5TH DRAFT_CAPGEMINI WORLD QUALITY REPORT 2016 – EXECUTIVE SUMMARY

LAST YEAR'S WORD COUNT = APPROX 3,500

Executive Summary

The past year has seen an unrelenting uptake of new technologies, including the Internet of Things, as organizations seek to disrupt with digital at an ever faster pace. This eighth edition of the *World Quality Report* illustrates the impact of these trends on the Quality Assurance (QA) and Testing function, which is increasingly required to transform into an enabler for securing business outcomes and client value from Digital Transformation programs.

This year's research was conducted among 1,600 CIOs and IT and testing leaders from 33 countries across the globe. It reveals a shifting set of primary objectives for the QA and Testing function compared with last year. It's a change that reflects a desire to stay close to the essential objective of testing, which is to prevent serious defects from reaching production, but always related to the higher objectives of customer value and business outcomes.

What clearly emerges in this year's survey is that organizations continue to evolve their QA and Testing function in their traditional Core Enterprise IT (systems of record), as well as in their nimbler digital Business IT (systems of interaction). This QA evolution in these parallel, but different, worlds often sees a duality of processes, technologies, skills and testing organizations co-existing. Our study findings thus reveal various multiple approaches and trends, sometimes partially shared, but at other times running in tandem.

There has been a shift towards a focus on how QA and Testing can improve business outcomes, such as customer experience, revenue growth, and uninterrupted business operations. It is no longer simply about getting a product or service to market quickly and with as few defects as possible. Instead it is about transparent business risk profiling and the shifting left of quality responsibilities, along with upgrading critical QA enablement components, such as test data, test environments and test network. Together, these will drive effective decision making and actual business outcomes.

When combined with the relentless push for speed through rapid release cycles enabled by agile and DevOps, digital is resulting in an escalating volume of new developments, technologies and interconnected systems. We see organizations increasingly struggling to find the right approach to quality validation and testing for these systems and technologies. So while there is clarity on the part of this year's study participants in terms of their understanding of the challenges in the Core QA (a term we coined to support the Core Enterprise IT), newer challenges and contrasting priorities seem to emerge as they seek to understand what we refer to as Business QA.

Organizations must adopt a fit-for-purpose test strategy to manage these differing challenges in their bi-modal IT, in both their legacy and agile development approaches. Our research clearly shows that despite the continued adoption of agile methodologies, challenges with quality and testing in agile projects are increasing. The most notable difficulties are in identifying the right areas on which to test, the availability of flexible and reliable test environments and test data, and the realization of benefits from

automation. In the world of traditional Core Enterprise IT systems, the centralized Testing Center of Excellence (TCOE) has played an enormous part in bringing efficiency and higher maturity of testing. In the de-centralized and agile world this is apparently much more difficult to achieve.

When asked for their opinions concerning the objectives of QA and Testing, our senior management survey participants revealed very distinct, yet equally high scoring, expectations. On the one hand, they have a basic and essential expectation of testing, which is to prevent defects from production. On the other hand, there are expectations at a very different abstraction level: to contribute to business growth and business objectives, as well as to ensure end-user satisfaction. The QA team must be aware that these expectations are of equally high importance, but to comply with them will require a very different level of reporting on QA and Testing results.

We believe that the most important solution to overcome increasing QA and Testing challenges will be the emerging introduction of machine-based intelligence. This will be the next big wave of change after the introduction of risk-based test strategies and test automation technologies. An intelligence-led QA approach enables QA activities to be automatically defined and adjusted to reflect the realities of past projects and releases as well as day-to-day data points from production. It will radically change the QA and Testing approach, which currently relies too heavily on largely subjective manual decision making, preparation and execution.

World Quality Report Findings

1. **Digital Transformation continues to drive IT strategy and make itself felt in the QA and Testing function.**

   Organizations in all sectors continue to use new digital technologies to accelerate change and connect in new ways with their customers. For the QA and Testing function tasked with assuring customer value and business performance, Digital Transformation brings both challenges and opportunities.

   The challenges include the need to manage escalating test volumes at increased speeds, while specific skillsets in multiple areas are still relatively immature or scarce. The most notable lack of skill is in the areas of: intelligence-driven QA and Testing strategies; newer test automation skills; optimizing test environments; test data management; and enabling QA activities in agile/DevOps settings. Keeping tight control of budgets is also a challenge, with a large and growing percentage of the QA and Testing budget for new developments now consumed by digital technology solutions (mobile, cloud, business intelligence/business analytics, Internet of Things).

   There is also a growing opportunity to use the host of new tools in the mobile and digital testing space to measure, quantify and better understand the user experience. This gives QA and Testing professionals a bigger role to play in the strategic imperative to embed customer experience at the heart of Digital Transformation programs. We also observe a levelling in the digital maturity across sectors this year, with previously immature sectors catching up, or even overtaking, last year’s digital leaders.

2. **Agile and DevOps continue to grow in adoption, with QA making a corresponding move.**

   The ability to bring new products and services to market ahead of the competition is a crucial differentiator for today's digital enterprise. It is no wonder, therefore, that the agile methodology is firmly embedded in development lifecycles, and now DevOps principles are growing in use, albeit still as an emerging practice. This trend looks set to continue and grow in the future.

   While both agile and DevOps offer significant opportunity to drive faster release cycles, it is evident that the issues around managing and implementing the quality and test measures are an increasing challenge. Organizations are struggling to find the answer to the question of how to achieve speed (or velocity) with the right level of quality. By removing boundaries between the disciplines, quality validation and testing activities are being more fully integrated in the agile development lifecycle, although there is still a long way to go. For example, while agile implies a shift left in QA and Testing to earlier in the lifecycle, 44% of this year's survey participants using agile claim involving the testing team in the inception and sprint planning phases is a challenge.

   This year we have also identified a need for agile testing expertise to become more strategic, with a focus on transformation, rather than purely on execution. Organizations report a lack of specific QA and Testing skills to be a challenge, so in addition to the key skills such as test strategists, test environment specialists and test data specialists mentioned earlier, we see an emerging need for data scientists to implement a data-led predictive QA approach. Overall, the key themes for testing in agile this year are to establish distributed agile and test approaches, and to focus on business outcomes and customer value, rather than on tools.

   The study findings pertaining to DevOps show an increasing maturity with a better appreciation of the true purpose and application of DevOps. A striking development in the approach to QA is the uptake of continuous monitoring with predictive analysis, along with the increased adoption of more cloud-based test environments, both reported by 42% of this year's study respondents.

   Despite the growing maturity, it is clear that DevOps implementation challenges go far beyond just issues with QA. After an initial focus on delivery pipeline automation and tool implementation, it is evident that breaking down the silos of business, development, quality and operations requires a culture change. There is a risk that the implementation of Quality Assurance in the development cycle will be buried among other generic and potentially more pressing DevOps implementation challenges. However, this would be a serious mistake because a QA guideline and toolkit for DevOps can be the enabling glue that keeps teams focused on customer value and business relevance.

3. **The emergence of Internet of Things functionality is a disrupting force with the potential to increase the impact of failure.**

   With 85% of participants in the *World Quality Report 2016* study saying Internet of Things products are part of their business operations, it is clear that there's a whole new world of connectivity and functionality that must be validated and verified.

It is very worrying that 68% of the organizations in which Internet of Things products or solutions play a role do not currently have a test strategy for this specific aspect of their IT. Apparently many of them are relying on the quality validations performed by the device manufacturers. This situation must change and it appears that 30% are planning an Internet of Things test strategy in the near future.

Assuring the quality of Internet of Things functionality will become an increasingly bigger part of the QA and Testing function's remit as more and more things are connected and able to share data across networks. This will see the emergence of new test tools and approaches designed to deal with the exponential increase in test requirements and data. For example, a form of artificial intelligence/machine learning is viewed as valuable functionality for achieving and maintaining good test coverage, leading to a high level of product quality.

4. **The challenges around managing and driving down the cost of test environment management are growing.**

The key challenges in test environment management (TEM) revealed this year are:

- Having to maintain multiple versions of test environments, claimed by 48% of survey respondents;
- Lack of facilities to book and manage their own environments, cited by 46% of respondents;
- Lack of visibility to test environment availability and demand, cited by 46% of respondents;
- Lack of the right tools for testing has jumped again, with 46% of respondents citing it as a challenge.

While there is an increasing trend for investing in test environment management, the rising cost of test environments is turning the spotlight on how to drive TEM efficiency. Investment in test environments is aimed at removing the testing bottlenecks in the development cycle that are a barrier to rapid releases.

The relative lack of TEM maturity gives rise to inefficiency and this has a knock-on effect on the budget. Indeed, increased challenges with test environments are cited as having the third biggest impact on QA and Testing budgets.

Despite the growing challenges, TEM is slowly maturing. Previously scarce skillsets are increasing, although it will be a while before TEM is fully professionalized. Core systems built to support testing are becoming increasingly smart, using analytics and self-managing capability for testing environments and data. As the needs of agile and DevOps cycles escalate, test environments and test data management will become ever more automated and virtualized.

5. **The continued requirement to find efficiencies at every level in QA and Testing remains evident despite this year's success in containing costs.**

This year's share of the IT budget devoted to QA and Testing has dropped to 31% after a significant and worrying increase from 18% to 35% during the preceding four years. There is no room for complacency, however. Despite this year's reduction, there is an overall prediction that spending will increase to 40% in 2019. This far exceeds reasonable levels of up to 25% and points to a continued urgent need to find efficiencies.

This need is brought into sharp focus by the knowledge that the growing adoption of digital innovation will lead to an increase of test cycles and require further investment in test platforms and test tools. This will potentially drive up costs still further if not sufficiently controlled. Traditional measures for driving efficiency have been: low-cost offshoring, centralizing test functions and increasing automation levels. However, agile and DevOps adoption limits the possibility of low cost offshoring, and automation is still only delivering a partial return on investment (ROI). So other and new measures are required in addition to these traditional ones to ensure that the containment of QA costs can improve.

6. **Transformation to intelligence-led QA and Testing will be the next disruptive change.**

   All the previous findings highlight the need for a next level of change in the QA and Testing operations of all organizations. While the advent of new digital technologies and the Internet of Things is creating an increasingly heavy workload for the QA and Testing function, it also offers the potential to take an intelligence-led approach to validation and verification activities. From gaining a better understanding of the end user, to addressing challenges of what to test and improving environment availability, new approaches and tools are available, with more emerging. These can inform and drive more efficient test cycles with predictive analytics and the ability to leverage Big Data, including production and user data.

   This year's study findings reveal that 40% of participants foresee using predictive analysis as one of their automation techniques in the coming year. This will enable organizations to use automatic and self-learning analysis and decision making technologies on all QA aspects: from strategy decisions (what should be tested and to what depth), to test set generation and adjustment, test environment preparation, test execution and production quality decisions. This will be extended across the development and operations phase of the application in a continuous mode, with minimal human-led decisions in true zero-touch testing or test environment and data provisioning.

Key recommendations in order of importance

1. **Invest in intelligent self-learning QA and Testing platforms for all areas of the application landscape.**
   Intelligent, self-learning technology will drive analytics and artificial intelligence, processing and interpreting the huge volumes of data that it is not humanly possible to analyze. It will become far easier to identify what to test and where more testing is required to bring down costs with more efficient, data-led testing. Leveraging predictive analytics from various sources to bring speed efficiencies in all areas of quality decisions is one of the major emerging opportunities. This

intelligent data analysis will facilitate the strategic identification of what to test and predict quality issues before they occur in production.

The key on the journey toward intelligence-driven QA is to invest in and experiment with tools that enable the user to: analyze the root cause of defects; analyze coverage and efficiency of test sets; analyze utilization of resources and environments; predict test estimation based on requirements; predict risk areas and risk levels of projects; and plan the priority of test cases.

2. **Adopt a QA approach for DevOps, agile and traditional – powered by enablement teams that help to truly shift left quality.**
   The core idea behind DevOps is to remove the boundaries between the traditional silos of business, IT development, QA and IT operations, and to extend the agile and Lean principles from software development to the software deployment phase. It is our view that this process can only be successful if the Quality Assurance aspect is integrated and maximum automation is achieved in each step of the DevOps lifecycle. To begin to realize the benefits promised by the DevOps philosophy, we believe automation of QA activities is not only required but is the core enabler of increasing throughout and velocity. In other words, testing activities, done traditionally, will become the constraining factor. Or the alternative is that testing will not be done adequately, therefore putting your organization's reputation at risk. We recommend beginning your agile and DevOps journey by first shifting testing left to involve the test team right from inception. Then shift testing right over time once you achieve scale, and build continuous testing, environment virtualization capabilities, cloud-based environments and predictive analytics capabilities for DevOps.

   The right skillsets for the agile test organization should include test strategists and environment and data specialists, as opposed to pure play automation specialists. From an automation standpoint, test driven development (TDD), behavior driven development (BDD), white box testing skills and services virtualization should take on greater importance than functional automation skills. A way to resolve both strategy and competency challenges is to use a centralized Quality Management Office (QMO), which ensures the right degree of automation coverage and tools defined for the various levers, such as TDD, BDD, service virtualization, environment virtualization, continuous monitoring, test data automation, and functional and non-functional automation. In this way the QMO acts as an enabler for driving velocity in agile and DevOps initiatives, as well as the continuous improvement in the traditional development projects.

3. **Invest in as-a-service solutions for test environment management, test data management, and test execution.**

   The TEM and TDM challenges differ from a Core QA and a Business QA perspective. The challenges in Core QA are one of seeking a test-focused ecosystem, for example data or environment provisioning with a view to unlocking resource idling. Whereas the challenges in Business QA are more likely to be the simple and basic need of what to test and how to test. Given the different needs, we recommend organizations make use of mature solutions that

handle environment and data provisioning more as a service that can remain as a shared service to serve the needs of a highly efficient and offshored Core QA and an increasingly agile Business QA.

The increasing challenges with TEM and TDM are not only resulting in cost inefficiencies in traditional Core IT systems, but are also interfering with the velocity targets of digital Business IT applications. We believe that a few steps are critical to address this:

- Assign the responsibility of optimizing Core IT test environments to a TEM team;
- Invest in virtualized and cloud-based environments for the digital Business IT;
- Invest in intelligent test data generation and TDM solutions;
- Establish service-based solutions for test environment provision and test data provisioning for projects.

4. **Develop Internet of Things-specific test strategies**

Internet of Things developments are changing the value chains of enterprises by expanding the machine-to-machine and machine-to-human communication and data exchange. New devices, developments and content exchange between these devices are happening at a faster and faster pace. And as we increasingly rely on connected, self-steering and self-learning devices, the key quality aspects that should be considered are: security, operational reliability, ease of use, and performance. On top of this there is a series of technical level quality attributes: compatibility, installability, interoperability, and resource utilization.

The test approach and test depth will differ depending on whether you are a manufacturer of an Internet of Things device, an integrator of the device, or an end-user of the device. But as the Internet of Things is playing a more important role, each and every enterprise must have a specific risk-based test strategy for it, as well as availability of a test environment set up in which the device can be tested safely. Clearly this validation requires higher levels of engineering skills because it means dealing with: validation of the operation of the device itself; the validation of the connection of the device in its environment; the storage and processing of data; and validation of the potentially multiple applications by which humans can control and interact with the device.

5. **Manage quality with simple balanced scorecards per Line of Business and per application or process.**

With the transformation to more agile and DevOps-based development, organizations are relying more on self-empowered and self-steering teams. This obviously leads to more flexibility and speed, which is a good thing. However, the flip-side of this is that organizations now lack insight into the quality at an overarching enterprise level. The solution to this challenge is to balance the conflicting needs within the context of resource constraint.

One way to establish the balance and take the right decisions is to keep a real-time dashboard that tracks the enterprise-quality balanced scorecard with metrics that are critical to both velocity

and quality. This dynamic dashboard should represent a handy set of critical quality indicators on a platform and application level, together with a few managerial performance indicators. The minimum recommended managerial performance indicators are: release quality; test productivity; and test velocity. The minimum recommended quality indicators per application are: status of production incidents; release defect status; percentage features that have passed exit criteria; and total number of features delivered.