six months.

**QUICK TAKE**

**Business**

Analyze business requirements and authored user stories to assess the strength of requirements and proactively improve quality before the start of development.

*Business analysts can estimate the defect injection rate from authored user stories.*
Automated Defect Prediction for a Leading Communications Provider

This client faced escalating maintenance costs, with its QA team handling nearly 1,000 bugs, weekly. It sought a solution to predict defects for preemptive maintenance.

We implemented a machine learning solution to analyze defects trends based on source file changes and to predict their occurrence, enabling QA to shift left. This technique allowed the team to correctly predict 42% of the defects that occurred in a Sprint.

Looking Forward

An insight-driven QA approach provides real-time predictability to detect defects, empowering organizations to achieve software quality at speed. By embedding machine-learning-based robots into the quality lifecycle, organizations can fuel their digital agenda.

Given the colossal amount of data generated at every phase of the SDLC, it would be a mammoth task for QA professionals to manually select, study and draw patterns. To assist with faster delivery, robots can help testers, developers and operations teams work smarter.

Dedicated bots driving quality across the SDLC empower developers to write better software, help testers optimize test case execution, predict the number of failures and enable better decisions. Here are some ways in which QA leaders can steer the transition toward bot-assisted QA:

- **Develop the right skills.** Ensure relevant skill training to make the team well-versed in machine learning, commonly used statistics and bot-assisted QA.
- **Be agile:** build small, fail early. Unfortunately, there is no silver bullet when it comes to machine learning. Take small steps by implementing bots on a subset of historical data (the last four or five Sprints). Evaluate results, learn from your mistakes and sharpen your algorithms before undertaking larger and grander implementations.
- **Collaborate.** The benefits of bot-assisted QA don’t stop with the QA team – nor should

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Quick Take

Developers

Analyze correlated code-test data, source file changes and development system logs to improve quality early in the lifecycle.

*Developers can predict the probability of build failure based on code changes.*
Implementation. Expand your circle and work closely with the development and operations teams while building bots. Their insights will prove invaluable.

- **Communicate.** Building machine learning bots is not a quick fix project. It takes time for the benefits to be evident and speak for themselves. Ensure that failures and successes are frequently communicated, so project sponsors and stakeholders are aware of the progress made.

- **Identify the right business pain point** that can be resolved by bots. Ensure that data quality and process standardization are used as key qualification gates for bot use cases.
FOOTNOTES

1  www.reuters.com/article/us-ual-flights-idUSKBN15705C


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Vikul Gupta is a Director within the Digital Assurance CoE of Cognizant Quality Engineering and Assurance business unit. He has over 17 years of experience in product and service strategy formulation and delivery, with expertise in DevOps, analytics, digital assurance, cloud and data center automation. Vikul has helped several clients transform their QA organizations using analytics and cognitive automation-based solutions, which drive quality at speed. He holds a bachelor’s degree in engineering from the National Institute of Technology, Surat, in India. Vikul can be reached at Vikul.Gupta@cognizant.com.
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