

# *The future up close*

WORLD QUALITY REPORT

15th Edition | 2023-24



IN ASSOCIATION WITH:

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# WORLD QUALITY REPORT

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# CONTENTS

<b>INTRODUCTION</b>	<b>04</b>
---------------------	-----------

---

<b>EXECUTIVE SUMMARY</b>	<b>06</b>
--------------------------	-----------

---

<b>KEY RECOMMENDATIONS</b>	<b>08</b>
----------------------------	-----------

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## **CURRENT TRENDS IN QUALITY ENGINEERING & TESTING**

Business Assurance	12
Agile Quality Management	17
QE Lifecycle Automation	22
AI, the Future of QE	28
Quality Ecosystem	35
Digital Core Reliability	42
Intelligent Product Testing	48
Quality & Sustainability	53

---

## **SECTOR ANALYSIS**

Automotive	62
Consumer Products, Retail, and Distribution	65
Energy, Utilities, Natural Resources, and Chemicals	68
Financial Services	71
Healthcare and Life Sciences	73
Manufacturing	76
Public Sector	79
Telco & Media	82

---

<b>ABOUT THE STUDY</b>	<b>87</b>
------------------------	-----------

---

<b>ABOUT THE SPONSORS</b>	<b>92</b>
---------------------------	-----------

---

# INTRODUCTION

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Welcome to the very special 15th edition of the World Quality Report, which is recognized as the industry's largest research study on quality engineering (QE). The World Quality Report provides a comprehensive assessment of the current state of quality engineering practices around the world and across different industries. Over the last 15 years, this report has examined the most important trends and developments in quality engineering and testing by surveying 1,750 executives to put together the most interesting firsthand insights. It's a great honor for us here at Capgemini and Sogeti to publish this report, along with our strategic technology partner OpenText. We have made every effort to cover topics that are as wide and far-reaching as possible to give you an in-depth view of the latest trends, challenges, transformative initiatives, and disruptions shaping them. In this report, you will see our key findings and recommendations for several focus areas: Business assurance, agile quality management, QE lifecycle automation, AI, quality ecosystem, intelligent product testing, and sustainability. The expert findings are further accentuated by commentary, examples, and best practices from 10 senior executives from various Fortune 500 organizations, who participated in our deep-dive interview series around these topics.



**MARK BUENEN**

Global Leader, Quality Engineering & Testing, Capgemini & Sogeti

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## CHANGING TIMES AGAIN

In the past editions, we saw an immense drive for faster and more impactful IT developments and digital transformation. We also saw an even greater acceleration of that agenda on a global scale across all industries. Development of unified digital platforms, Agile solution delivery, hyper-automation, advanced analytics and AI, and business and IT fusion were required to push organizations forward. Having the right level of focus on quality was thus even more critical.

This year we see a continuation of these needs plus the emergence of a true game changer in the field of software and quality engineering: Generative AI adoption to augment our engineering skills, accelerated like never before. The lack of focus on quality seen in the last few years is becoming more visible now and has brought back the emphasis on the Hybrid Testing Center of Excellence (TCoE) model, indicating somewhat of a reversal trend. Business Assurance is the name of the game, and QE evangelists need to truly step up and elevate their real purpose to focus on assuring business outcomes.

## TOP, DOWN, ALL AROUND

The future and what it holds for quality engineering and testing is essentially two-dimensional. One view is of the big picture — macro dynamics and interdisciplinary synergies. The other is a deep dive into the nuances and micro shifts in the QE space. This year's World Quality Report offers insights through both lenses: a pull-back panorama of the future as well as the inner workings of minor developments and moving pieces.

## A TEAM EFFORT

This report wouldn't have been possible without the significant contributions of many people. If you are one of the 1,750 executives across 32 countries who took part in this year's survey, we would like to thank you for your time and contribution. Your input was invaluable in helping us gauge the prevailing moods and trends. We also have a special callout to the industry expert panel, whose insights have been valuable in illustrating the broader themes. We thank our partners at OpenText, and our lead authors, sector, and regional subject matter experts (SMEs) at Capgemini and Sogeti, who together



**SATHISH NATARAJAN**

Group Vice President, Quality Engineering & Testing, Capgemini & Sogeti, Americas

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analyzed, interpreted, and provided expert commentary on the research data and interviews to build this report. In addition, we thank the report's production team: much work takes place behind the scenes to ensure this annual exercise bears fruit.

Finally, we thank you, our readers. It's your own experience and interest that gives the World Quality Report its reason for being. As ever, we hope this year's edition makes a rewarding contribution to your continuing efforts in software quality assurance, and that you can take advantage of these findings and recommendations to shape your quality engineering strategy, and perhaps even to challenge some of your current thinking.

OpenText is excited to deliver the 15th edition of the World Quality Report. The ever-evolving global environment we face has highlighted the importance of emerging trends showcased in prior editions of the World Quality Report, from the rapid organizational adoption of cloud-based quality ecosystems to widespread investment in Artificial Intelligence (AI) solutions, all of which promise an exponential increase in productivity and efficiency.

This edition shines a light on AI - the future of quality engineering. More than half of organizations anticipate that AI adoption will lead to higher productivity and increased velocity of development, and they plan to continue the investment towards execution of scaling the quality engineering process accordingly. Of course, AI also comes with challenges, such as 33% of respondents believe sustainability concerns and lack of privacy will present roadblocks to maximizing the value of AI in their organizations. The organization that can overcome these roadblocks will be well positioned to be an industry leader going forward.

Once organizations overcome the challenges and mitigate the risks associated with AI, the opportunities and applications are endless. From performance engineering and autonomous testing to data generation and root cause analysis, AI is poised to permanently alter our understanding of what is possible. No matter how you decide to implement AI, the key will be making AI a part of your organization's DNA, which will require careful thought and analysis for prioritization along with unambiguous KPIs measuring tangible outputs to drive successful quality engineering transformation with AI.

As AI becomes ubiquitous, it will create the need for organizations to build holistic quality ecosystems in which data is simultaneously highly visible and secure for every part of the organization to see and interact with. Moreover, 64% of respondents recognize quality ecosystem sustainability as a priority, not just for themselves but for customers and investors as well, with the economic, social, and environmental benefits being profound.

It is critical that organizations build a robust quality ecosystem now, because soon, having one will not be optional, it will be a necessity. Organizations must invest in workforce transformation by building subject matter expert and chaos engineering capabilities within quality engineering organizations to embrace and support the emerging trends in digital and cloud migration strategies of the customers. They will also have to accelerate the inclusion of cloud and infrastructure testing as part of the software development lifecycle to improve on resiliency, security, redundancy, and data recovery. Lastly, they will also need to build systems resistant and resilient to failure by adopting stringent practices to test the impact of failure events on cloud and continue to give extreme high priority to the performance and resiliency of applications on cloud.

We invite you to delve into the report to discover the many challenges and opportunities that organizations will face in their endless pursuit of quality excellence and get a glimpse of the future up close.

Finally, I would like to express my appreciation and thanks to Capgemini, and to everyone who has worked so diligently to create this edition of the World Quality Report.



**MUHI MAJZOUB**

Chief Product Officer,  
OpenText

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# EXECUTIVE SUMMARY

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## World Quality Report 2023-24



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Offer Leader, Intelligent Testing for  
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**JEFF SPEVACEK**  
Head of QE&T,  
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Portfolio Manager, Testing Deal  
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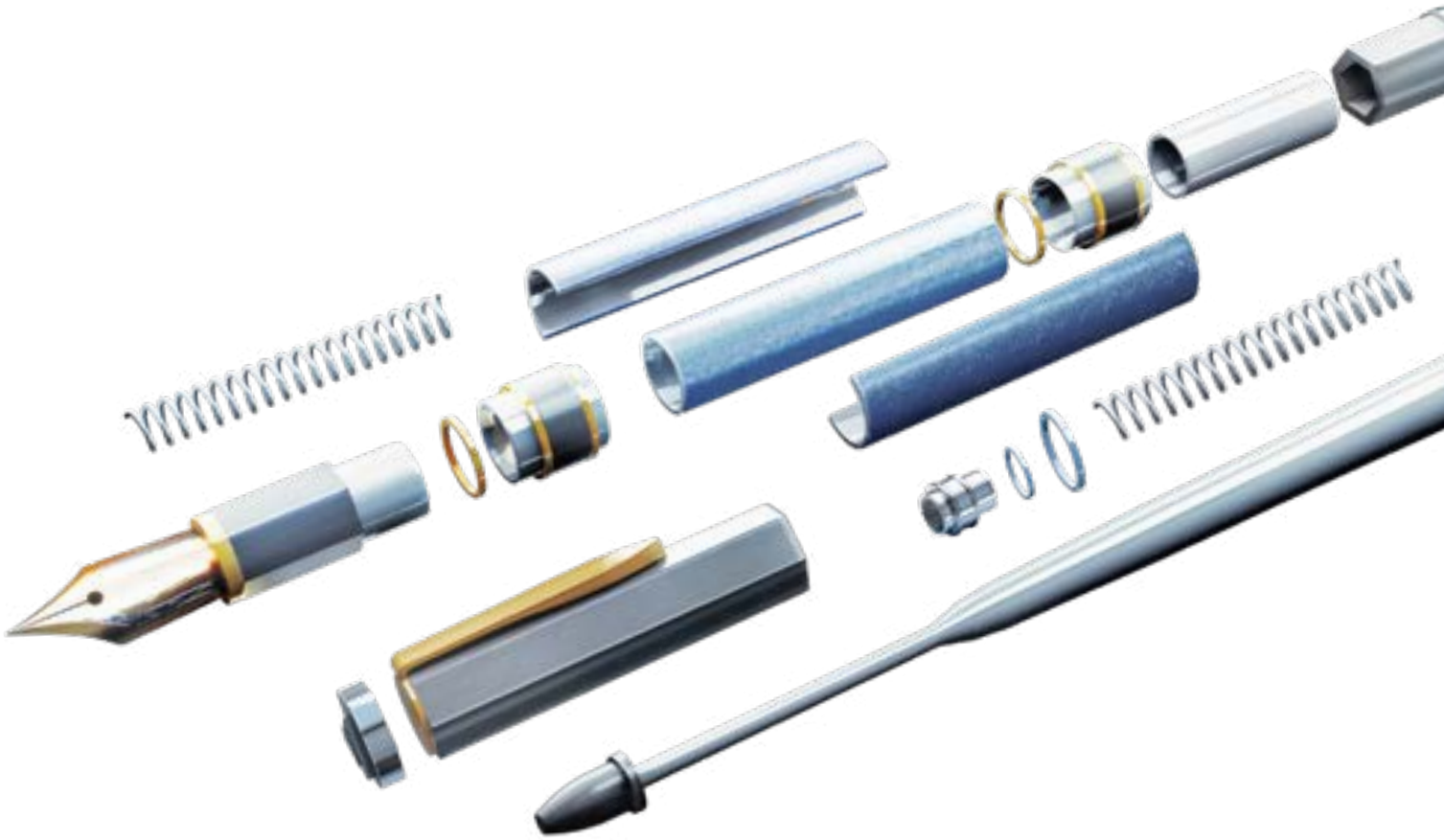
## EXECUTIVE INTRODUCTION: EMBRACING QUALITY TRANSFORMATION FOR SUSTAINABLE SUCCESS

In the constantly changing world of business, the pursuit of quality has become a key factor in achieving sustainable, long-term success. It's now more important than ever to develop a systematic approach to identifying business risks and crucial priority areas. This 15th edition of the World Quality Report explores new and evolving approaches in quality engineering (QE), and provides an in-depth view of the latest trends, challenges, transformative initiatives, and disruptions shaping them.

Quality is no longer a mere checkpoint; it's a serious boardroom agenda and part of a culture that organizations are increasingly embracing. As 38% of businesses shift their focus from volume to value, there's a growing recognition of the importance of quality in delivering value to customers. Notably, 67% have incorporated quality assurance (QA) into the core of their business operations, ensuring that their technology investments align with quality standards.

Furthermore, almost all organizations have transitioned from conventional testing to agile quality management. Evidently, they understand the necessity of adapting to the fast-paced digital world. An agile quality culture is permeating organizations, albeit often at an individual level rather than at a holistic program level. Many organizations are adopting a hybrid mode of Agile. In fact, 70% of organizations still see value in having a traditional Testing Center of Excellence (TCoE), indicating somewhat of a reversal trend.

What is clear is the extended knowledge and skills that are required from the QE experts who operate in agile teams. Coding skills in particular (C#, Java, SQL, Python), and business-driven development (BDD) and test-driven development (TDD) competencies, are in demand.



It is also evident that operating in a full agile model does still create some serious challenges for many organizations. The most important agile quality challenges are a lack of knowledge of techniques and inadequate support for testing processes. To address these challenges, a shift towards product-based quality engineering setup is recommended, with a focus on customer-centric design thinking, artificial intelligence and machine learning (AI/ML) adoption, and aligning to a business assurance mindset.

Objectives such as improved customer experience, risk reduction, increased QA efficiency, and reduced testing effort drive automation in quality. While quality automation is certainly on the rise, organizations still face critical challenges. An average of 27% report challenges related to dealing with legacy systems and the fast-changing application landscape.

Artificial intelligence (AI), and especially the application of generative AI, is poised to be a game-changer in quality engineering. It is fundamentally redefining the art of the possible. The expected outcomes of generative AI are sure to drive higher productivity and efficiency gains. Almost 77% of organizations are reportedly investing in AI solutions to drive the quality transformation agenda. However, concerns related to security, privacy, and biased outcomes need to be addressed. A significant percentage (31%) remains skeptical about the value of AI in QA, emphasizing the importance of an incremental approach.

Quality ecosystems are evolving rapidly, with a decisive shift in cloud adoption for test environments and the emergence of site reliability engineering (SRE). We are witnessing the metamorphosis of cloud testing, with over 82% of the organizations asserting the need for a cloud testing strategy as they modernize their application portfolios. Still, challenges persist in areas around test data provisioning for CI/CD pipelines without reliance on production data.

For most industries, if not all, the digital core is at the heart of how you do business. More than ever before, the strategic purpose

of testing is about delivering the best customer experiences and digital happiness, protecting the brand image, and ultimately assuring successful business outcomes. This requires more focus on end-to-end customer journey validation and a purposeful collaboration with business to maximize impact. We will soon start to see newer approaches such as test isolation and contract testing become mainstream to sidestep the roadblocks in end-to-end business process testing.

The interconnected product landscape brings a level of complexity never seen before. Demanding customer experiences, interoperability needs, regulatory pressures, constantly changing guidelines, and cyber threats warrant a much more rigorous testing focus. There is a genuine need to reinvent the product testing approach for the globally interconnected spaces we interact in. Hyper-personalization for unique user experiences necessitates exhaustive testing to validate all possible combinations, which is impossible to achieve. This is where AI takes center stage to drive maximum value, a key lever being an intelligent testing strategy.

Lastly, organizations recognize the role of QA in driving the sustainability agenda. It is very encouraging to learn that 73% of the respondents showed positive intent to become active in driving sustainability best practices in their organizations. A good first step towards making an impact is to own the process of bringing in transparency in measuring, reporting, and monitoring. They must act as custodians of sustainability and not allow greenwashing practices, which we are unfortunately starting to witness.

In conclusion, succeeding in quality engineering and assurance requires embracing change, fostering a culture of quality, and leveraging advancements such as AI and automation. As organizations continue to evolve, a commitment to quality ensures sustainable success now and in the future.

Ready to see the future up close? Let's take a look.

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# KEY RECOMMENDATIONS

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## World Quality Report 2023-24



- **BUSINESS ASSURANCE**

- **Leverage the testing function to deliver business outcomes.** This will ensure that business operation processes are aligned with business standards and objectives.
- **Use value stream mapping to strengthen business assurance** if you want to create the right conditions for improved business results and long-term success.
- **Embrace change and foster a culture of continuous improvement.** Prioritize continuous improvement to drive incremental change for sustainable success.

- **AGILE QUALITY MANAGEMENT**

- **Invest in robust training programs:** Organizations must adopt a build-or-buy mentality. Developing a robust training program reduces overall costs while setting your organization up to continue to adapt to the industry's ever-changing technology and skillset requirements.
- **Integrate with DevOps/DevSecOps:** Forging a seamless integration with DevOps/DevSecOps practices through close collaborations can ensure the smooth incorporation of quality engineering assets into CI/CD pipelines.
- **Modernize your QE organization:** To empower individual agile aligned teams to be more self-sufficient.



## • QE LIFECYCLE AUTOMATION

- **Continue to expand on what works** – don't adopt new automation technologies or platforms just because they are new or trendy.
- **Automation can be prioritized against legacy systems** – focus on automating the test scripts and technologies which yield a larger and faster return on investment first.
- **Upskill teams to use AI and to evaluate AI systems.** – Develop training plans and career pathways so that your organization knows how to leverage and assess these systems.
- **Set up an Automation Marketplace platform** – Let your automation engineers own the development and maintenance of the scripts while other teams integrate them into their daily routines.

## • AI, THE FUTURE OF QE

- Organizations need to **continue the investment towards scaling** the Quality Engineering process, skills, and bandwidth accordingly.
- Implementation of AI use cases in Quality Engineering will require **careful thought and analysis for prioritization along with unambiguous KPIs** measuring tangible outputs to drive successful transformation with AI.
- **An iterative approach towards chosen prioritized use cases, along with an MVP strategy** is recommended as there is going to be considerable experimentation around AI solutions in the near future with multiple unknowns, that will get uncovered during the journey.

## • QUALITY ECOSYSTEM

- **Accelerate the inclusion of cloud and infrastructure testing** as part of the software development lifecycle, to improve on resiliency, security, redundancy, and data recovery.
- **Continue to consider intelligent integrations** to make the best use of commercial off-the-shelf and cloud-native tooling – as a hybrid strategy for non-production environment provisioning.
- **Adopt stringent practices to assess the impact of failure events on cloud**, and continue to give extremely high priority to the performance and resiliency of applications on cloud.
- **Invest in workforce transformation in building SRE and Chaos Engineering capabilities** within quality engineering organizations.

## • DIGITAL CORE RELIABILITY

- **Use newer approaches like test isolation, contract testing etc.**, to drive more segmentation and higher automated test execution.
- **Utilize service virtualization to overcome challenges** around multiple applications, environments, and data dependencies.
- **QA teams of the future will need to have a mix of skills** – strong testing skills need to be augmented with some domain and platform skills to drive efficiencies.

## • INTELLIGENT PRODUCT TESTING

- **Invest in AI solutions for test prioritization and test case selection** to drive maximum value from intelligent testing.
- **Focus on an E2E testing approach** to ensure seamless customer experience through effective utilization of abstraction of various architecture layers.
- **Give equal priority to the non-functional aspects** of the system as the functional aspects as they equally influence the end-user experience.

## • QUALITY & SUSTAINABILITY

- **Have a set of key KPIs or metrics** that can be easily understood across the organization. Ensure regular reviews of the KPIs, and ensure they remain effective in driving improvements.
- **KPIs need to be considered** not just in QE&T but through requirements gathering, production support, and working with external vendors.
- **Sustainability needs to be part of the whole lifecycle**, included as a non-functional requirement, tested-for as a requirement, and reported on against the success (or not) of that compliance.
- **Know your green success factors** and ensure they are part of your strategy, your education, your procurement, and your hiring processes.





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## BUSINESS ASSURANCE

- **ASHWINI NADIGER**

Vice President, Portfolio CoE Head for Quality Engineering & Testing, Capgemini North America

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- **KYLE ABRAHAM**

Associate Vice President, Quality Engineering & Testing, Capgemini USA

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- **KAUSHIK MUKHERJEE**

Associate Vice President, Quality Engineering & Testing, Capgemini USA

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- **VICTORIA VOINIGESCU**

Sr. Product Manager, OpenText

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- **OREN ZIV**

Product Manager, OpenText

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*“The first thing is, really listening to our product teams that represent the business. These product teams not only have product owners, but also our business transformation teams that do the end-to-end program-level introduction. Everything for us is about our guest experience at each of our destinations.”*

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**FABIAN RODRIGUEZ**

Vice President, Application Delivery & Strategy | Digital & Technology, Universal Destinations & Experiences, NBC Universal

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*“Business results are assessed by ensuring the reliability of the orchestration layer, cost-effectiveness in resource allocation, automation, and defect prevention strategies. Some of the challenges in achieving these objectives are: keeping up with rapidly evolving technologies and platforms, the scale and complexity of the orchestration layer (as we continue to grow rapidly), and releasing new features quickly while also ensuring quality standards.”*

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**VYSHALI REDDY**

Senior Director, Mobile Quality Engineering (MQE), Charter Communications

Today’s dynamic digital age has steered a host of new opportunities toward us. However, managing multiple streams in complex business projects and delivering the highest quality in omnichannel customer experiences is a herculean task. A business assurance practice is a necessity today.

We live in a world where a single social media post could cause an irreversible dent in an organization’s brand image and reputation. And one lapse in business judgment could hamper customer satisfaction at large, and undo achievements gathered over the years. It’s a tightrope, and businesses must maintain a fine balance.

## BUSINESS ASSURANCE FOR BRAND PROTECTION, RELIABILITY, DIGITAL EXPERIENCE, AND POSITIVE BUSINESS OUTCOMES

The last few decades have transformed the scope of testing, as well as the definition of business assurance practices. Business assurance has now become an integral part of strategic business functions and is considered imperative for long-term organizational success.

Business assurance encompasses a systematic approach to determining business risks and focusing on what really matters the most. It consists of a comprehensive plan, methodologies, and approaches to ensure that business operation processes and outcomes are aligned with business standards and objectives.

In a volatile business landscape that demands full control, business assurance can help new products and services launch ahead of the competition with a consistent level of quality.

Organizations are finally recognizing business assurance as a necessity, and we think that is driving a fundamental shift in business culture today. We see more and more businesses adopting comprehensive business assurance practices to mitigate risks, ensure quality, promise reliability, maintain compliance, and safeguard the organization’s reputation and financial stability.

Businesses are even diverging from traditional, set ways of functioning to adapt to business assurance principles, which is reassuring.

## A SHIFT IN MINDSET: VALUE OVER VOLUME

**FIG 1** Optimization of IT lifecycle WQR 2023- Global Results

Which of the following best describes how much use you make of Value Stream Mapping and related techniques in optimizing the IT lifecycle?



TOTAL n = 1750

One of the key trends of this year's survey is the rapid adoption of a business outcome-driven approach across enterprises. Many businesses are now shifting from mere output to a results-driven mindset with value stream mapping (VSM).

This has brought an increased focus on knowledge that helps businesses carve out their niche and differentiate from competitors. Value stream mapping is one of the key business

drivers focusing on customer-centricity, adding value to the customer, and enhancing customer experience.

In this year's WQR survey, we find a sharp increase in the adoption of VSM and related techniques in optimizing the IT life cycle - 71%, which is up by 11 % from last year.

**FIG 2** **Driving business outcomes** WQR 2023- Global Results

How do you drive business outcome in your projects?



TOTAL n = 700

*Base: Those Who Selected "Chief Information Officer AND Chief Marketing Officer OR Chief Digital Officer AND Chief Technology Officer/ Product Head"*

Organizations are prioritizing value over volume, indicating that they are harnessing non-linear growth. VSM helps deliver business outcomes through a systematic approach. It defines, visualizes, and analyzes processes, and optimizes them by eliminating inefficiencies. It aligns all operational activities with customer needs and strategic goals.

This preference for value has also been key for over 64% of organizations actively undertaking product-oriented delivery models. This is driving large-scale transformations and has enabled 46% of organizations to build specialized capabilities aligned with customer needs.

Importantly, another positive step in this direction: there's more acknowledgment that business assurance is not a one-step effort, but a continuous journey to ensure long-term organizational success.

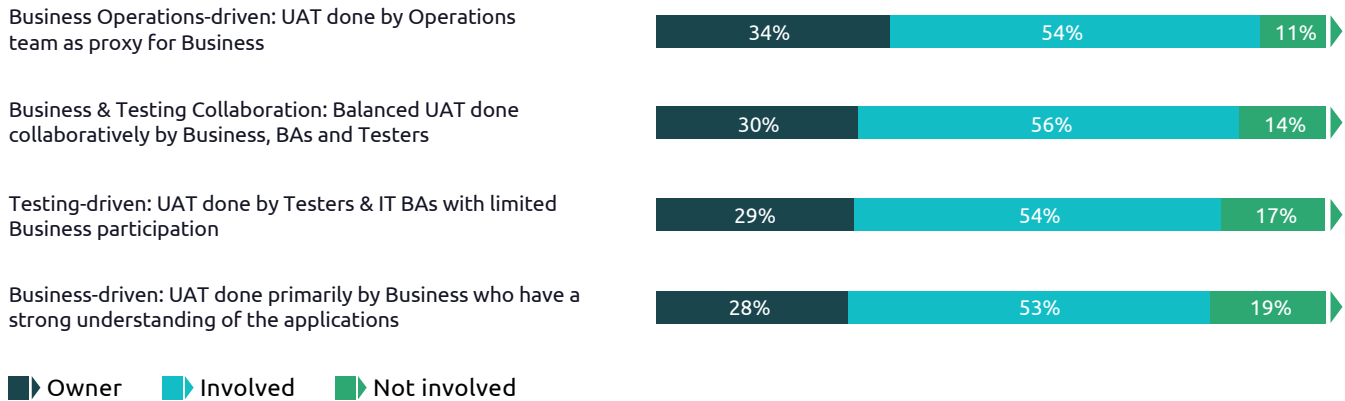
The fact that 58% of organizations are experiencing a shift in mindset and behaviors to get measurable business results, and 49% are building and sustaining customer trust by going beyond conventional testing KPIs, affirms this.

FIG 3

### QE involvement in Business Assurance testing

WQR 2023- Global Results

What is the involvement of QE in performing Business Assurance testing?



Question sample size = 314

Base: Those Who Selected "QA Testing/ Testing Manager AND Quality Engineers". Don't know excluded from base.

## IS THE CULTURE SHIFT AFFECTING THE ROLE OF A QE FUNCTION?

Interestingly, along with a change in priorities, the culture shift is also affecting the role of quality engineering (QE) and its function within the business.

We found that 56% of organizations are now successfully fostering collaboration between their business and testing teams to achieve a balanced approach to user acceptance testing

(UAT). This shows that both business stakeholders and testers are working together during the UAT process to drive value.

These findings also indicate how QE has evolved and integrated with business to successfully deliver business outcomes by meeting business standards and objectives and raising overall quality standards.

## TAKING A RELENTLESS ROAD TO CONTINUOUS IMPROVEMENT

It is encouraging to see that organizations are embracing the culture of QE and continuous improvement to remain effective, relevant, and aligned with the changing needs of the business environment.

Having said that, driving this improvement is not only about making incremental changes but it's also a strategic approach. Interestingly, this year's survey shows that 56% of the organizations are aligning strategic business goals, products,

and value streams, and 53% of organizations are leveraging fact-based, measurable methods and monitoring.

Overall, 49% of the organizations are measuring the numerous benefits of continuous improvement, including increased efficiency, quality, innovation, and customer satisfaction. Additionally, 38% of organizations are prioritizing continuous improvement by changing their business mindset and driving incremental change to be better positioned to adapt, thrive, and achieve their long-term goals.

What are the top three most important considerations when driving continuous improvement?



TOTAL n = 1750

## RECOMMENDATIONS AND SUMMARY

**1. Leverage the testing function to deliver business outcomes.** This will enable a fundamental shift in the organization's culture and mindset to ensure that business operation processes are aligned with business standards and objectives.

**2. Use value stream mapping to strengthen business assurance.** Align processes with customer objectives to mitigate risks, protect reputation, and further drive quality, reliability, customer satisfaction, and financial stability. Collectively, these factors create the conditions for improved business results and long-term success.

**3. Embrace change and foster a culture of continuous improvement.** Prioritize continuous improvement to drive incremental change for sustainable success. Set goals, evaluate solutions, and iterate for ongoing growth.

The scope of business assurance is massive and there is no one-size-fits-all solution when it comes to its application in enterprise processes. However, with mindful strategies that are hyper-focused on business outcomes, we can create thriving ecosystems that are ready to take on the future.



## AGILE QUALITY MANAGEMENT

- **JEFF SPEVACEK**

Head of Quality Engineering & Testing, Financial Services, Capgemini North America

- **KAVITHA VELCHAL**

Portfolio Manager, Testing Deal Architect for Global Sales Support Team, Quality Engineering & Testing, Capgemini Financial Services

- **RAMA YAMMANURU**

Principal, Quality Engineering & Testing, Capgemini USA

- **PARINITA PATANKAR**

Vice President, Quality Engineering & Testing, Sogeti India

- **BARRY WESTON**

Delivery Head of Quality Engineering & Testing, Sogeti UK

- **HITESH PATEL**

Region Practice Manager, Quality Engineering & Testing, Sogeti USA

- **AYAL COHEN**

Director, Product Management Functional Testing, OpenText

- **MOTTI FINE**

Product Manager, OpenText

- **OREN ZIV**

Product Manager, OpenText

*“Quality Engineering needs to take on a “Quality as Code” mentality. Instilling a higher degree of development capabilities into the team, so that they can more closely integrate with the overall development lifecycle”.*

- **IFTEKHAR IVAAN**

Head of Quality Engineering of a Major Global Bank

*“Quality requires more attention than ever because you are now on a massive growth path. People are moving towards more digitalization and you must ensure what you release or what you give to customers is of the highest quality”.*

- **SHIVAPRAKASH MOOLYA**

Manager, Quality Engineering, BUPA (UK)

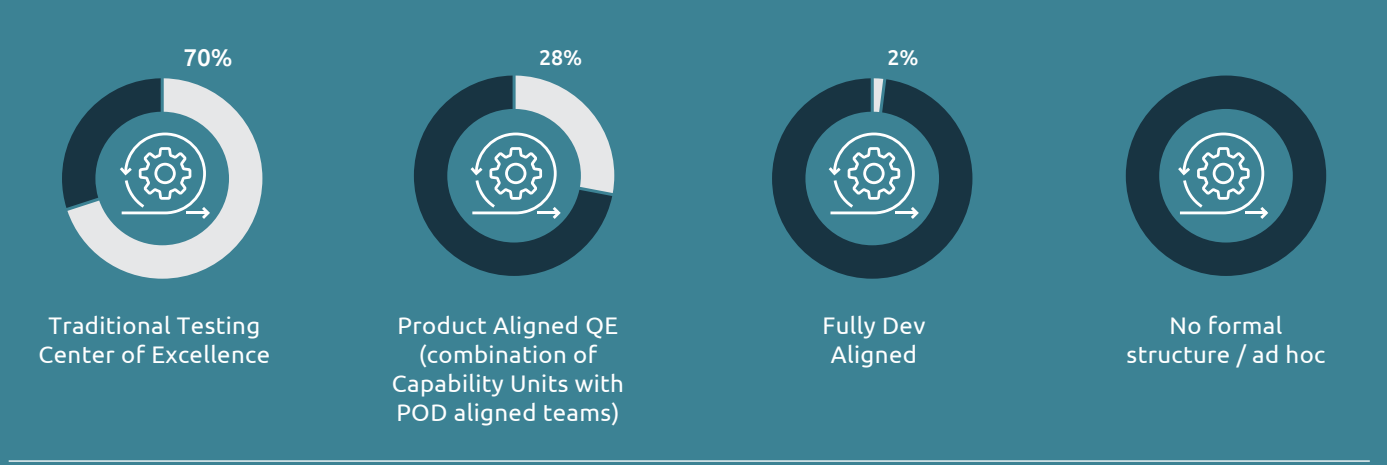
The concept of agile organizations has been a part of boardroom conversation over the past decade. Businesses continue to pursue the goal of remaining relevant in volatile, uncertain, complex, and ambivalent environments. Over time, this concept has evolved into much more than a mere development methodology. It has become a way of thinking and a mindset that emphasizes continuous improvement, adaptability, and customer-centricity. This evolution is clearly represented in the trends shaping agile quality management (AQM) practices today.

Last year, we noticed a paradigm shift in AQM through the emphasis placed on embracing agile principles rather than merely implementing agile methodologies. This year, we try to uncover how deep this understanding of agility runs.

## ARE BUSINESSES 'AGILE' READY?

**FIG 5** Setup of QE organization to support agile projects WQR 2023- Global Results

How is your Quality Engineering organization set up to support agile projects today?



**TOTAL n = 300**

*Base: Those Who Selected "IT Directors"*

The adoption of agile principles across the industry is beyond nascent stages and most organizations today are well into their agile and DevOps journey. However, the approach quality engineering organizations have taken varies; some have taken a ground-up approach, focusing first on workforce transformation, while others have taken a top-down approach, first choosing to re-structure their quality engineering (QE) organization from a process standpoint.

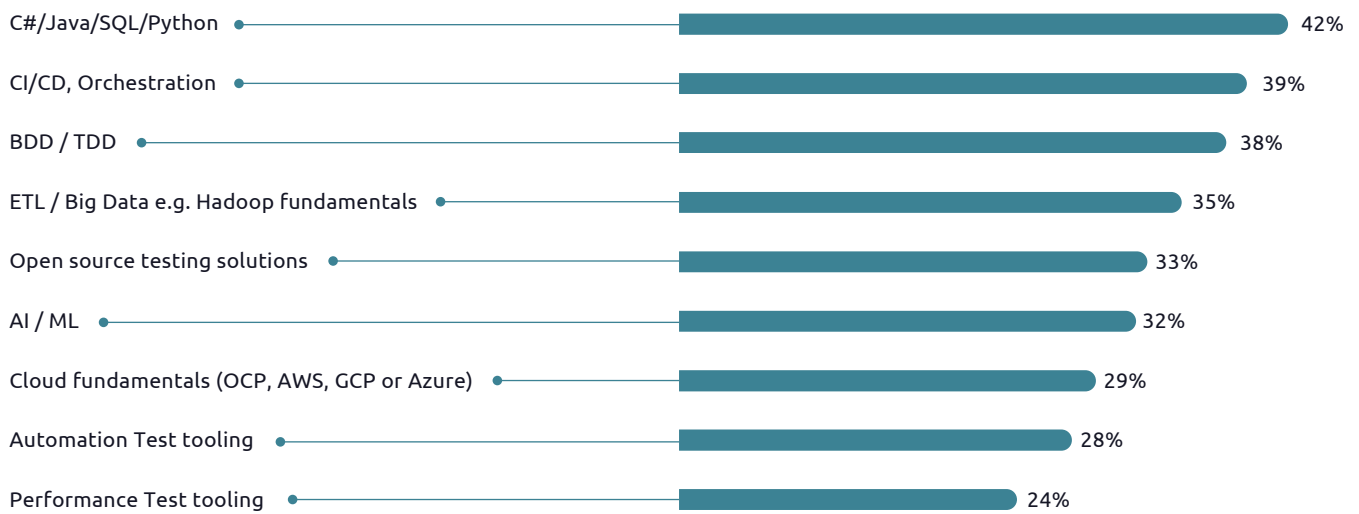
Organizations are now prioritizing development skills over traditional testing skills as the most critical skills for quality engineers. Development-focused skills like C#/Java/SQL/Python and CI/CD are all ranked in the top 5, while traditional testing skills like automation and performance tooling ranked at the bottom of the results.

Many organizations are undergoing some form of workforce transformation, evolving their traditional quality engineers into full-stack quality engineers. When looking at QE organizations through the lenses of organization setup and critical skills, it can be interpreted that most organizations are taking a grassroots or reactionary approach – choosing to upskill their team first and then focusing on change at an overall organization level.

## WE SEE THE QUALITY ENGINEER’S ECOSYSTEM EVOLVING

**FIG 6** Top five most critical skills for Quality Engineering Associates WQR 2023- Global Results

Please select the five (5) most critical skills for your Quality Engineering Associates.



TOTAL n = 580

*Base: Those Who Selected "VP Applications/ Product Owner AND QA Testing/ Testing Manager AND Quality Engineers"*

There is a clear trend that suggests a parallel evolution in the skills makeup of quality engineers. Initially automation-centric, the role has shifted towards a more development-oriented approach.

A quality engineer today is expected to support in-sprint development activities, with respondents citing development skills such as SQL/Python, CI/CD/Orchestration, and C#/Java as the most critical skills for quality engineers today.

The global survey of agile-oriented organizations revealed that 42% of the respondents felt scripting language like C#/Java/SQL/Python is the most critical skill required by today’s quality engineer, 39% voted for CI/CD and orchestration closely followed by BDD/TDD at 38%; compared to just 28% for automation tooling and 24% for performance tooling. While skills like ETL, open-source testing solutions, Artificial Intelligence (AI)/Machine Learning (ML), cloud, and tooling were considered important; the above-mentioned three stood ahead of the rest.

We feel this is in alignment with the industry’s continued focus on speed to market; as quality engineers continue to adopt more of a developer mindset, their ability to introduce automation earlier in the lifecycle increases as is their ability to troubleshoot and even remediate defects on a limited basis.

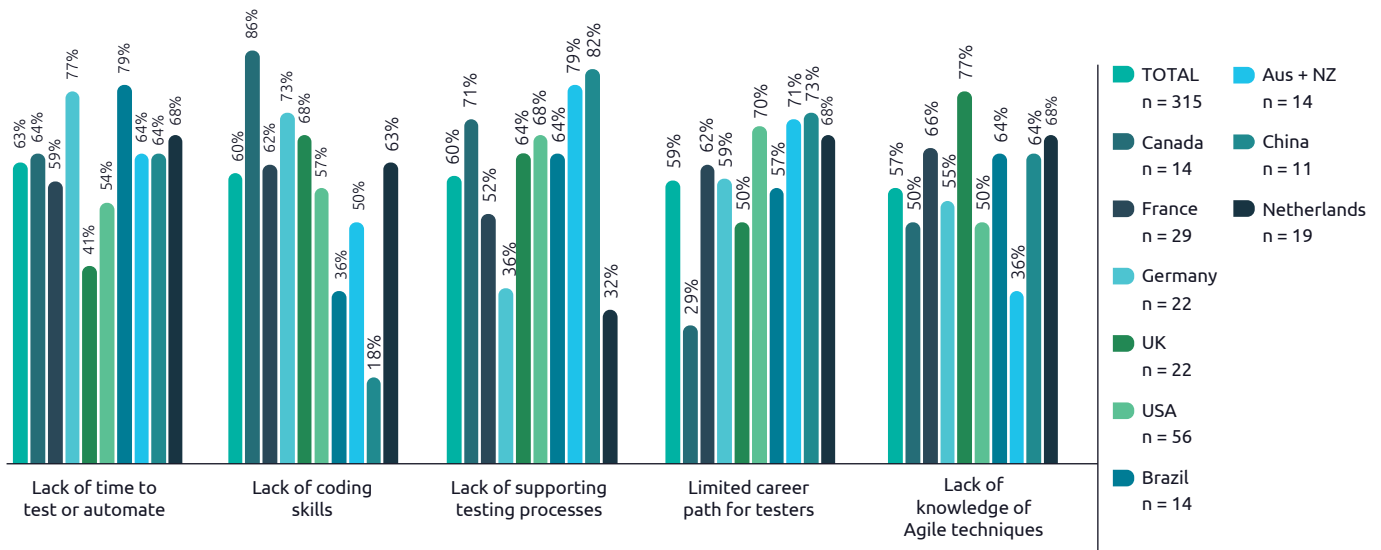
## HOWEVER, WITH EACH INDUSTRY TREND, A NEW SET OF CHALLENGES EMERGE

FIG 7

Major challenges faced by quality engineers in Agile projects

WQR 2023- All Countries Results

What are the major challenges faced by quality engineers in your Agile project?



Base: Those Who Selected "QA Testing/ Testing Manager AND Quality Engineers" At S1

Each region appears to have its own set of challenges which aligns with how the QE organizations are set up today. The US and Canada face similar primary challenges, with >65% of respondents confirming a general lack of supporting test processes; although 86% in Canada confirming a lack of coding skills, and 70% of US respondents confirming a limited career path. This is indicative that organizations are attempting to operate in traditional Testing Center of Excellence (TCoE) models even today. To stay competitive in the market, organizations are pushing to get new features and enhancements out faster, which puts a greater focus on speed to market instead of a long-term view on maintainability.

On the contrary, other regions like the UK reported a lack of knowledge of agile techniques (77%) as the most common challenge. This could indicate the speed at which these organizations moved into a product-aligned QE model while still trying to utilize their traditional testers.

Global survey results indicate all the above-mentioned challenges need to be addressed as more and more organizations "embrace" agility in the true sense.

## SHIFTING TO A PRODUCT-BASED QUALITY ENGINEERING SETUP MIGHT BE KEY TO OPTIMAL AGILE QUALITY MANAGEMENT PRACTICES

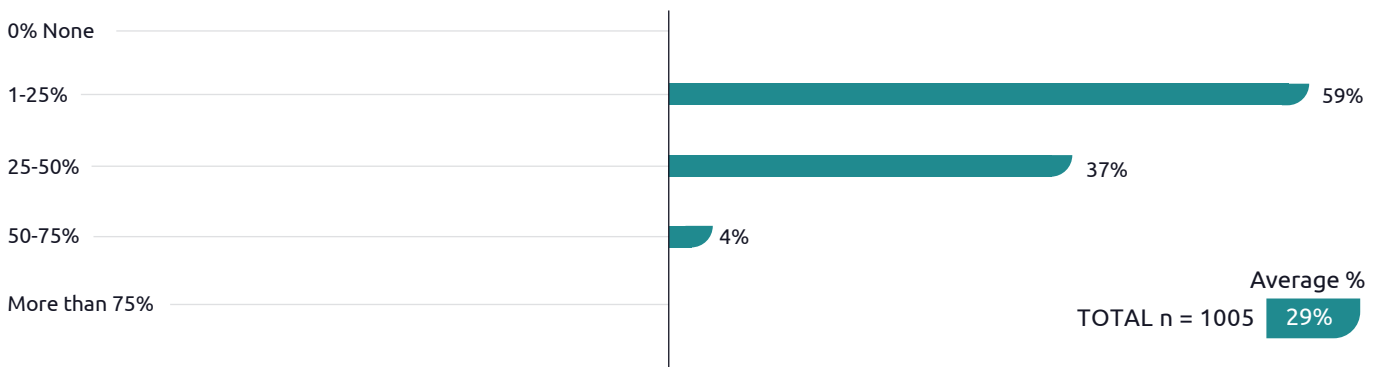
Many quality engineering organizations predicted the evolution and took a more proactive stance by shifting from a traditional 'Testing Center of Excellence' approach to a product-based quality engineering setup; however, most organizations are still in the process of truly integrating their quality engineering teams into an agile-centric model. As shown in the diagram above, only 4% of respondents report that more than 50% of their quality engineering teams are operating in a more agile-centric pod-based model.

The product-aligned QE organization setup enables organizations to diverge from centralized automation, test data, and performance testing teams to nimbler ‘capability units’, relieving the overarching burden on quality engineers. Apart from this, businesses might be able to maximize outputs through:

1. Customer-centric **design thinking**, which emphasizes rapid feedback and improves a business’s agility to inculcate an innovation mindset, aligned with customer needs.
2. Incorporating **Artificial Intelligence** and **Machine Learning** in test automation in a business tech ecosystem can also directly contribute to higher-quality outcomes by predicting issues, analyzing data, and enhancing testing efficiencies.
3. **Embracing agile practices** across the organization to promote better alignment and enabling seamless collaboration to achieve goals.

**FIG 8** Percentage of QE associates who are Agile POD aligned WQR 2023- Global Results

What percentage of your Quality Engineering associates are Agile POD aligned?



TOTAL n = 1005

*Base: Those Who Selected "VP Applications/ Product Owner AND QA Testing/ Testing Manager AND Quality Engineers AND Chief Information Officer"*

### CONSIDERING THE CURRENT LANDSCAPE, WE HAVE A FEW RECOMMENDATIONS FOR ENSURING AGILE ADHERENCE IN BUSINESS OPERATIONS.

**Invest in robust training programs:** Organizations must adopt a build-or-buy mentality – either looking for new talent in the market or upskilling their current workforce to meet the evolving demands of the business. Replacing the existing workforce will yield faster results but comes at the drawback of increased cost and reduced sustainability. Developing a robust training program reduces overall costs while setting your organization up to continue to adapt to the industry’s ever-changing technology and skillset requirements.

**Integrate with DevOps/DevSecOps:** Forging a seamless integration with DevOps/DevSecOps practices through close collaborations can ensure smooth incorporation of

quality engineering assets into CI/CD pipelines by identifying and rectifying issues promptly, enabling rapid and secure software delivery, and enhancing overall product quality and customer satisfaction.

**Modernize your QE organization:** Establish lightweight capability units for test process and governance, test automation, performance engineering, test data management, and test environment management to establish enterprise frameworks and tooling platforms. This will enable a capability for all approaches, empowering individual agile aligned teams to be more self-sufficient.

Now, more than ever, the role of quality engineering is elevating – quality engineering teams are asked to take on a more development-focused persona and build utilities for the rest of the organization to leverage rather than focusing solely on safeguarding quality. The evolution of agile practices, the

integration of AI and ML, and the synergy between DevOps and agile are transforming quality engineering in infinitely futuristic ways. The question is, when will organizations embrace these changes en-masse, adopt proactive strategies, and make them a norm? Next year’s report will probably unveil the answer.

## QE LIFECYCLE AUTOMATION

- **ANDREW FULLEN**, Head of Innovation and Technology, Sogeti UK
- **JEFF SPEVACEK**, Head of Quality Engineering & Testing, Financial Services, Capgemini North America
- **CHAITALI LAMBAT**, AI & Automation Lead, Quality Engineering & Testing, Sogeti India
- **AYAL COHEN**, Director, Product Management Functional Testing, OpenText
- **JULIAN FISH**, Director, Product Management, OpenText
- **VICKY GIAVELLI**, Director, Product Management, Performance Engineering and Virtualization, OpenText

Humankind has always been in the pursuit of simplifying work, and automation is probably one of the best fruits of this pursuit.

Today, as we notice accelerated paces of delivery that need lightning-fast development speeds and adherence to quality benchmarks - QE Automation holds the promise to deliver seamless results.

This year, we decided to probe its potential and extend our focus beyond functional automation and encompass the entire quality engineering (QE) lifecycle. We attempted to analyze the challenges in non-traditional automation areas to mirror those in conventional ones and to assess the far-reaching benefits of automation.

And even though we are charting unfamiliar territories like Artificial Intelligence (AI) and Machine Learning (ML) – we would echo what the English author Douglas Adams once said, “Don’t panic,” because we believe that with automation, we learn, we adapt, we benefit, and we will deliver.

Let us dive into the findings of this year’s World Quality Report (WQR) survey and its revelations for the near future.

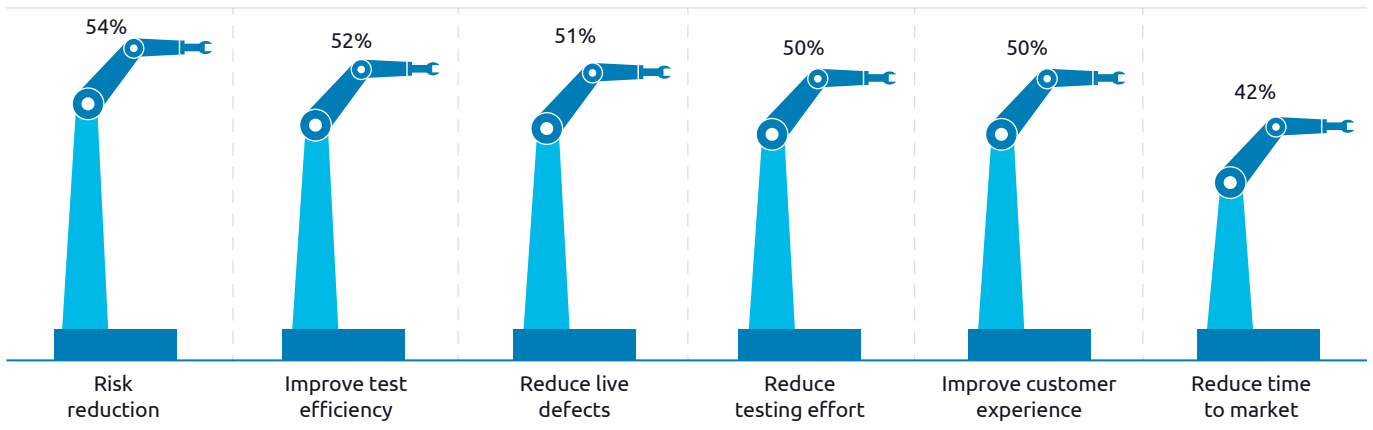
## WHAT IS EVERYONE EXPECTING OUT OF AUTOMATION?

FIG 9

Top benefits needed from automation

WQR 2023- Global Results

What are the top three benefits you need automation to deliver to your organization?



TOTAL n = 1750

It is interesting to note that the top benefits from automation this year include risk reduction (54% of respondents), improved test efficiency (52% of respondents), and reduced live defects (51% of respondents). We were surprised to learn that reduced time to market held the least priority at just 42% of respondents – while it had topped the list last year. We think the reason behind this could be that organizations are already moving as fast as they can and seeing less benefit in cutting time further. It is also

interesting to note that in a year where many organizations are freezing or reducing their IT spending, improved test efficiency and reduced testing effort came up as key priorities. This shift is a clear indication that organizations are starting to achieve their speed-to-market goals, and now more focused on reducing technical debt and overall spending on IT instead.

So, where are organizations placing their bets now?

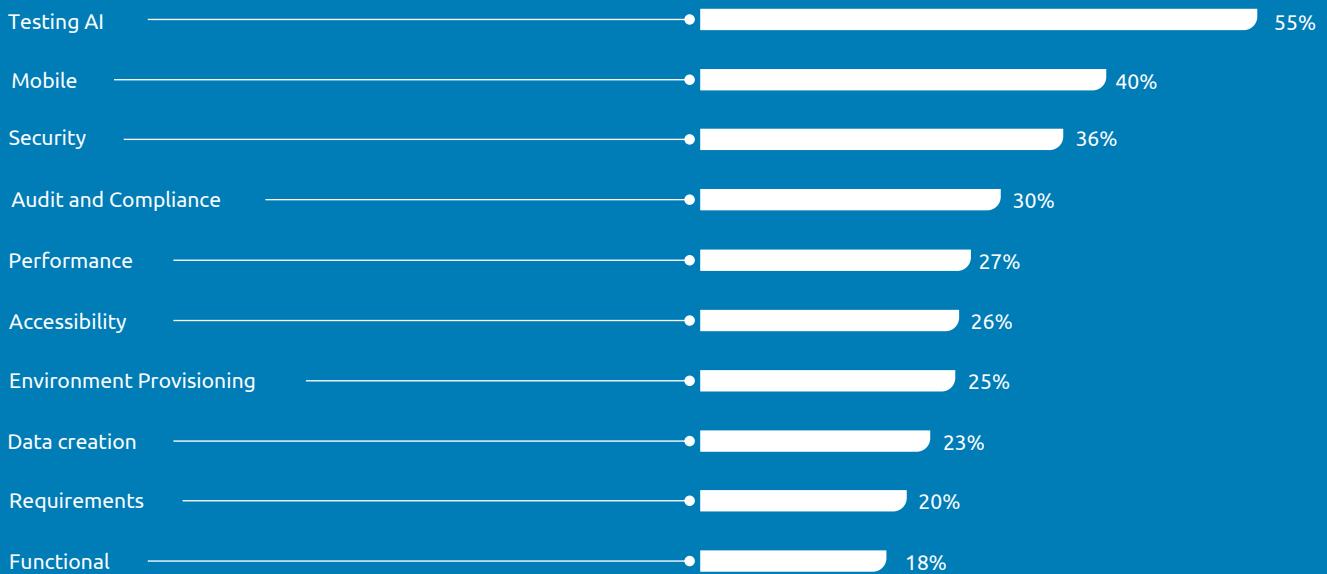
## ALL EYES ON AI

FIG 10

### Top three focus areas for automation

WQR 2023- Global Results

Which are the top three focus areas for automation in your organization over the 12 months?



TOTAL n = 1435

*Base: Those Who Selected "Chief Information Officer AND VP Applications/ Product Owner AND IT Directors AND Chief Marketing Officer OR Chief Digital Officer AND Chief Technology Officer/ Product Head AND VP OR Director Of Research AND Development/ Engineering"*

We were expecting AI to steal the limelight this year since it is the buzzword in the boardroom these days. We think that AI is the new tide that needs to be ridden with caution, which means quality engineering and testing (QE&T) teams need to understand how AI-based tools work for them, how they can do their jobs better, and bring better outcomes for their customers.

More than 50% of the respondents were eager to see testing AI with automation, which is well ahead of the other top focus areas like security and mobile.

Interestingly, we found that functional (18% of respondents) and requirements (20% of respondents) automation were of the least focus for organizations, presumably because of the challenges in automating and regular updating involved in these

areas. Perhaps, this is an area where we can expect to see AI tools becoming a key part of automation toolkits.

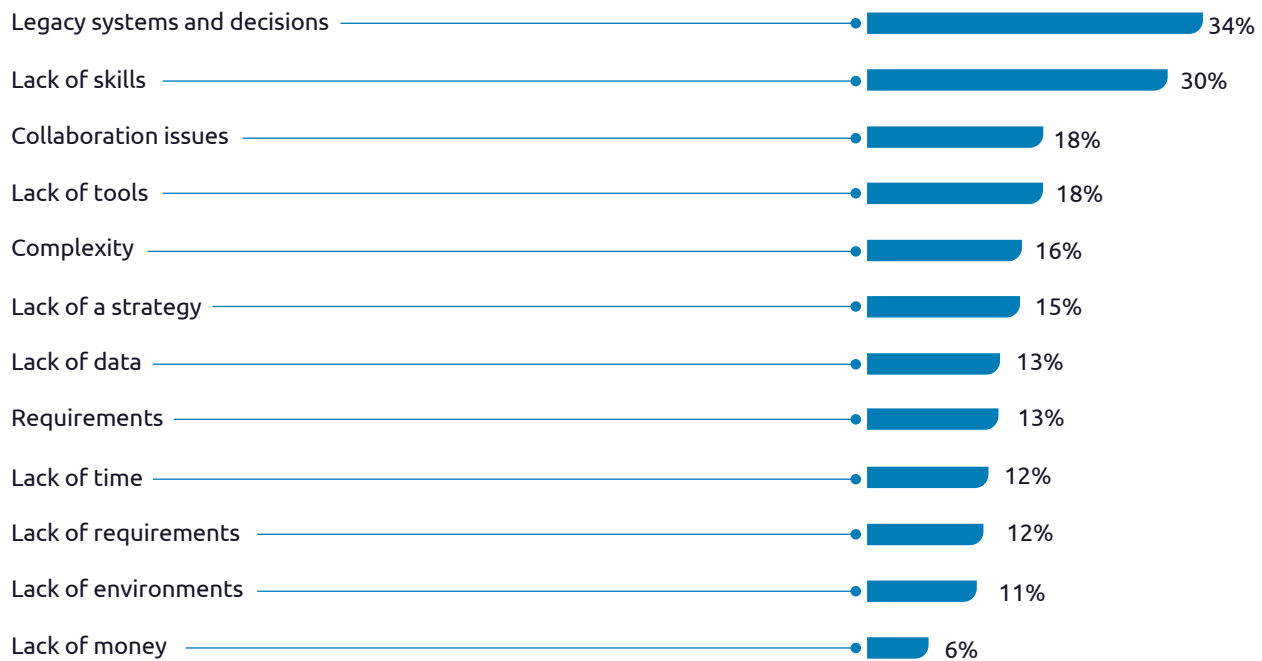
Closely following this, were security and mobile. With 36% of the respondents voting for security to remain a key focus area, we predict that risk reduction will continue to be a key benefit of automation. In a globally digitized economy, we are seeing end-user interactions dominating mobile devices, and mobile-first platforms taking precedence, as they will continue to do for the foreseeable future.

Another noteworthy trend was how respondents chose non-functional (performance and accessibility) over functional automation features, indicating more focus on customer experience.

## BUT EVEN AS AUTOMATION CONTINUES TO RUN DEEP IN ORGANIZATIONAL ECOSYSTEMS, THERE ARE DILEMMAS TO DECODE

**FIG 11** Main roadblocks to automation WQR 2023- [Global Results](#)

When it comes to doing more with automation, what are the two main things holding your teams back?



TOTAL n = 615

Base: Those Who Selected "IT Directors AND QA Testing/ Testing Manager AND Quality Engineers"

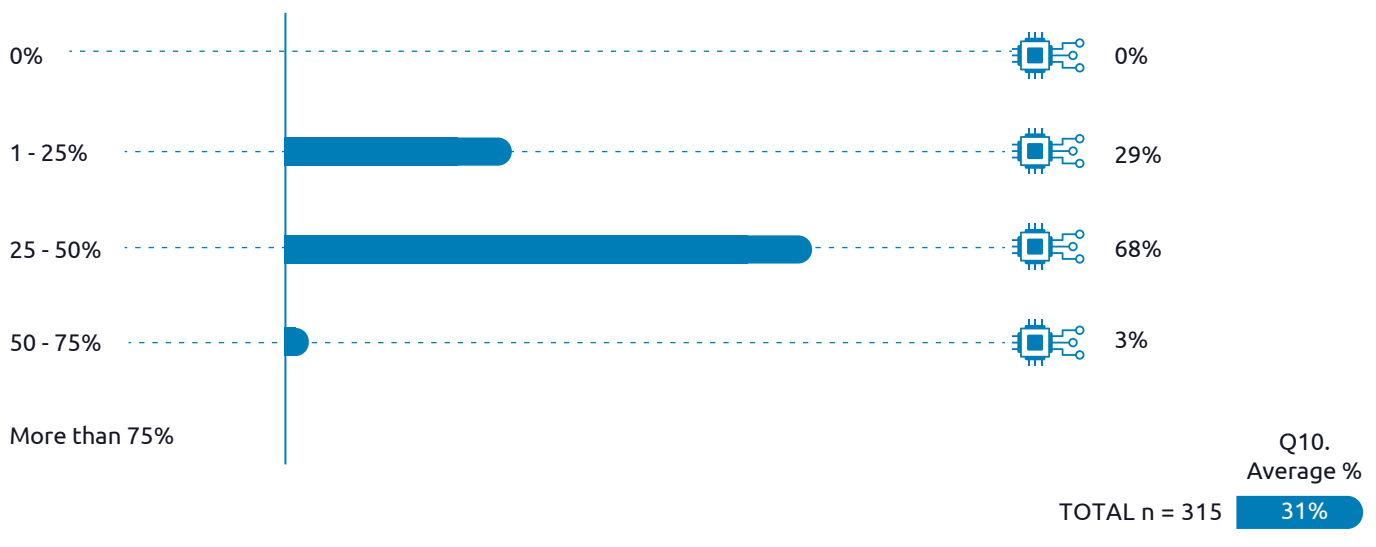


The WQR survey suggested that legacy systems and decisions (34% of respondents), followed by the lack of skills (30% of respondents) as the two things holding back automation. There is a continued need for developing technical skills to deal with both existing and upcoming technologies. But it was heartening to see that only 6% of the respondents claimed 'lack of money' as an issue, making it evident that organizations are ready to invest in automation when the strategy is right and return on investment is attractive.

## WE ALSO SEE AN URGENCY TO OPTIMIZE TEST SUITES

**FIG 12** Integration of automation test suites into pipeline WQR 2023- Global Results

What percentage of your automation test suites (smoke + regression) are integrated into your Orchestration / lifecycle / delivery pipeline?



TOTAL n = 315

Base: Those Who Selected "QA Testing/ Testing Manager AND Quality Engineers"

Overall, the survey revealed that only 3% of respondents' organizations have more than half of their suites integrated which may be due to diminishing returns or lack of QE access to orchestration instances. This comes as a surprise since most of the organizations now have some automated test suites integrated into their pipelines for smoke and regression testing.

*"This shift-left mentality has also given testers the opportunity to shift their testing farther left and lean more on automation as an early to potentially only solution. The idea of in-sprint automation vs. regression-only automation has become a reality".*

**CHAD FETTER**

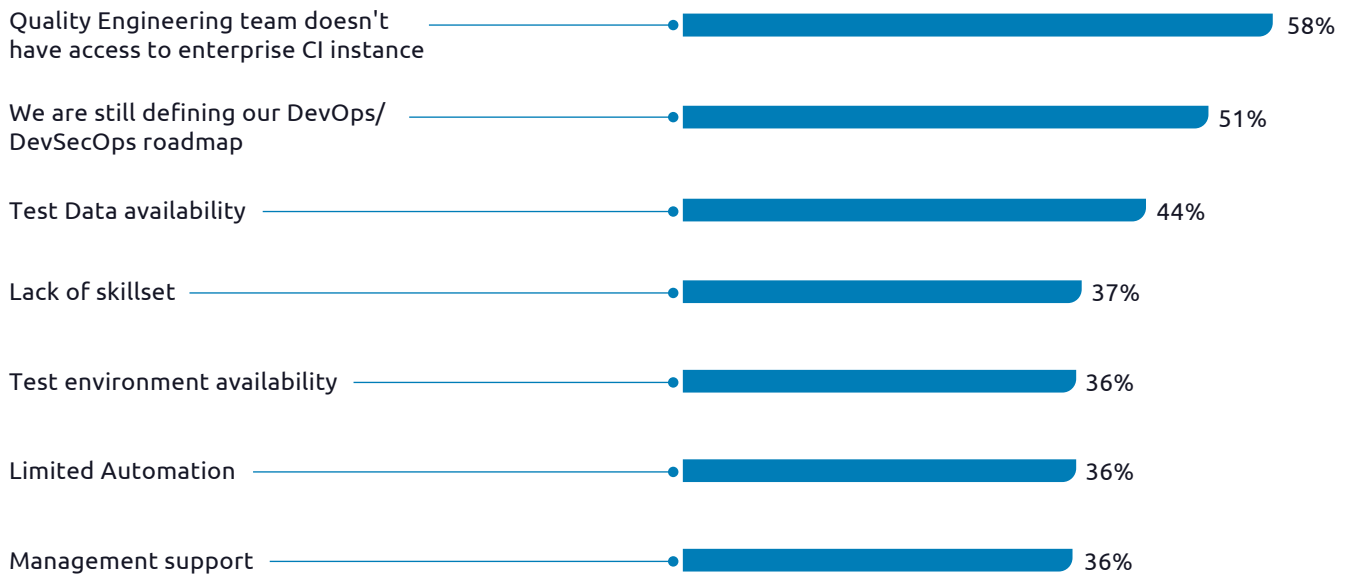
Director of Quality Strategy and Delivery, Medica

FIG 13

## Challenges preventing integration into DevOps / DevSecOps pipeline

WQR 2023- Global Results

What are the most impactful challenges preventing your Quality Engineering organization from integrating into the DevOps/DevSecOps pipeline?



TOTAL n = 750

Base: Those Who Selected "VP Applications/Product Owner AND QA Testing, Testing Manager AND Quality Engineers AND Chief Technology Officer/Product Head

58% of the respondents stated that quality engineering teams still do not have access to an enterprise CI for instance. This may be due to a lack of knowledge of legacy systems, stability issues of test scripts and high maintenance. Especially, since we know that increasing QE integrations into DevOps/DevSecOps lifecycle

requires greater collaboration between the development, quality engineering, and DevOps/DevSecOps teams. What was worth noting was that the more senior respondents (those furthest from the actual automation) reported higher levels of integration than those solely responsible for the work.

*"If you look at productivity, hyper-automation, zero-touch, and full end-to-end lifecycle automation, people still struggle to get there. I look at AI-augmented tool ecosystems that really help us automate and make your testing life cycle faster and better from a productivity side".*

**GANESH PRACTOOR**

Director - Quality Engineering Group at one of the world's leading financial organizations

## INABILITY TO ADOPT ADVANCED AUTOMATION SOLUTIONS

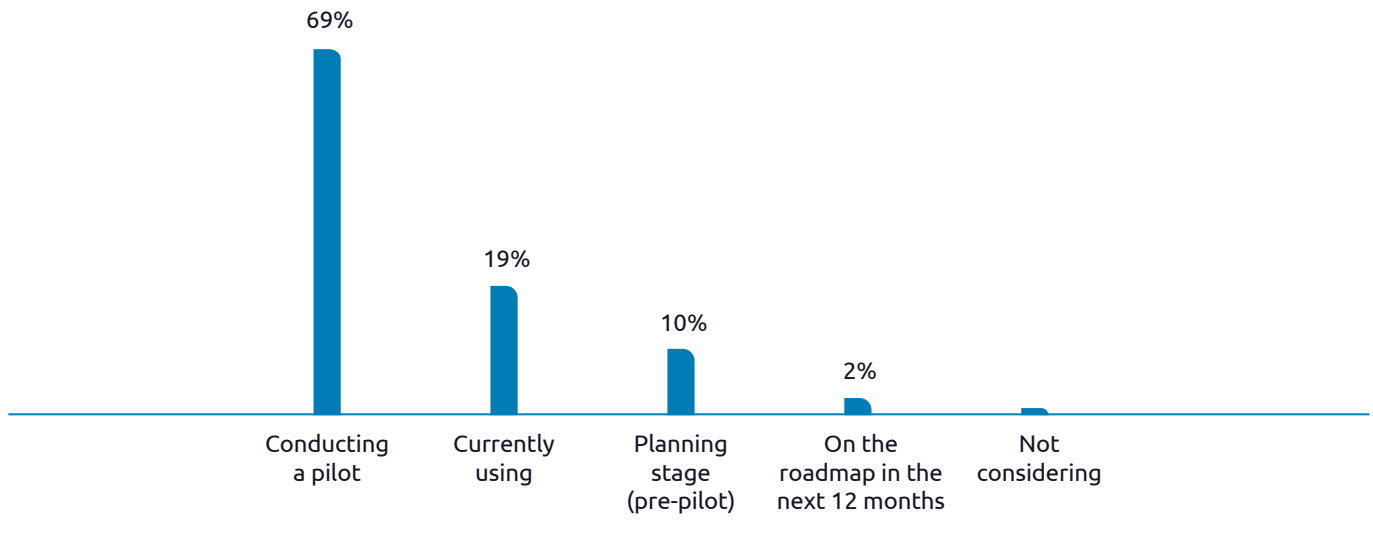
Despite the promises of low code/no code and automation-based frameworks, only 19% of respondents are currently using such tools, with nearly 70% of respondents at the stage of testing a pilot. While low-code type tools can allow an easier entry point into automation, there is still a long way to go before they truly challenge more traditional and feature-rich automation options, especially in terms of productivity and efficiency.

FIG 14

## Use of advance automation solutions

WQR 2023- Global Results

Are you using or plan to use advance automation solutions like Low Code/ No Code or AI-based automation frameworks?



TOTAL n = 315

Base: Those Who Selected "QA Testing/ Testing Manager AND Quality Engineers"

## RECOMMENDATIONS AND SUMMARY

While delivering good systems with quality is a priority, it also must be done in a timely manner. Quality engineering and testing teams must adapt to working with AI and testing AI systems. Even as lawmakers address the challenges of AI systems, there are already legal requirements to prove AI systems have been tested and are fair.

Considering legacy systems and decisions still have a major impact on automation teams everywhere. It is important to equip teams with the right skills to understand legacy systems and technologies, while also adapting and adopting AI systems – which by no means will be easy.

Our research leads us to the following recommendations to increase the value from your quality automation initiatives:

- **Continue to expand on what works** – don't adopt new automation technologies or platforms just because they are new or trendy. There is elegance in simplicity; continue using the frameworks and solutions that are providing value. When new solutions arise, evaluate them first before pushing for full adoption.

- **Automation can be prioritized against legacy systems** – focus on automating the test scripts and technologies which yield a larger and faster return on investment first. Once you have achieved the desired coverage, capability and speed to market goals; then move on to the more challenging technologies.
- **Upskill teams to use AI and to test AI systems** – AI-based systems are here to stay, whether used for testing or the focus of testing. Develop training plans and career pathways so that your organization knows how to leverage and test these systems.
- **Set up an Automation Marketplace platform** – enables an "automation as an asset" approach, empowering development, infra and business communities to leverage automation test scripts which have been created. Your automation engineers own the development and maintenance of the scripts while other teams integrate them into their daily routine.

## AI, THE FUTURE OF QE

- **JEBA ABRAHAM**

Practice Vice President, Quality Engineering & Testing, Sogeti USA

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- **CHAITALI LAMBAT**

AI & Automation Lead, Quality Engineering & Testing, Sogeti India

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- **SAI GRANDHI**

Associate Vice President, Quality Engineering & Testing, Sogeti USA

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- **UDI WEINBERG**

Director, Product Management, OpenText

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- **AYAL COHEN**

Director, Product Management Functional Testing, OpenText

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*“To be very simplistic, my experience and my view is that AI can do wonders for you, but not before you make yourself mature. You cannot jump in there prematurely because AI wants to take you from the mature level to the next level of excellence, not from the ground level. There are several use cases, real good use cases of AI implementation, but none of them will be helpful if you are not good at your basics”.*

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- **RAJESH NATARAJAN**

Senior Director, Quality Engineering at Hiscox

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*“We will need skill augmentation, we will need people who can operate bots, who know about the technology... The human workforce will not become obsolete with AI, instead, the expected skillset for them is going to change”.*

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- **AMITA KARADKHEDKAR**

Senior Vice President of Quality Engineering of a Major Global Bank

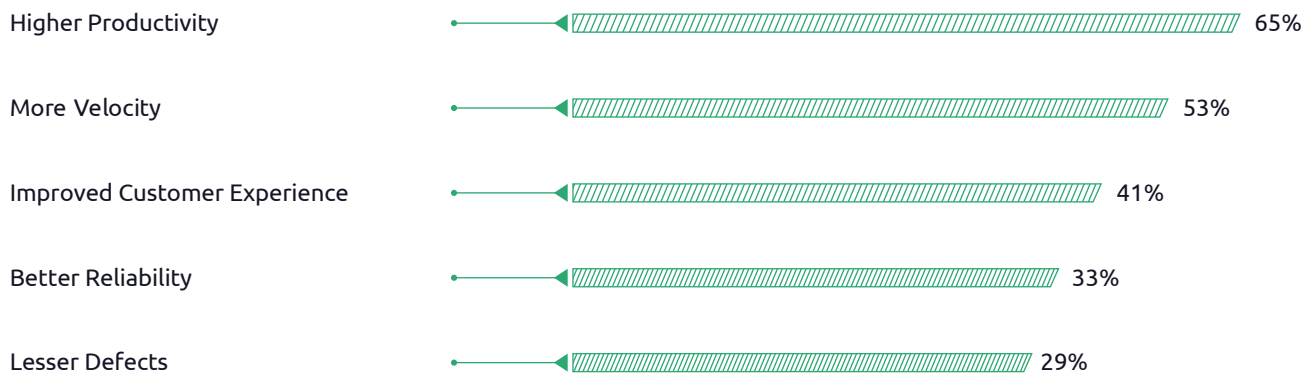
Artificial Intelligence (AI) is the most exciting technological advancement today. While the concept of AI is not exactly new, Generative AI is a game changer and has brought in an exciting revolution in how AI is applied across industries and organizations. So much so that one of the biggest pioneers of the technology industry, Bill Gates, in his blog 'The Age of AI has begun',\*\* he says, "The development of AI is as fundamental as the creation of the microprocessor, the personal computer, the Internet, and the mobile phone. It will change the way people work, learn, travel, get health care, and communicate with each other. Industries across the globe will reorient around it. Businesses will distinguish themselves by how well they use it." So, what does this mean for the future of quality engineering (QE)? Let's dive right in.

## HOW IS THE SCENE UNRAVELING?

We have been experimenting with AI to improve quality outcomes for a while now. However, with the advent of Generative AI, we see for the first time that higher productivity is the primary outcome organizations are using AI for, and we are not really surprised.

**FIG 15** Quality outcomes driven by AI WQR 2023- Global Results

What are the quality outcomes your organization is utilizing AI to drive?



//// TOTAL n = 750

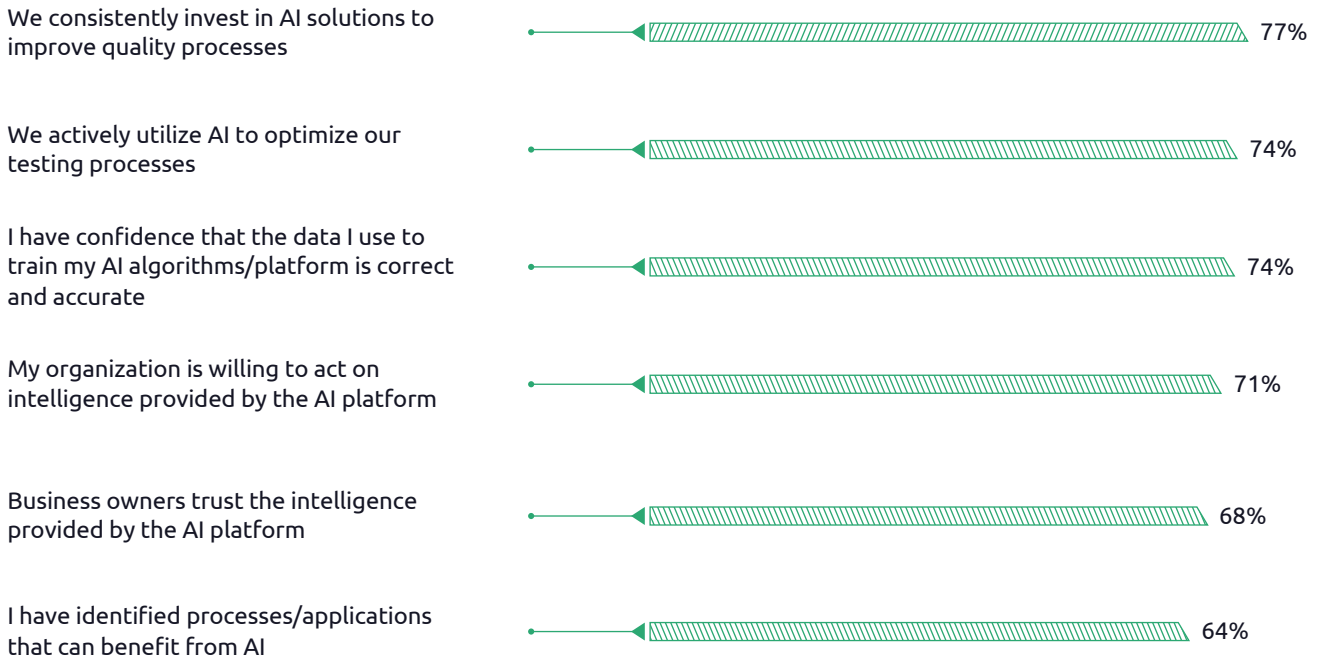
*Base: Those Who Selected "VP Applications/ Product Owner AND QA Testing/ Testing Manager AND Quality Engineers AND Chief Technology Officer/ Product Head"*

It's heartening to see data that shows us that 77% of organizations today consistently invest in AI and utilize it to optimize QA processes. We believe that this is directly linked to the fact that the trust in training data for AI solutions is very high, which in turn reflects the robust infrastructure and processes that organizations have developed over the years to collect continuous telemetry from all parts of the quality engineering process.

**Reference:**

\*\* [https://www.gatesnotes.com/The-Age-of-AI-Has-Begun?WT.mc\\_id=20230326130000\\_Artificial-Intelligence\\_BG-LI\\_&WT.tsrc=BGLI](https://www.gatesnotes.com/The-Age-of-AI-Has-Begun?WT.mc_id=20230326130000_Artificial-Intelligence_BG-LI_&WT.tsrc=BGLI)

Please indicate how much you agree or disagree with the below statements with regards to the use of AI in your organization.



TOTAL n = 1750

When we deep dive into what quality engineering use cases those AI investments are driving, we found that the majority of organizations are using AI towards building and improving test scope along with improving performance engineering, as well as the test ecosystem overall.

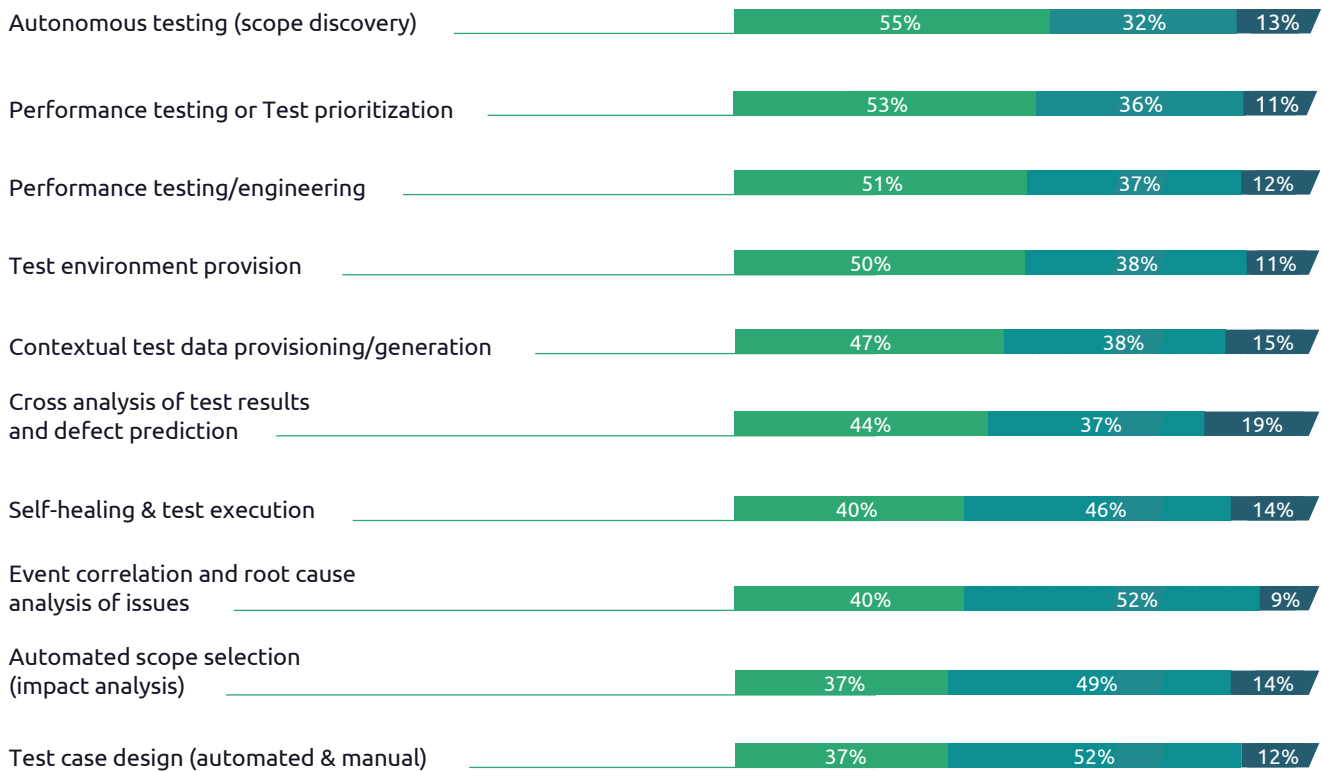


FIG 17

## Frequency of the use of AI in use cases

WQR 2023- Global Results

How frequently, if at all, has your organization used AI for the following use cases?



■ Used a lot   
 ■ Used on some occasions   
 ■ Have not used

Total sample size = 1750

## TRENDS THAT CAUGHT US BY SURPRISE

That said, there are some big changes in trends we need to delve deeper into. Reliability and fewer defects are at the very end of the list, which came as a big surprise for us. Improving the reliability of tests (be it rooting out stale tests or self-healing automated tests) and reducing the number of defects (defect analysis, defect prediction, risky code

analysis, etc.) have been focus areas for the application of AI to improve quality engineering for a while now. So, while it wasn't completely a surprise to see productivity be the top outcome organizations were aiming for, we didn't expect to see these two at the very bottom of the list. What's possibly causing this?

## WE THINK THERE COULD BE TWO FACTORS AT PLAY HERE:

1. With the availability of multiple large language models (LLM), the ability to achieve much higher productivity is possible now without too much effort. Higher productivity naturally leads to higher speed. Higher productivity and speed in the quality engineering process makes it possible to ship code more frequently with a high customer experience. Generative AI has drastically upended the cost vs. benefit equation for these use cases, effectively making them low hanging fruits, ripe for harvest.

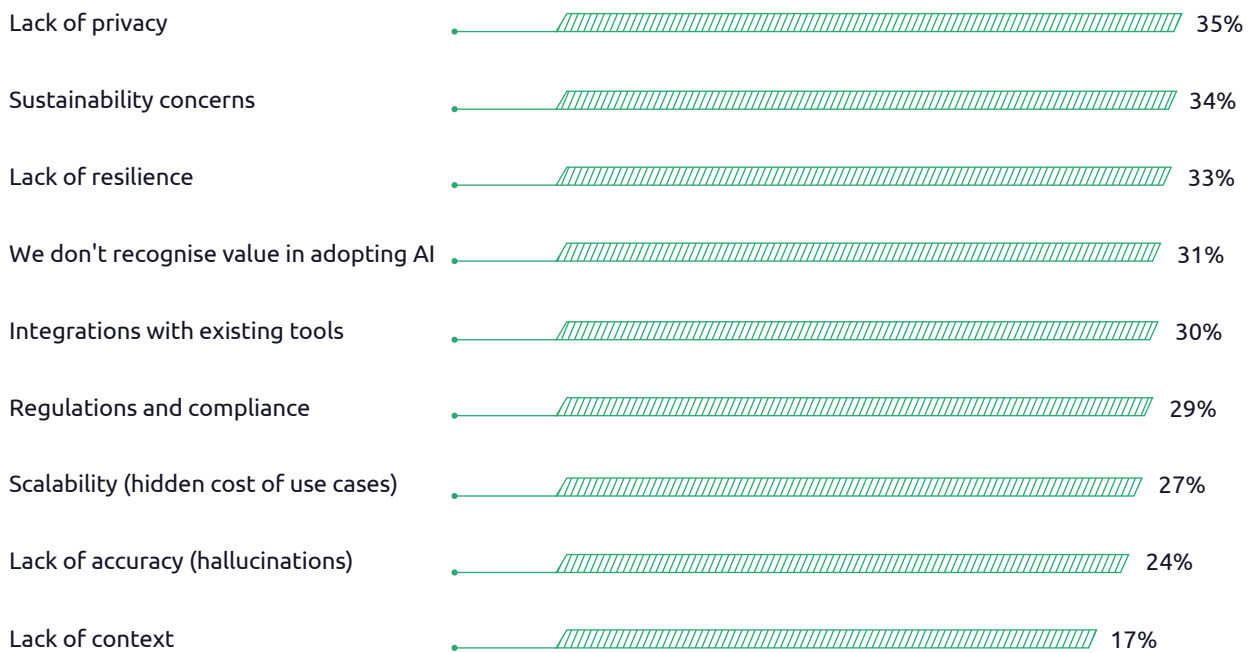
2. With Agile and DevOps practices being adopted across organizations, there is more continuous testing with multiple philosophies like “fail fast” and “perpetual beta” increasing the tolerance for defects being found, as long as they can be fixed quickly and efficiently. That said, it makes us wonder what (if any) additional changes we would be seeing in the survey next year, with the rapid evolution of AI technologies. This is definitely something to watch out for.

### SOME OLD ROADBLOCKS, SOME NEW

The survey data also suggests that there are multiple challenges for organizations to overcome while driving quality outcomes through AI. The roadblocks range from concerns on privacy and compliance to a lack of resilience and dealing with hallucinations and bias. We feel that the roadblocks to large scale AI adoption in QE haven’t changed too much over the years. Although organizations have learnt to deal with these roadblocks better, they haven’t all been completely overcome yet. With 77% of organizations investing in AI solutions, we feel that those solutions are coming very soon in the near future.

**FIG 18** Biggest roadblocks of Generative AI to improve quality WQR 2023- Global Results

What are the biggest roadblocks/ concerns on utilizing Generative AI to improve quality?



/// TOTAL n = 750

*Base: Those Who Selected "VP Applications/ Product Owner AND QA Testing/ Testing Manager AND Quality Engineers AND Chief Technology Officer/ Product Head"*

But, interestingly, 31% of organizations still don’t see the value in adopting AI yet. For this group, we assume that the costs/risks outweigh the benefits and that is a bigger roadblock to overcome. It will probably require sustained investment/effort to break past the barrier.



## WHAT WILL IT TAKE TO DRIVE SUCCESS IN THIS NEW AGE?

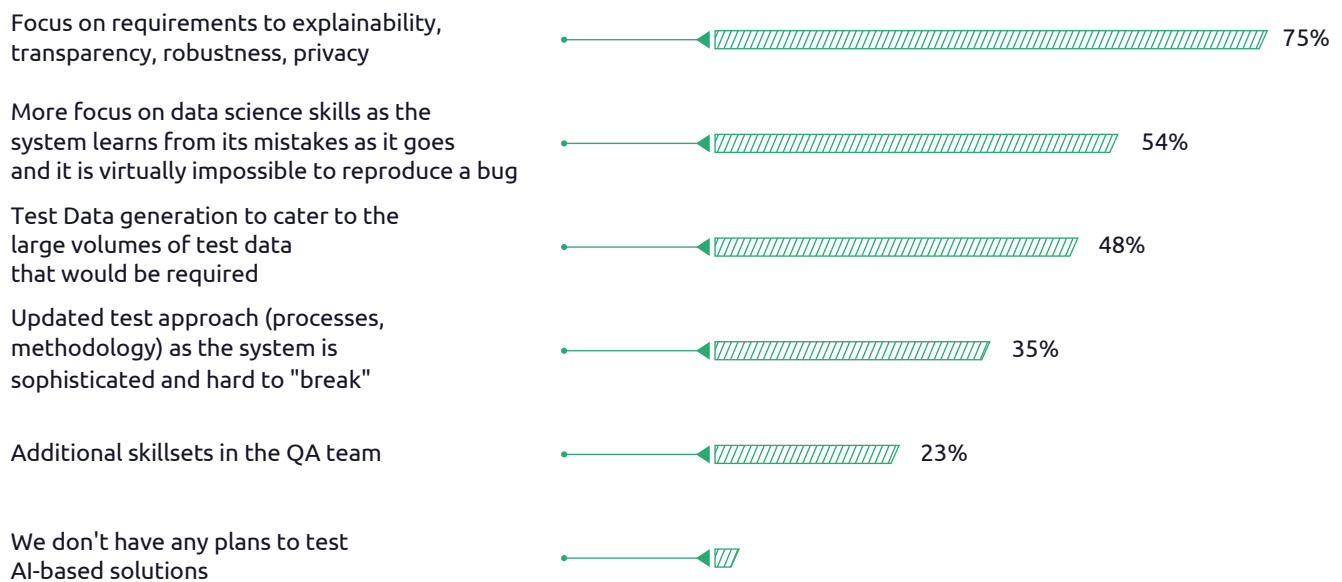
With the amount of investment in AI, there is bound to be a large influx of AI projects across organizations. Successfully testing these solutions and deploying them while ensuring high quality will be critical for driving success in the future.

FIG 19

### Plans for testing of AI-based solutions

WQR 2023- Global Results

How is your organization planning for testing of AI-based solutions?



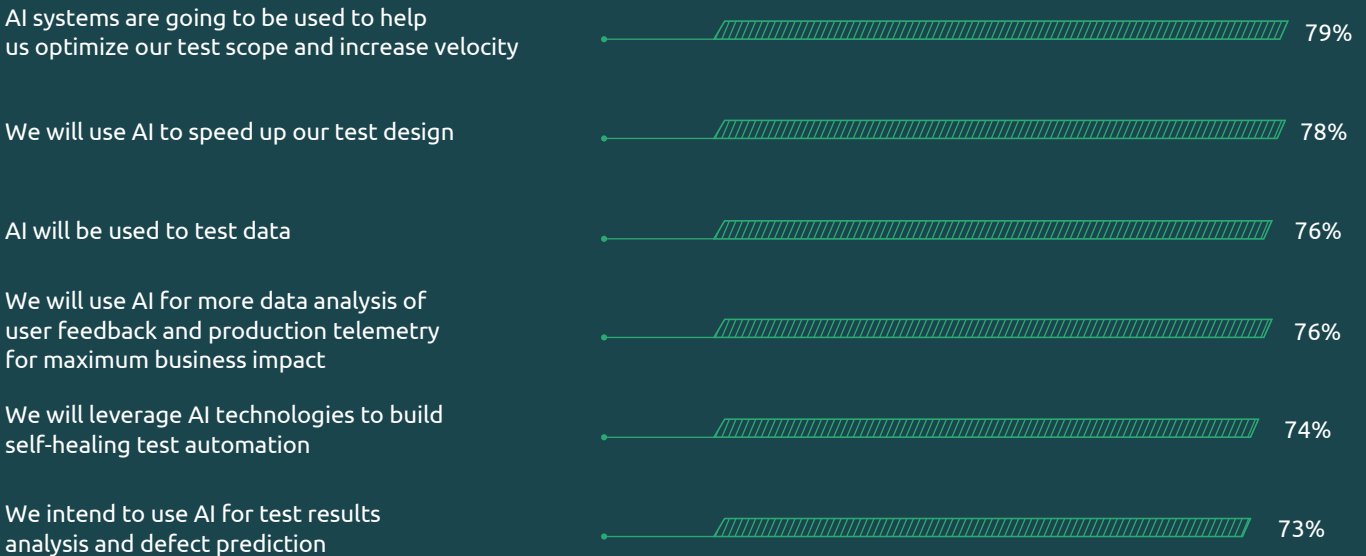
//// TOTAL n = 750

Base: Those Who Selected "VP Applications/Product Owner AND QA Testing/ Testing Manager AND Quality Engineers AND Chief Technology Officer/Product Head"

Our respondents overwhelmingly plan to focus on requirements related to transparency, robustness, and privacy of these upcoming AI solutions along with a continued investment in data science skills within their quality teams.

The other thing we see from the survey is that there is no clear winner when it comes to where organizations want to use AI to improve quality outcomes. Of course, AI can bring benefits to every tenet of the quality engineering lifecycle. We, however, feel that the approach needs to be treated with caution given the risk of things quickly going too far down the wrong path when it comes to AI solutions, unless they are robust enough to begin with.

Please indicate how much you agree or disagree with the following statements regarding your plans for artificial intelligence and testing.



TOTAL n = 750

Base: Those Who Selected "VP Applications/Product Owner AND QA Testing/ Testing Manager AND Quality Engineers AND Chief Technology Officer/Product Head"

## RECOMMENDATIONS AND SUMMARY

- Higher productivity driven by AI will rapidly increase the development speed and organizations need to continue the investment towards scaling the quality engineering process, skills, and bandwidth accordingly.
- Implementation of AI use cases in quality engineering will require careful thought and analysis for prioritization along with unambiguous KPIs measuring tangible outputs to drive successful transformation with AI.
- An iterative approach towards chosen/prioritized use cases along with an MVP strategy is recommended as there is going to be considerable experimentation around AI solutions in the near future with multiple unknowns that will get uncovered during the journey.

## QUALITY ECOSYSTEM

- **ASHWINI NADIGER**

Vice President, Portfolio COE Head for Quality Engineering & Testing, Capgemini North America

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- **ANISH BEHANAN,**

Head of Quality Engineering & Testing, Capgemini UK

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- **PADMAJA ALAPATI,**

Practice Lead, Quality Engineering & Testing, Sogeti India

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- **DEEPA TALWARIA**

Director, QEP Offer Lead, Quality Engineering & Testing, Capgemini USA

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- **KYLE ABRAHAM**

Associate Vice President, Quality Engineering & Testing, Capgemini USA

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- **LIOR URBANI,**

Functional Testing Product, Manager, OpenText

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- **AYAL COHEN,**

Director, Product Management Functional Testing, OpenText

*“Rapid technological advancements require QE teams to keep pace with testing new platforms, devices, and technologies. QE teams will need to invest in upskilling, and adopting advanced testing tools and methodologies while maintaining flexibility to adapt to the evolving tech landscape”.*

- **VYSHALI REDDY**

Senior Director, Mobile Quality Engineering (MQE), Charter Communications

*“It’s about testing to make sure that it works. Optimizing the customer journey and making sure that customers have an overall good experience and not just an accurate experience is important. So, whilst its obviously important that our customers get the right offer, we also want the customer experience to be as easy to navigate as possible”.*

- **MARK PAIN**

Head of Product Delivery, Volkswagen Financial Services, UK

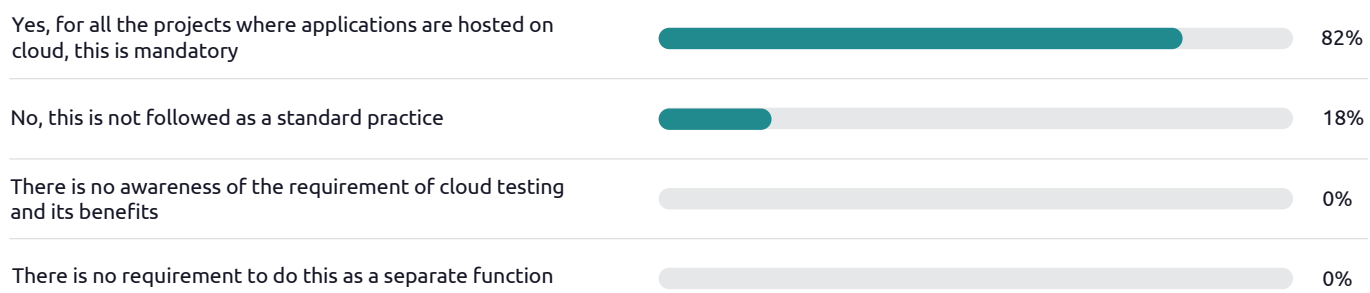
In the last few chapters, we pieced together various elements of the quality engineering (QE) landscape. However, to understand the 'quality ecosystem' in depth let us take a step back – or two and look at the bigger picture. The quality ecosystem comprises all the capabilities that enable effective testing of applications. This includes, but is not limited to, functions such as test environment management, test data management, etc.

Even as organizations continue to test and expand the quality ecosystem capabilities to hyper-focus on customer needs, we look at how emerging industry trends such as cloud testing and mobile testing impact the overall ecosystem. With site reliability engineering (SRE) increasingly being recognized as a necessary capability, and the eventual movement of workloads to cloud, we dive deeper to further understand the role of cloud testing and SRE in building exceptionally reliable and resilient software for the future.

## WITNESSING THE METAMORPHOSIS OF CLOUD TESTING

**FIG 21** Inclusion of cloud and infrastructure testing WQR 2023- Global Results

Does your organization include cloud and infrastructure testing as part of the development life cycle?



TOTAL n = 315

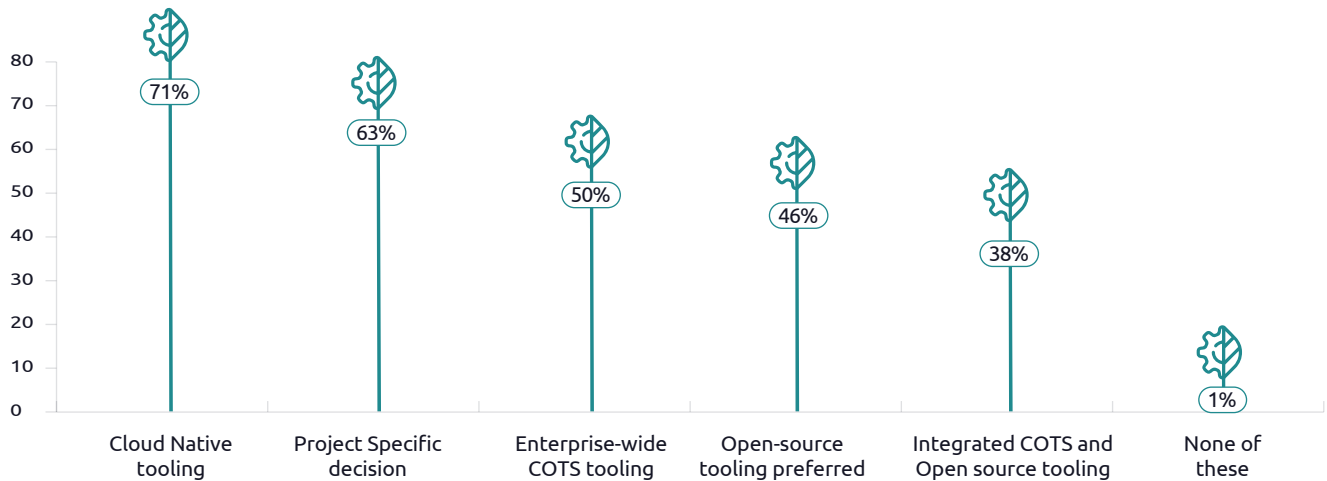
*Base: Those Who Selected "QA Testing/ Testing Manager AND Quality Engineers"*

Last year, our World Quality Report (WQR) reported that 57% of organizations considered cloud testing as a part of the software development lifecycle but not as a mandatory function. This year, however, 82% of the survey respondents highlighted cloud testing as mandatory for applications on cloud. This highlights a positive and decisive shift in the testing strategy that organizations are taking on cloud and infrastructure testing. It also demonstrates how important it is to test cloud-related features for functional and non-functional aspects of applications. This change in thinking is a result of organizations realizing that movement to cloud alone does not make the system available and reliable.

**FIG 22** End-to-end tooling plans for cloud testing

WQR 2023- Global Results

Which, if any, of the following end-to-end tooling plans for cloud testing do you have?



TOTAL n = 315

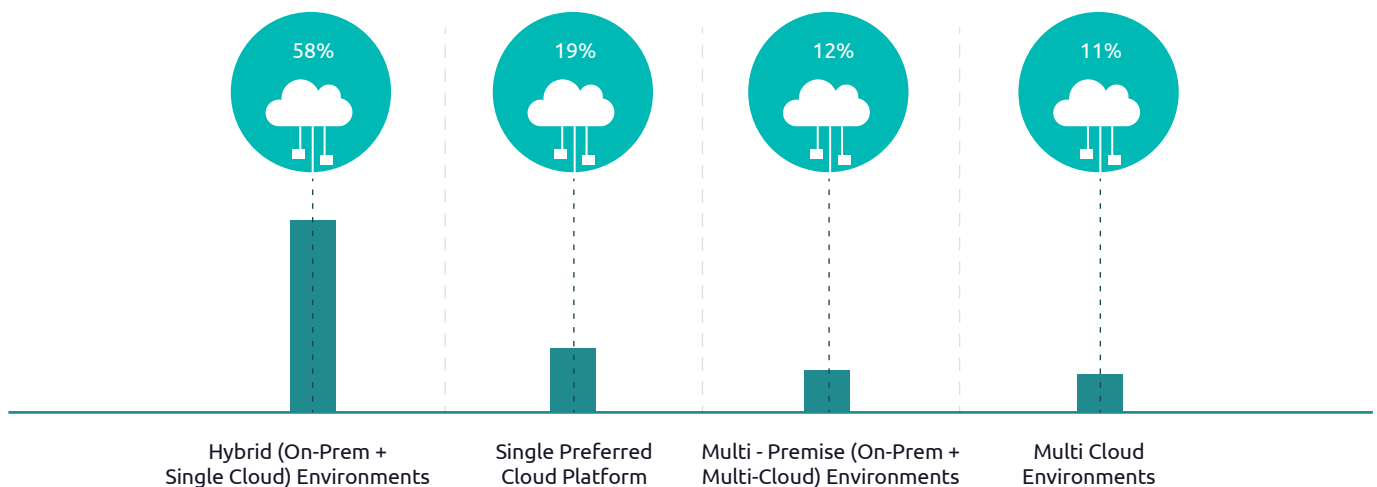
Base: Those Who Selected "QA Testing/ Testing Manager AND Quality Engineers"

This year's survey also highlighted that 71% of organizations prefer cloud native tooling (while only 50% prefer commercial off-the-shelf tooling) to perform cloud testing, thus, alluding to the ease of using the former when workloads are using a specific cloud platform.

**FIG 23** Cloud platform strategy for provisioning non-production environments

WQR 2023- Global Results

What is your cloud platform strategy for provisioning non-production environments?



TOTAL n = 315

Base: Those Who Selected "QA Testing/ Testing Manager/ Quality Engineers"

Interestingly, a hybrid cloud strategy seems like another upcoming trend since many organizations are using this approach for their non-production environments over single cloud platforms. We think the shift to a hybrid cloud strategy is from a multi-cloud and a multi-premise model point-of-view and is driven by cost-related decisions. Nonetheless, with almost 58% of organizations adopting a hybrid cloud (single cloud platform along with on-premises environments) strategy this year, we think this trend stands to become the mainstream in the next few years, even though 19% of organizations still prefer single cloud platforms to provision non-production workloads.

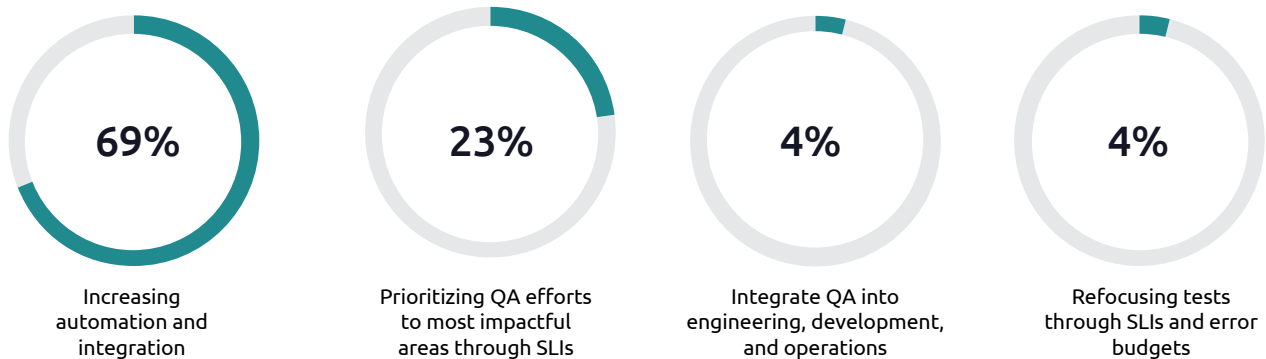
But as more organizations jump onto the cloud wagon, a question looms large – what is the point of an immaculate cloud-hosted site, if it's unreliable?

## EMERGENCE OF SITE RELIABILITY AND CHAOS ENGINEERING

The applications hosted on cloud could be impacted by the unexpected turbulence and outages of the cloud services. An hour-long Microsoft Exchange Online outage in March 2023 and a fire that wreaked havoc for Google Cloud users in Europe are a few major examples in recent times. Such incidents have given way to focus on site reliability and chaos engineering.

**FIG 24** Embracing the transformation that SRE can bring WQR 2023- Global Results

How are your QA teams embracing the transformation that SRE can bring in designing performant software and scalable practices?



TOTAL n = 1040

Base: Those Who Selected "QA Testing/ Testing Manager AND Quality Engineers AND IT Directors AND Chief Information Officer"

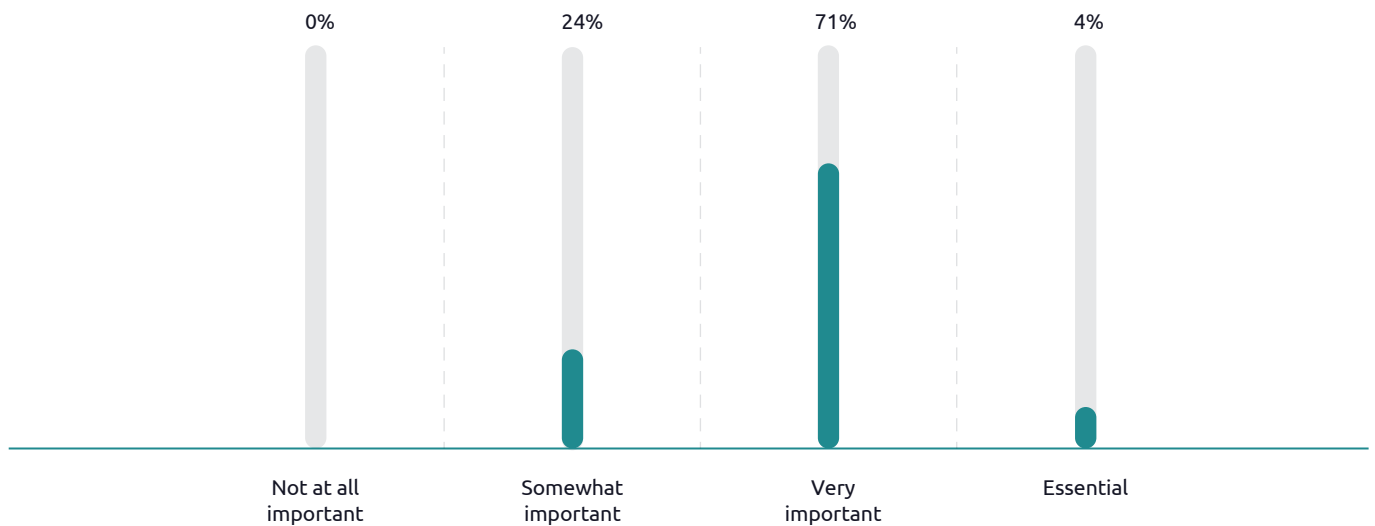
Site reliability engineering (SRE) applies engineering to operations, aiding automation, and integration from a quality perspective, and 69% in this year's survey emphasized this. While organizations seem to recognize that SRE offers transformative potential in design, scalability, and its features offer enhanced automation and integration to boost app reliability, the lack of a skilled workforce remains a pressing challenge to tackle.

FIG 25

## Importance of testing impact of failure events

WQR 2023- Global Results

How important is it in your organization to test the impact of failure events on applications running on cloud especially using chaos engineering?



● TOTAL n = 1040

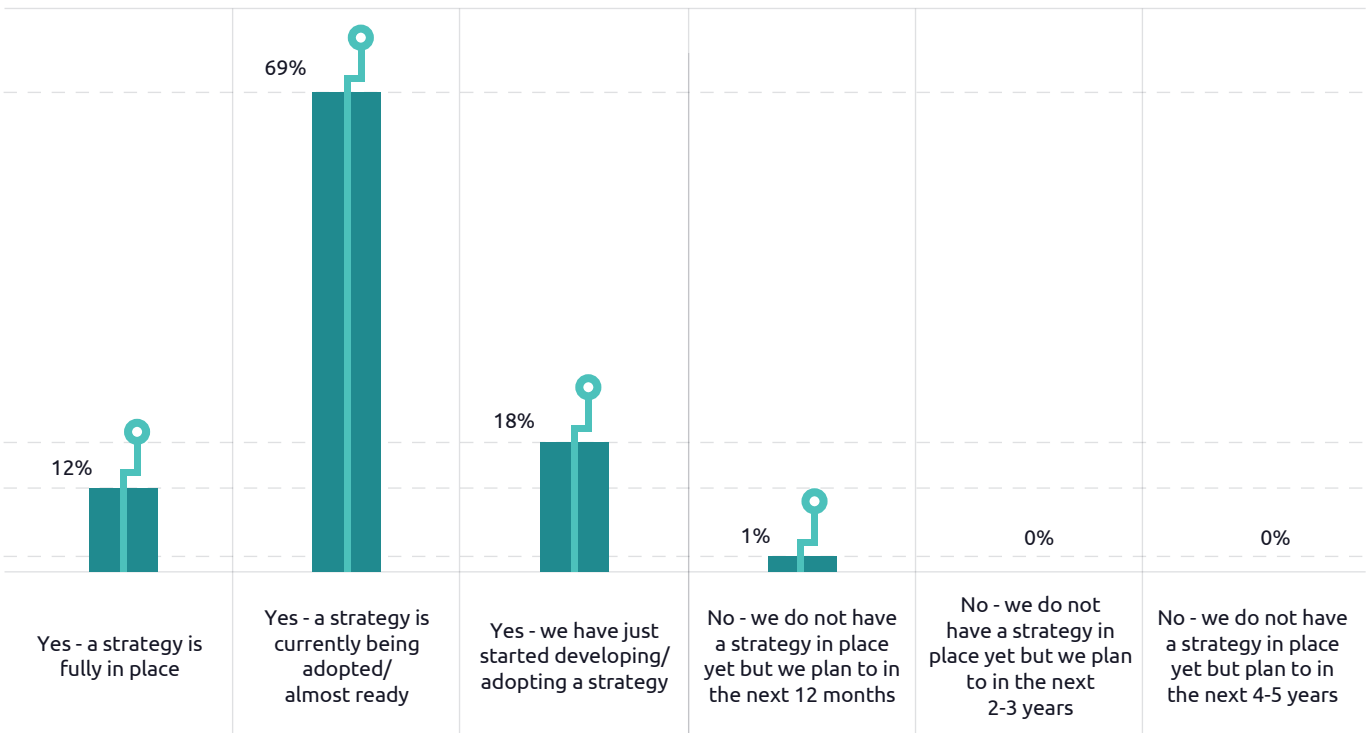
*Base: Those Who Selected "QA Testing/ Testing Manager AND Quality Engineers AND IT Directors AND Chief Information Officer"*

Simultaneously, we see a rise in the importance of testing failure in cloud events, with 71% of respondents calling it 'very important.' This brings chaos engineering into the scene. Most Quality Assurance (QA) organizations today are adopting it along with performance engineering to validate if applications hosted on cloud can handle any unplanned infrastructure outages, service, or configuration changes gracefully without impacting the end-user experience significantly. Hence there is an increasing need for QA organizations to adopt chaos engineering practices and tools to support their customers.

# OTHER TRENDS THAT HAVE OUR ATTENTION: ENTERPRISE LEVEL TEST DATA STRATEGY, MOBILE APPLICATION TESTING, AI (ARTIFICIAL INTELLIGENCE) AND MORE

**FIG 26** Adoption of enterprise-wide data provisioning strategy WQR 2023- Global Results

In your organization, is there an enterprise-wide data provisioning strategy adopted as a standard across all line of business / projects?



**TOTAL n = 1040**

*Base: Those Who Selected "QA Testing/ Testing Manager AND Quality Engineers AND IT Directors AND Chief Information Officer"*

It is understood that effective test data management is vital in the test ecosystem. The growing demand for end-to-end automation highlights the need for abundant, on-demand test data. This year, 69% of organizations adopted or prepared for an enterprise-wide test data provisioning strategy—a significant leap from last year’s 31%. Data privacy remains crucial, yet 61% of organizations overlook integrating test data provisioning with delivery pipelines. This challenge hinders the provision of suitable test data at the pace of automation.

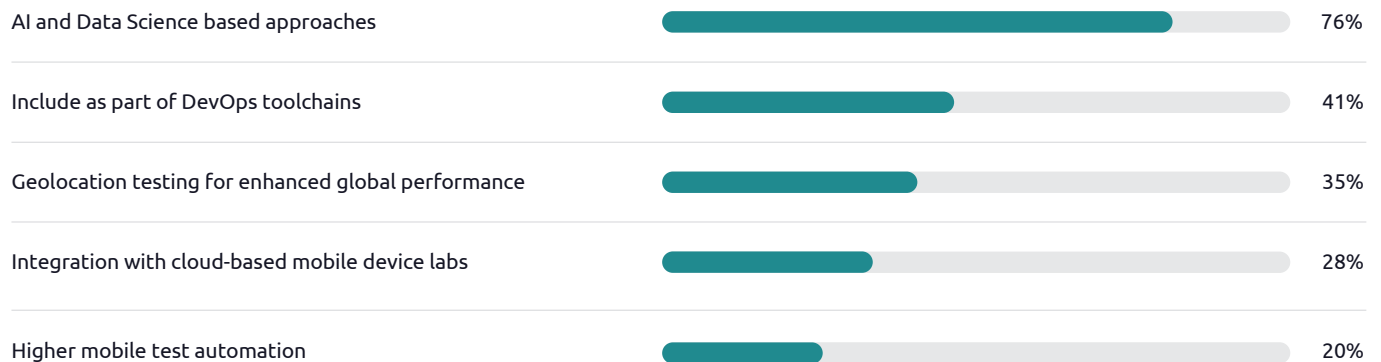


FIG 27

## Making mobile application testing more effective

WQR 2023- Global Results

What steps are being taken by your organization to make mobile application testing more effective?



● TOTAL n = 315

Base: Those Who Selected "QA Testing/ Testing Manager/ Quality Engineers"

And talking about data management in an ever-increasing digitized world without mentioning mobile app testing would be unmerited. It's no surprise that 76% of organizations are adopting mobile app testing to optimize testing across countless device variants while employing AI and data science. Cloud-based automated testing with AI/ML techniques has further refined testing efforts for diverse mobile devices worldwide.

## WHAT SHOULD ORGANIZATIONS FOCUS ON?

It is great to see that more organizations are moving non-production environments to cloud even though it is more concentrated on a hybrid strategy. Organizations increasingly embracing SRE and leveraging chaos engineering and AI-data science approaches to specialized testing is also a move in the right direction.

### Our recommendations and summary:

- **Accelerate the inclusion of cloud and infrastructure testing** as part of the software development lifecycle, to improve resiliency, security, redundancy, and data recovery.
- **Continue to consider intelligent integrations** (including customizing specific features) to make the best use of commercial off-the-shelf and cloud native tooling – as a hybrid strategy for non-production environment provisioning.
- **Adopt stringent practices to test the impact of failure events** on cloud and continue to give extremely high priority to the performance and resiliency of applications on cloud.
- **Invest on workforce transformation** in building SRE and chaos engineering capabilities within quality engineering organizations to embrace and support the emerging trends in digital and cloud migration strategies of the customers.

## DIGITAL CORE RELIABILITY

- **JEBA ABRAHAM**, Practice Vice President, Quality Engineering & Testing, Sogeti USA
- **STEFAN GERSTNER**, Vice President, Quality Engineering & Testing, Sogeti
- **KHUSRO SIDDIQUI**, Director, SAP Business Assurance, Capgemini USA
- **SHASHANK LOKHANDE**, Senior Director, Quality Engineering & Testing, Sogeti India

In the last few decades, the world has undergone a transformative journey propelled by an unparalleled force: digitalization. This sweeping phenomenon, characterized by the integration of digital technologies into various aspects of human life and industries, has reshaped our societies, economies, and interactions at a pace that defies historical norms.

When the COVID-19 pandemic broke out, much of the world moved online, further accelerating digitalization at a breakneck speed\*.

The accelerated adoption of digital technologies, primarily driven by the necessity to keep functioning during a global pandemic has transformed our world forever. A simple metric is digital payments. In Asia alone, the number of digital payments has increased by 300% between 2017 and 2023\*\*. Needless to say, the digital core - technology platforms and applications that enable organizations to transform into digital businesses - requires thorough testing to enable success in the digital marketplace of the future.

## UNEARTHING THE CORE OF IT ALL: TESTING, PROCESSES, AUTOMATION, AND MORE

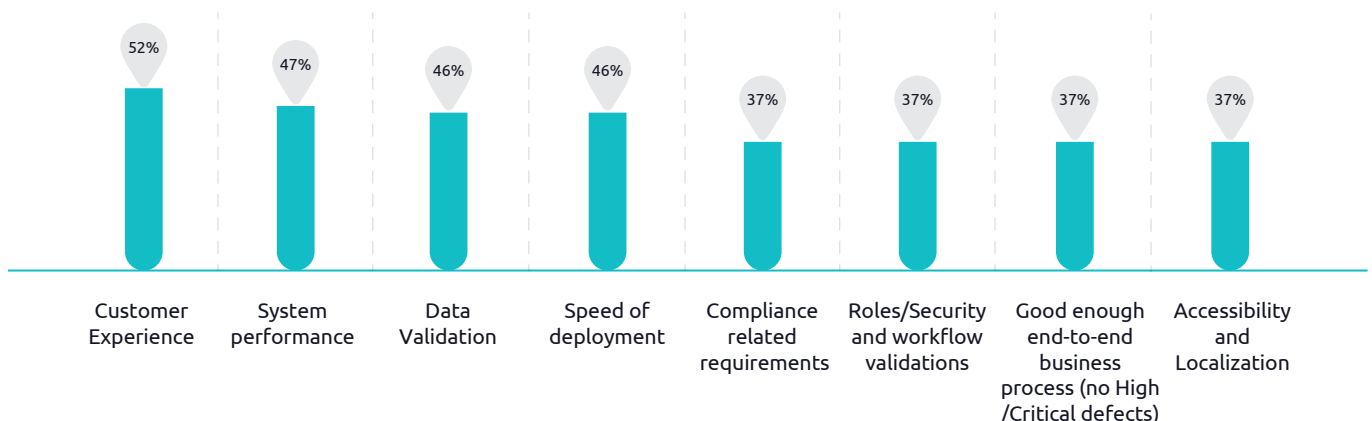
We looked at quality engineering and testing trends across organizations around the digital core. Some of the findings were expected – like the most important focus areas when testing digital solutions are customer experience and system performance (directly impacting the usability of the platform/solution). This reiterates the fact that the digital core is all about building experiences and solutions, delighting, and retaining customers and driving growth. It also underlines the importance of being able to act in a swift way on market opportunities while ensuring clients' digital happiness.

FIG 28

### Most important when testing 'digital core' solutions

WQR 2023- Global Results

What is most important to your organization when testing 'digital core' solutions?



TOTAL n = 750

Base: Those Who Selected "VP Applications/ Product Owner AND QA/ Testing Manager/ Quality Engineers AND Chief Technology Officer/ Product Head"

#### References:

\*<https://www.oecd.org/digital/digital-economy-outlook-covid.pdf>

\*\* <https://www.statista.com/outlook/dmo/fintech/asia#transaction-value>

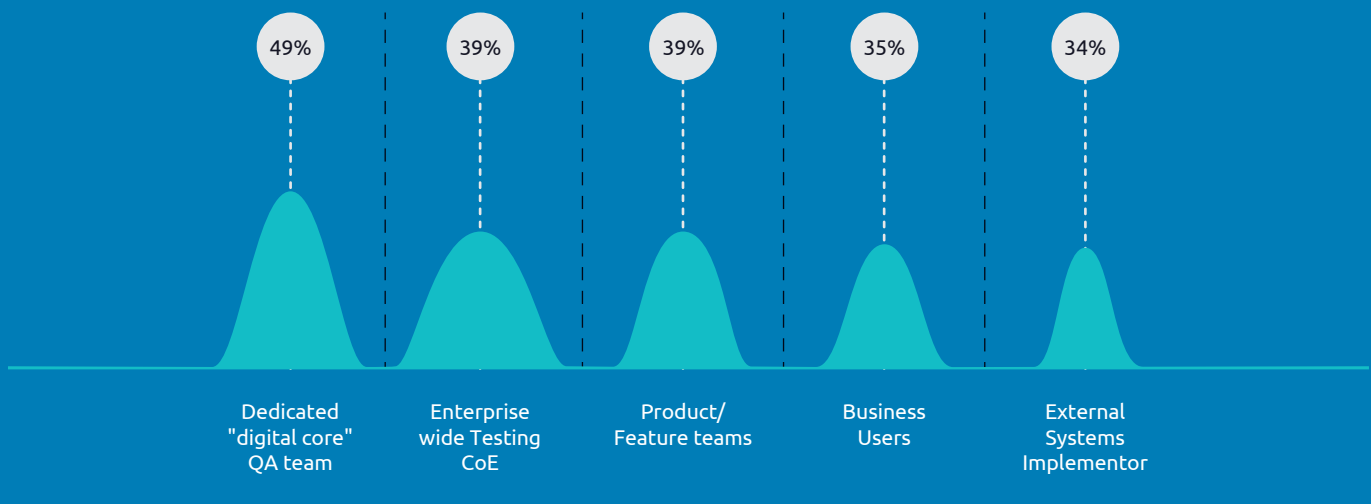
Another trend that was expected was the focus on end-to-end business processes. Organizations have arranged testing teams for maximum support towards end-to-end (E2E) testing, with ~50% of them having dedicated quality analysis (QA) teams testing digital core applications. To top it all off, 35% of organizations have their business users testing digital core solutions to ensure E2E quality. While the close involvement of business users clearly adds value, further professionalization is required to optimize their involvement and gain maximum benefit.

FIG 29

## Involvement in ensuring the quality of the end-to-end solution

WQR 2023- Global Results

Who is involved in ensuring the quality of the end-to-end solution?



▲ TOTAL n = 1750

E2E testing is also extremely complex and is one of the top challenges while testing digital core applications, but more on that later.

Another trend observed was the pervasive usage of automation across the entire lifecycle of quality. In fact, more than half of the organizations use automation across every step of the lifecycle – from test scope selection to analysis and reporting.

***"It is vital for Volkswagen Financial Services (VWFS) that our digital products are robust, as we are representing more than just VWFS. VWFS does have its own market presence, but fundamentally, most consumers will consider the car brand as the brand. So, quality is important, and as you would expect, those car brands are naturally keen to ensure that their customer experience is outstanding, and anything we do as the financial services captive reflects on their brand level too".***

**MARK PAIN**

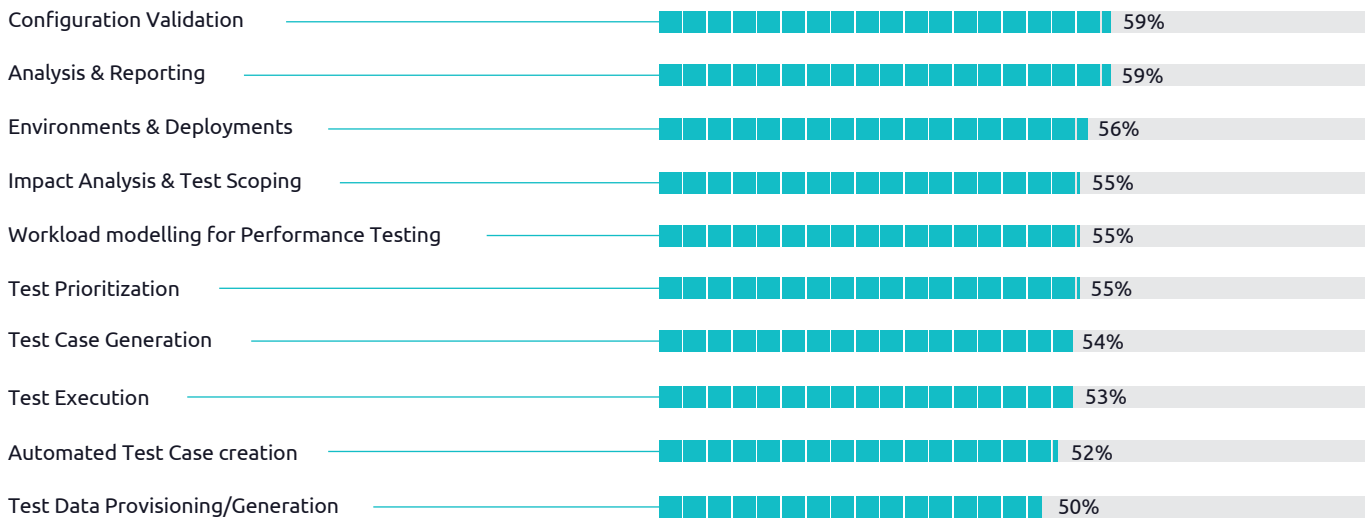
Head of Product Delivery, Volkswagen Financial Services, UK

FIG 30

## Where automated solutions are used for 'digital core' testing

WQR 2023- Global Results

Where do you use automated solutions for your 'digital core' testing?



TOTAL n = 750

Base: Those Who Selected "VP Applications/ Product Owner AND QA/ Testing Manager/ Quality Engineers AND Chief Technology Officer/ Product Head"



## BUT HOW MUCH IS AUTOMATION TRULY CONTRIBUTING?

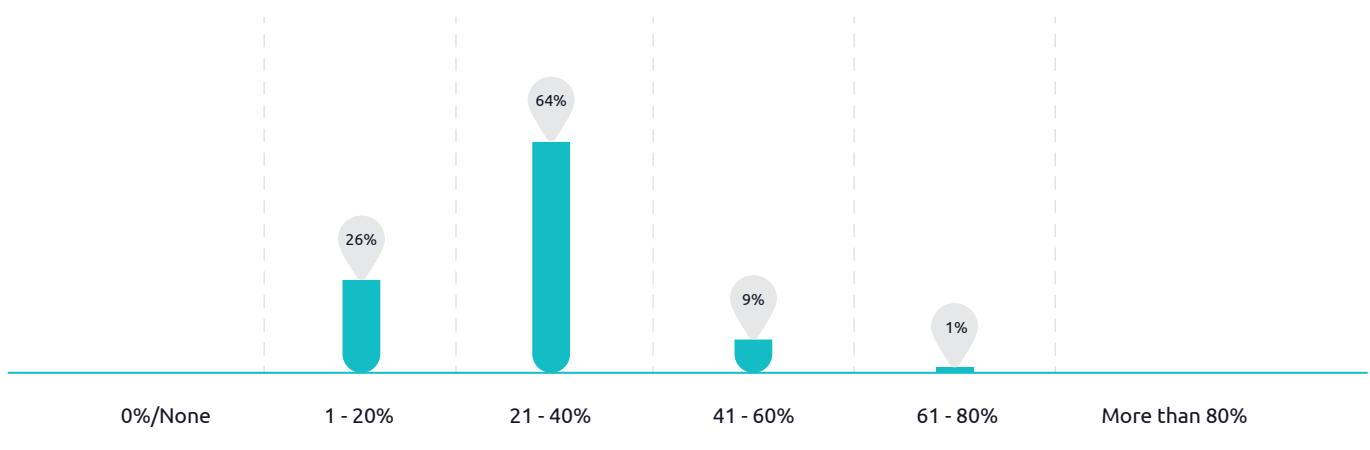
Although automation is pervasive across the lifecycle, we observed that the usage of test automation still has a long way to go. About 90% of organizations have <40% automation coverage of their testing and 26% of them have 20% or less coverage.

FIG 31

### Level of automation of 'digital core' testing

WQR 2023- Global Results

How much of your 'digital core' testing is automated?



TOTAL n = 1750

This clearly is due to the same top challenges around testing digital core solutions - the complexity of the environment owing to the mix of tools, dependencies related to environment and data availability. When it is hard to test, it is even harder to automate.

There's also another contradiction we need to address - while 31% of organizations feel the pressure to keep up with the pace of development teams developing digital core solutions, 69% of organizations do not feel the pressure. With <40% of automation coverage and digital core solutions becoming more SaaS and less customized, it is a bit of an enigma to unravel. Why don't organizations feel the pressure to keep up? Is that because they have large QA teams rushing to complete all testing manually? Or are teams stressed by the number and frequency of code drops coming in for testing?

## WHAT'S STOPPING GUARANTEED QUALITY FOR DIGITAL CORE SOLUTIONS?

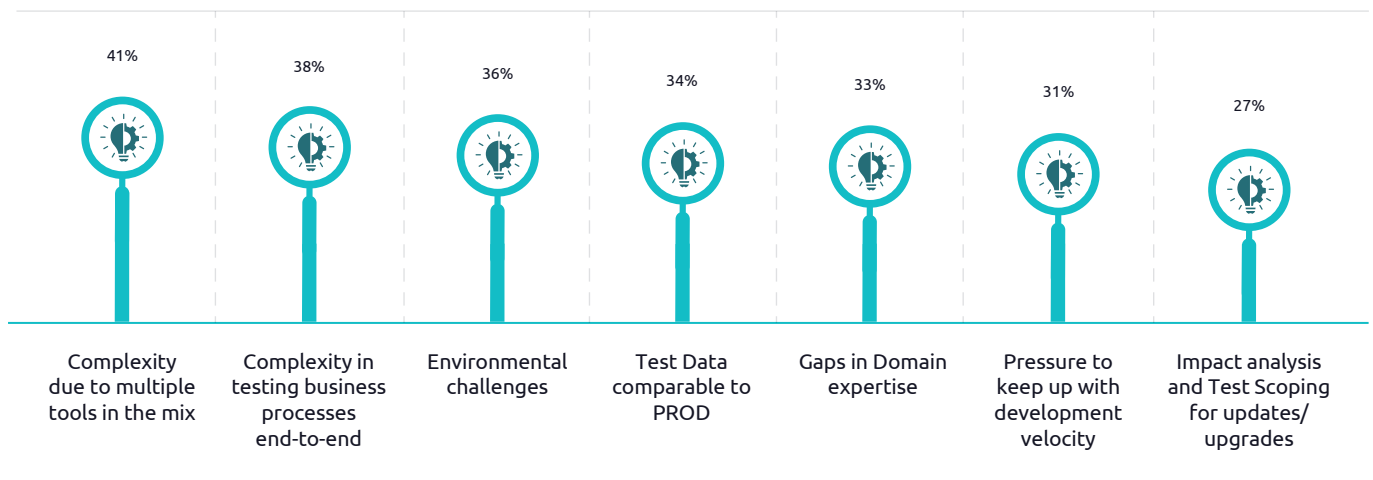
We saw earlier that there is a clear focus on end-to-end testing of business processes. And this is highly relevant for the most important objective of testing digital solutions – customer experience. However, we identified numerous challenges to ensuring quality of digital core solutions.

FIG 32

## Key challenges faced while ensuring quality of 'digital core' solutions

WQR 2023- Global Results

What are the key challenges you face while ensuring quality of 'digital core' solutions (ERP, Salesforce etc.)?



 TOTAL n = 750

*Base: Those Who Selected "VP Applications/ Product Owner AND QA/ Testing Manager/ Quality Engineers AND Chief Technology Officer/ Product Head"*

Complexity around tools, environmental and data dependencies are still prevalent. There is also additional complexity in testing business processes end-to-end. This might be due to the dependencies on multiple interconnected systems in complex landscapes, which is quite typical when testing digital core solutions. This could also be due to the number of people/teams involved in ensuring E2E quality through testing process chains and handing off the testing. Determining if identified issues are real issues is another challenge in such environments.

## ENSURING QUALITY OF DIGITAL CORE SOLUTIONS DEMANDS NEWER STRATEGIES AND APPROACHES

When it comes to test automation, replicating what functional testers do manually step by step through a tool might not be the best possible approach. Trying to break the end-to-end tests into more manageable pieces with a level of contract testing could be a more sustainable approach for building automated tests.

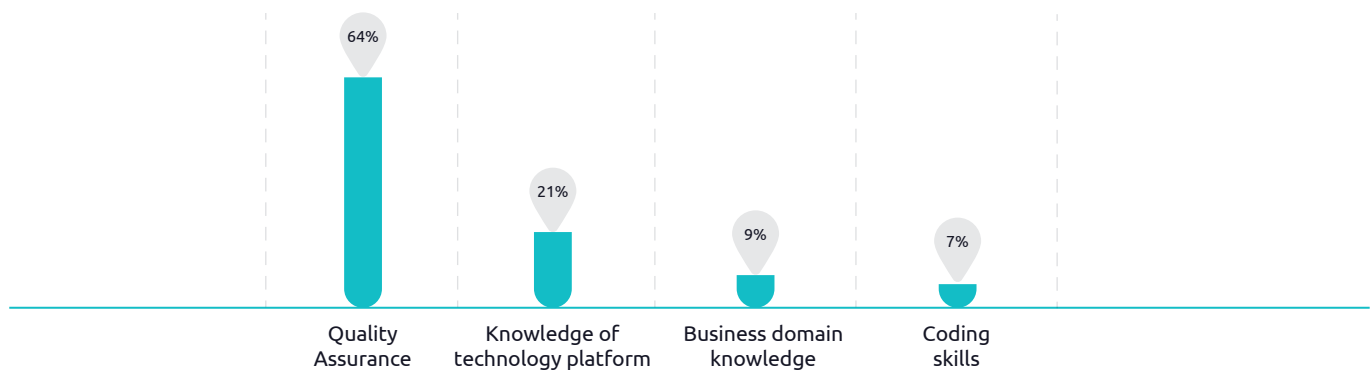
The other important success factor is to have the right skills in QA Teams. When we looked at the data, quality assurance skills were rated as the most important skillset over domain or platform skills required for testing digital core solutions. This datapoint feels like bit of an outlier when compared to two other datapoints – 35% of organizations still utilize business users in validating digital core solutions and 33% of organizations pointed to gaps in domain expertise as a challenge to overcome when testing digital core solutions. The truth is while solid testing and quality assurance skills are sought after due to the nature of digital core solutions, domain expertise remains invaluable.

FIG 33

## Most important skillset to testers when testing 'digital core' solutions

WQR 2023- Global Results

What is the most important skillset to the testers in your QA organization when testing 'digital core' solutions?



TOTAL n = 750

Base: Those Who Selected "VP Applications/ Product Owner AND QA/ Testing Manager/ Quality Engineers AND Chief Technology Officer/ Product Head"

Organizations need to find a way to integrate quality assurance skills and domain skills into teams. There is more than one way to achieve this of course – building and sustaining stable teams over longer durations for functional areas, getting business users to test with QA teams, and upskilling QA teams on domain knowledge are some to be highlighted.

*"You have to test with the right code and the right data, and the biggest shift we recently made is testing with production data. One of the biggest realizations we had was no matter what you test if you are not testing with prod data, there are going to be big gaps".*

**RAJESH NATARAJAN**

Senior Director, Quality Engineering at Hiscox

## RECOMMENDATIONS AND SUMMARY

There is a lot of room to grow automated testing coverage and further build customer delight via seamless experiences. These are our recommendations to organizations building and deploying digital core solutions:

1. **Use newer approaches like test isolation, contract testing, etc.**, to drive more segmentation and higher automated test execution – this will solve the challenge around domain skills as well as relieve teams of stress to keep up with the development speed.
2. **Utilize service virtualization** to overcome challenges around multiple applications, environments, and data dependencies. Service virtualization combined with test automation will really move the needle in the future.
3. **QA teams of the future will need to have a mix of skills** – strong testing skills will always be needed and will form the core. However, they will need to be augmented with some domain and platform skills to drive efficiencies.





Point at any car you see on the road, chances are it features a complex infotainment system, maybe additional connected medical devices, wellness devices, or even appliances, which might all be connected to mobile apps. Products today are an extension of us.

Over the last decade, the product landscape has transformed in unimaginable ways. We have long moved from stand-alone products to upgraded globally interconnected products. Naturally, this evolution has introduced 'a never seen before' level of complexity.

A lot is at stake. An unsavory user experience can not only jeopardize a product launch but also damage a brand image. And it is not just about customer experiences - regulatory pressures, changing guidelines, and cyber threats all suggest the need for robust product testing mechanisms.

There is even a need to re-invent the product testing approach for this globally interconnected world we now live in.

## SO, WHAT REALLY GOES INTO CREATING THE PERFECT INTELLIGENT PRODUCT TESTING SYSTEM ECOSYSTEM?

This year's quality survey report highlighted three main activities:

1. Ensuring seamless integration with the cloud ecosystem
2. Ensuring the security of the product
3. Ensuring a perfect user experience

What was interesting to note in the results was that although the trend in the importance of testing activities was within a very narrow range, cloud testing came up as the most prominent factor with 50% of respondents placing high importance on it. In fact, some considered it as important as performance testing itself. This further validated the predominance of interconnected products.

Tending to cybersecurity needs came up as another important activity (47% of respondents) which makes perfect sense considering adherence to future regulations, or deterring threats for connected products is paramount for the overall robustness of the ecosystem. A few other activities such as functional testing (48%), accessibility testing (46%), and embedded testing (46%), also showed up as relevant testing areas.

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***"We must provide robust solutions for our customers because that is an expectation from a regulatory perspective, but more importantly, we want to ensure a good customer experience".***

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**MARK PAIN**

Head of Product Delivery, Volkswagen Financial Services, UK

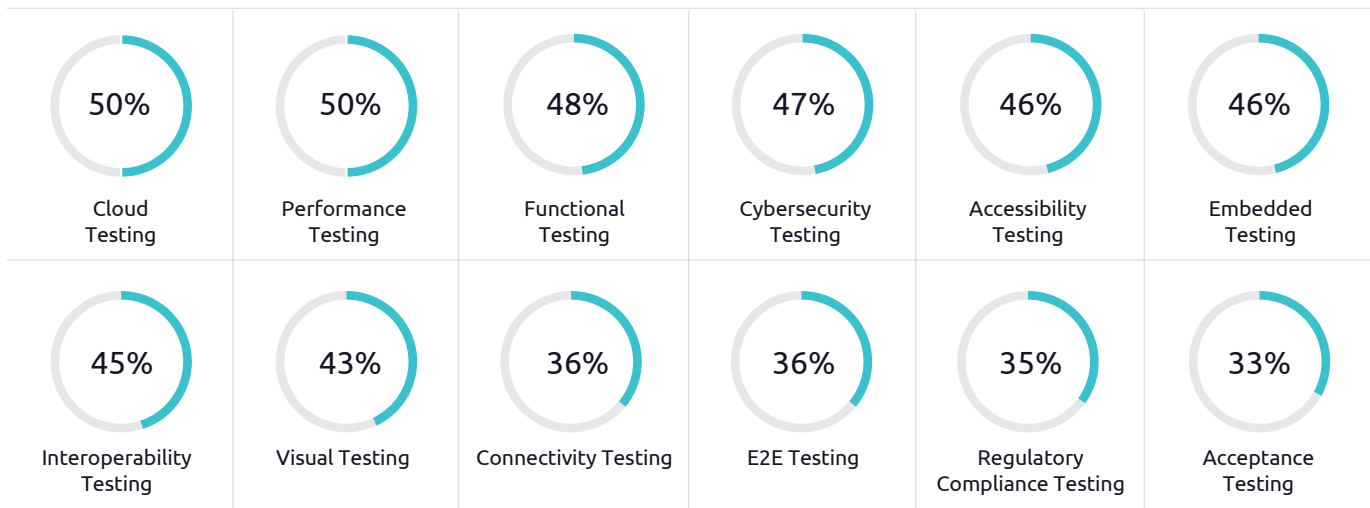
## FROM CHIP TO CLOUD

While the respondents acknowledged the need for an evolved testing ecosystem, we were surprised to learn that only 36% thought end-to-end (E2E) testing was necessary. It has been established that the value of connected products is distributed throughout the entire chain, and its resilience depends on the weakest link in the chain, and yet, the overall value of E2E testing has not been fully recognized. One reason we suspect could be that it requires significant investment in test benches, hardware, and cloud infrastructure for E2E testing.

An E2E approach is frequently viewed through the abstraction of various layers of the system, such as embedded systems, cloud, and connectivity. However, in our experience, we believe this is going to have a minor impact on intelligent product testing in the future.

**FIG 34** Importance of test activities to industry WQR 2023 - Global Results

Please rate each of the test activities below in terms of how important they are to your industry.



TOTAL n = 315

*Base: Those Who Selected "QA/ Testing Manager/ Quality Engineers"*

## WHAT ARE THE MASSES EXPECTING FROM INTELLIGENT TESTING?

One of the significant trends observed in the WQR 2023 survey is the expectation for improving the test definition. The increasing complexity of products, along with hyper-personalization to create a unique user experience, necessitates passing millions of test cases to achieve the perfect user experience. Realistically speaking, it's not possible to determine all possible combinations.

According to respondents, the critical aspect of intelligent testing is test-case definition, with test case selection (52%) followed by a prioritization of test cases (50%). It emphasizes that testing approaches need to constantly evolve to prevent systemic failures. Following the two main expected outcomes, the test data and test case generation are aligned (at 45%

and 42% respectively), with the required improvement of the testing approaches.

Another key finding was that 47% of respondents consider root cause analysis to be of high priority. This denotes a shift to the left and a willingness to use test results not only to assess product quality but also to provide R&D with insights throughout the development process.

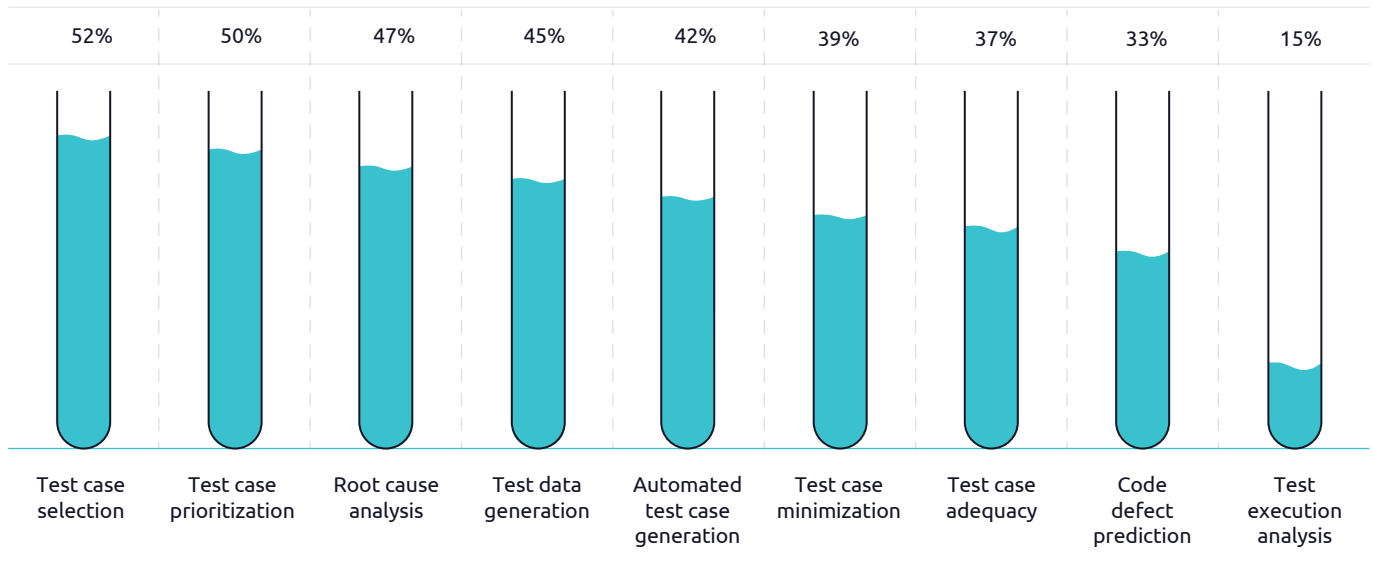
Expectations regarding intelligent product testing clearly focus on the key elements of the user experience, such as functionality, interoperability, and cybersecurity. Additionally, respondents have the highest expectations of improved test coverage.

FIG 35

## Importance of implementing testing use cases as part of Intelligent Product Testing

WQR 2023 - Global Results

Please rate each of testing use cases below in terms of how important they are to be implemented as part of Intelligent Product Testing?



TOTAL n = 615

Base: Those Who Selected "IT Directors AND QA Testing/ Testing Manager AND Quality Engineers"

*"It is now about automating everything that is a part of the testing life cycle, is taking your time, and needs to be done repeatedly".*

**RAJ SINGH**

Vice President, Head of Wholesale IT QA of a Leading Investment Bank and Brokerage Group

## AI TAKES THE CENTER STAGE, BUT AT WHAT COST?

As previously discussed, there are high expectations for use cases related to test plan definition, especially in terms of prioritization, selection, and automatic generation of test cases.

Artificial Intelligence (AI) and Generative Artificial Intelligence (Gen AI) are at the core of all these technologies. The analysis of the WQR 2023 responses indicates that the respondents are well aware of the significant impact that these new technologies will have on their activities, and they need to incorporate these skills into their quality engineering teams.

Data is the main area of interest for the respondents. Hyper-automation of testing and expanding test cases to cover the entire product domain results in a significant increase in the volume of data, that needs to be stored and processed.

43% of respondents consider integrating data platform technologies like Hadoop or MapReduce to be essential to their core competencies.

As expected, AI-related technologies are the most important, with 44% of respondents believing that they will need to use both supervised and unsupervised machine learning technologies in their activities. Furthermore, to a lesser extent (42%), natural language processing techniques are also required.

For product testers, the latest findings suggest that automation toolchain skills and programming languages are now considered mainstream and no longer considered core competencies.

FIG 36

### Importance for the skills required for Intelligent Product Testing

WQR 2023 - Global Results

Please rate each of the items below in terms of how important they are for the skills required for Intelligent Product Testing.



TOTAL n = 435

Base: Those Who Selected "VP Applications/ Product Owner AND Chief Technology Officer/Product Head"

## RECOMMENDATIONS AND SUMMARY

There is a lot at stake in terms of interconnected products or services, as other studies have indicated that a vast majority of consumers abandon the product or service in question if they are disappointed. Our recommendations for organizations building connected products of the future-

- Invest in AI solutions for test prioritization and test case selection** to drive maximum value from intelligent testing, against the millions of possible combinations in today's hyperpersonalized connected product environment.
- Focus on an E2E testing approach** to ensure seamless customer experience through effective utilization of abstraction of various architecture layers (embedded software, cloud, and connectivity).
- Give equal priority to the non-functional aspects** (performance, security, scalability, usability) of the system as the functional aspects as they equally influence the end-user experience.

## QUALITY & SUSTAINABILITY

- **ANDREW FULLEN**

Head of Innovation and Technology, Sogeti UK

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- **ANTOINE AYMER**

CTO, Quality Engineering & Testing, Sogeti

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- **MAHESHWAR KANITKAR**

Vice President, Global Quality Engineering & Testing Sales Leader, Sogeti Global

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- **RAJARAO TADIMETY**

Associate Vice President, Quality Engineering & Testing, Capgemini USA

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- **JENNA FELDMAN**

Director, Corporate Citizenship, OpenText

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*“Sustainability is one of our key objectives. Sustainability is extremely important. Really knowing the impact that our actions have is critical”.*

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### GANESH PRACTOOR

Director - Quality Engineering Group at one of the world's leading financial organizations

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*“We look at sustainability as reuse and it's not just within our QE practice, but it's how we reuse it across our environments. So, we're taking certain platforms and saying that this is the baseline for our product, which then becomes the baseline for all of our other parks”.*

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### FABIAN RODRIGUEZ

Vice President, Application Delivery & Strategy | Digital & Technology, Universal Destinations & Experiences, NBC Universal

A constant challenge reported to us over the years by the World Quality Report (WQR) editions revolves around managing various tech environments, and yet there is a far more serious environmental concern - our planet.

Thankfully, sustainable IT is increasingly becoming a boardroom discussion topic highlighting how much of an impact IT really has on the environment.

This year, we wanted to deep dive and gauge how far the ideas of sustainability and environmental impact have made their way into quality engineering and testing (QE&T) landscape.

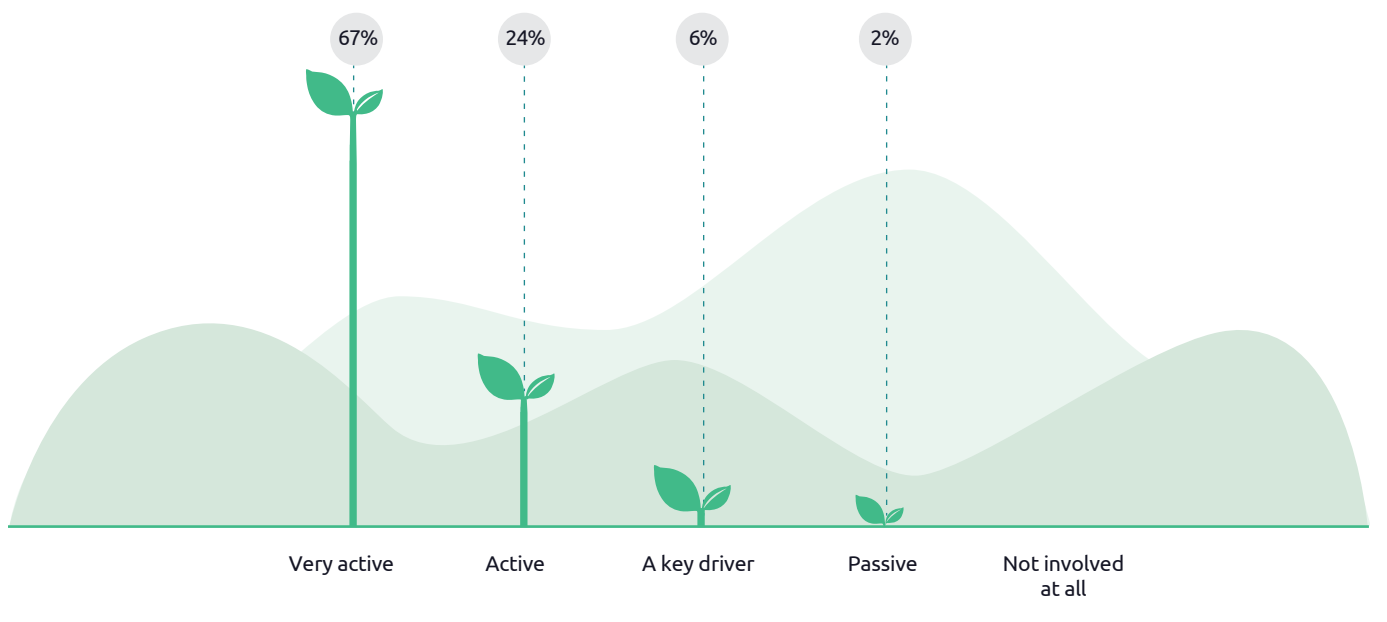
In this chapter, we identify some pressing questions and observations around the impact of QE&T on sustainability and understand where we are truly headed as an industry.

1. What role does quality engineering play in reducing the environmental impact of IT programs and systems? Especially while reports show that data centers and cloud contribute more to greenhouse emissions than the aviation sector.
2. Understanding the enormity of influence is key to reducing the impact of IT. It may be through being part of an organization-wide program or by helping track emerging metrics.
3. What are people currently engaged in? What are their future plans? And what motivates these actions - is it driven by financial considerations or a sense of moral obligation?

Let us dive into some of the trends we received from this year's WQR survey results.

**FIG 37** **QE's contribution to the sustainability agenda** WQR 2023- Global Results

Which of the following best describes how the Quality Engineering (QE) contributes to the sustainability agenda of an organization?



TOTAL n = 1435

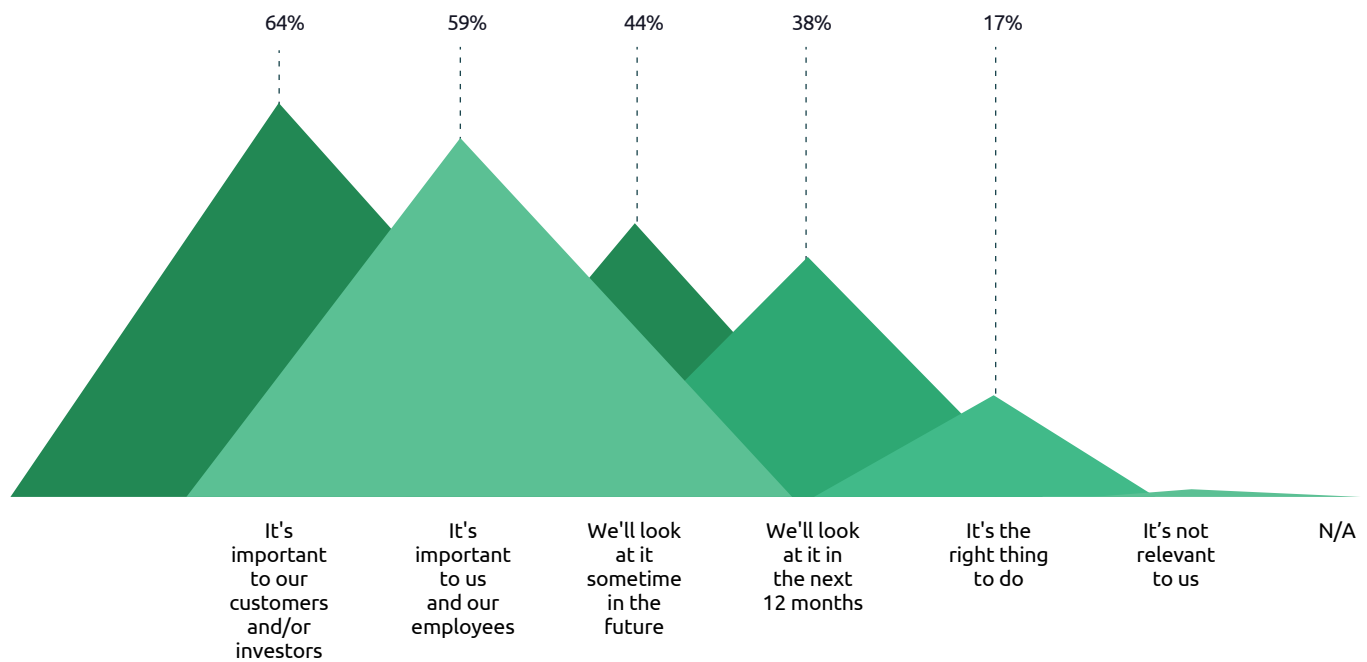
*Base: Those Who Selected "Chief Information Officer AND VP Applications/ Product Owner AND IT Directors AND Chief Marketing Officer AND Chief Digital Officer And Chief Technology Officer/ Product Head AND VP OR Director Of Research AND Development/ Engineering"*

# IS QUALITY ENGINEERING (QE) REALLY CONTRIBUTING TO BUSINESSES' SUSTAINABILITY AGENDAS?

The vast majority (97%) felt QE was active or continually active in driving the sustainability agenda in their organizations. We saw 73% of respondents describing themselves as highly active, or key enablers in driving sustainability best practices in their organizations. Such a high degree of engagement bodes well for delivering on the promises of a sustainable IT world.

**FIG 38** Priority given to sustainability in QE&T WQR 2023- Global Results

Is sustainability in QE&T a priority for your organization?



TOTAL n = 315

Base: Those Who Selected "QA Testing/ Testing Manager AND Quality Engineers"

But our findings were not rid of contradictions - two-thirds said that sustainability was important to their customers and investors, but worryingly, nearly half said they would look at it sometime in the future, with only a third planning to look at it in the next year.

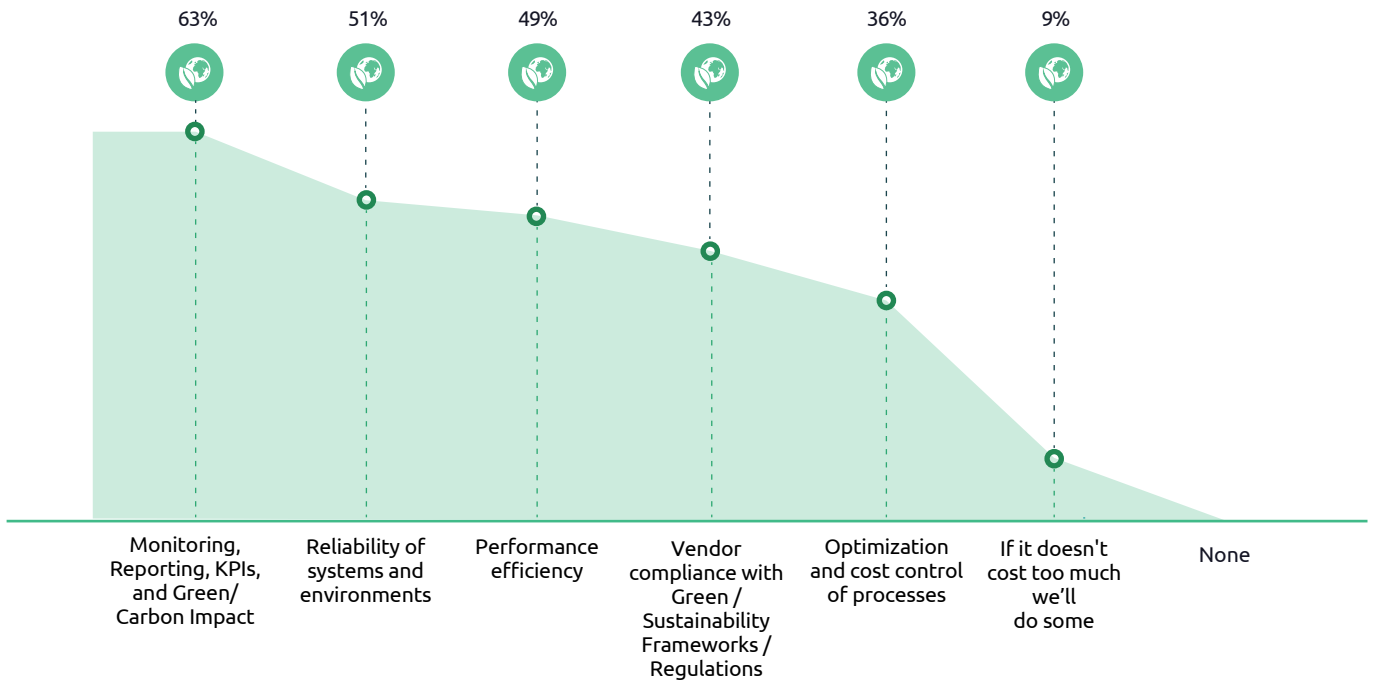
Half of those who responded positively called out vendor compliance with green frameworks and regulations as key drivers of focus in this area. We believe this is a trend that will grow as more governments implement green credentials, especially in areas like procurement of services and supplies.

# HOW ARE WE INTEGRATING SUSTAINABLE PRACTICES INTO QE&T PROCESSES TODAY?

For most respondents (63%), the priority over the next 12 months was to understand how they could monitor and report on green metrics within their QE testing processes. It certainly will take time to find the right metrics for organizations.

**FIG 39** Focus for sustainability practices in QE&T processes WQR 2023- Global Results

What areas will you focus on in the next 12 months to incorporate sustainable practices into your Quality Engineering and Testing (QE&T) processes?



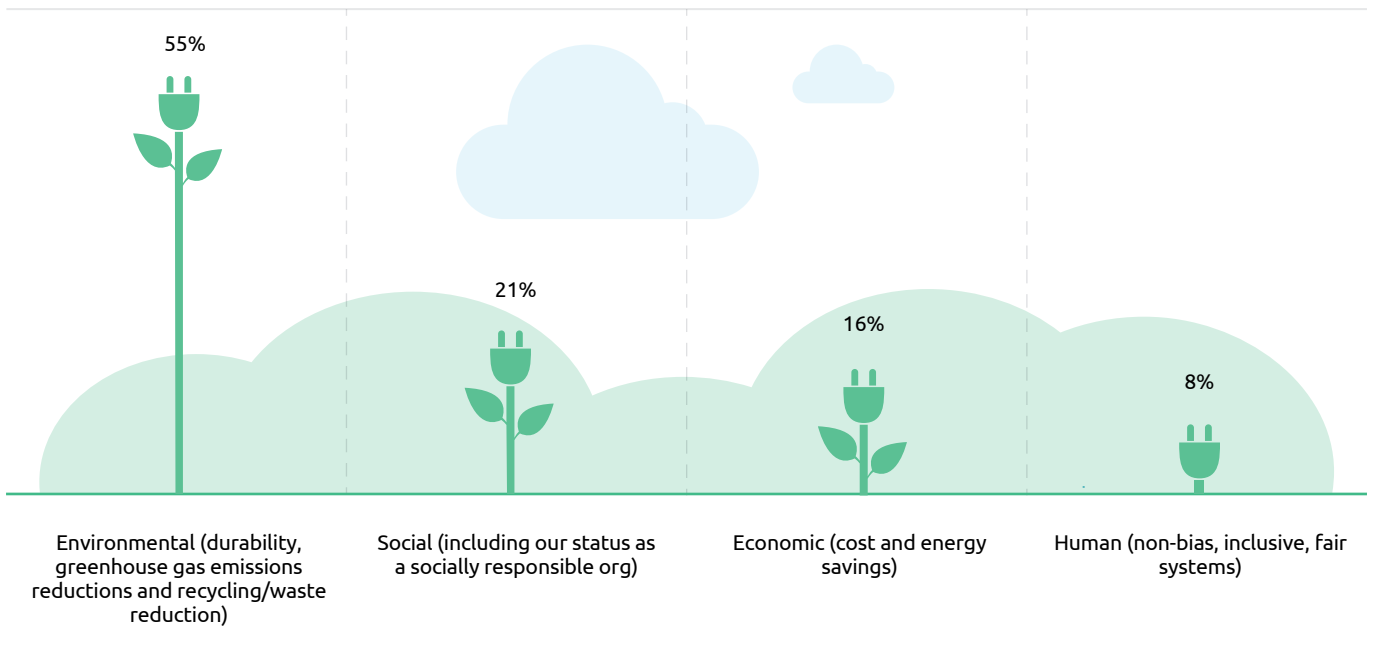
**TOTAL n = 315**

*Base: Those Who Selected "QA Testing/ Testing Manager AND Quality Engineers"*

We had expected the prioritization of process optimization and cost-saving efforts to receive a higher response rate than it did (36%). We were surprised to learn that only 16% saw an economic benefit as being a driving factor. It is reassuring, in a way, that economic benefit is not seen as the key reason to focus on sustainability.



What is the most important benefit of sustainability that QE&T can contribute to?



 TOTAL n =1750

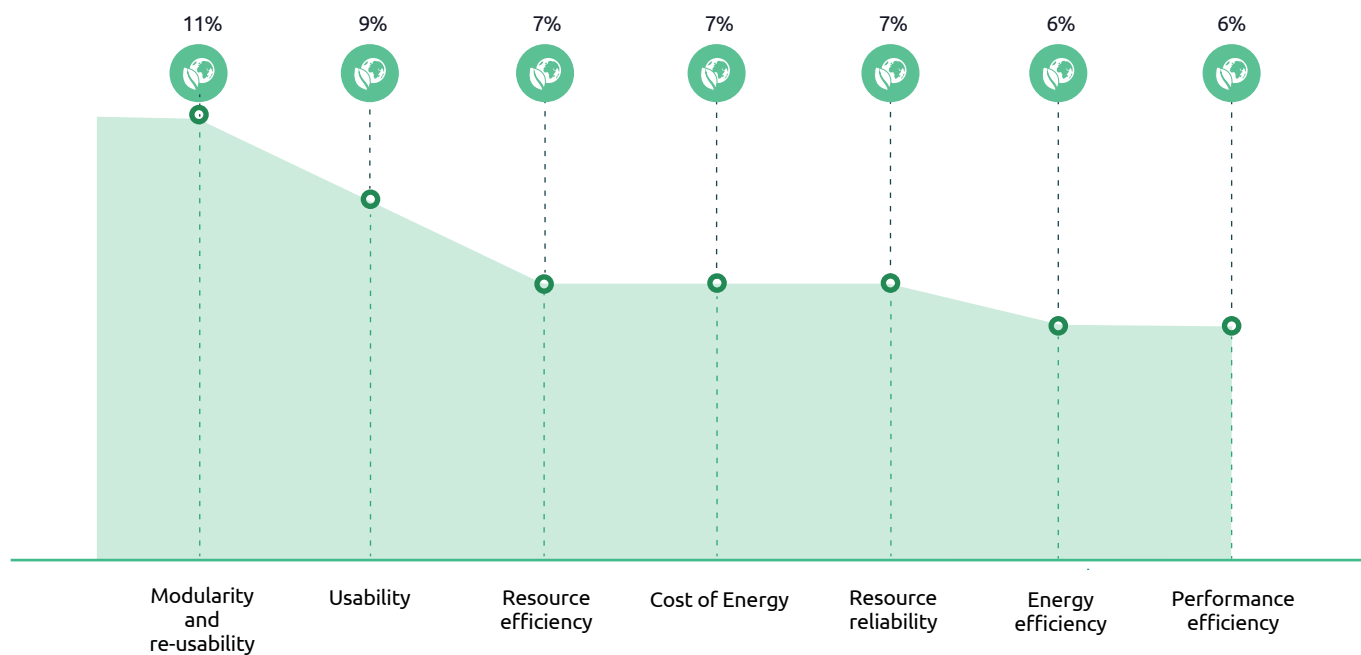
It was promising to learn that over half of the respondents felt that the most important benefit to come from a focus on sustainability was the benefit to the environment. Less promising though was that 21% of replies admitted they were only focused on sustainability because it “looked good for the organization”.

FIG 41

## Frequency of testing for sustainability attributes

WQR 2023- Global Results

How frequently are your teams testing for the following sustainability attributes for Environments & Testing & Development & Production?



**○** TOTAL n = 315

*Base: Those Who Selected "QA Testing/ Testing Manager AND Quality Engineers"*

When it came to the frequency of testing for sustainability attributes - modularity, and re-usability were clear winners, followed by usability. These are good engineering practices that align with sustainability practices. A win-win situation that hopefully will continue to drive best practices and make a difference to sustainability.

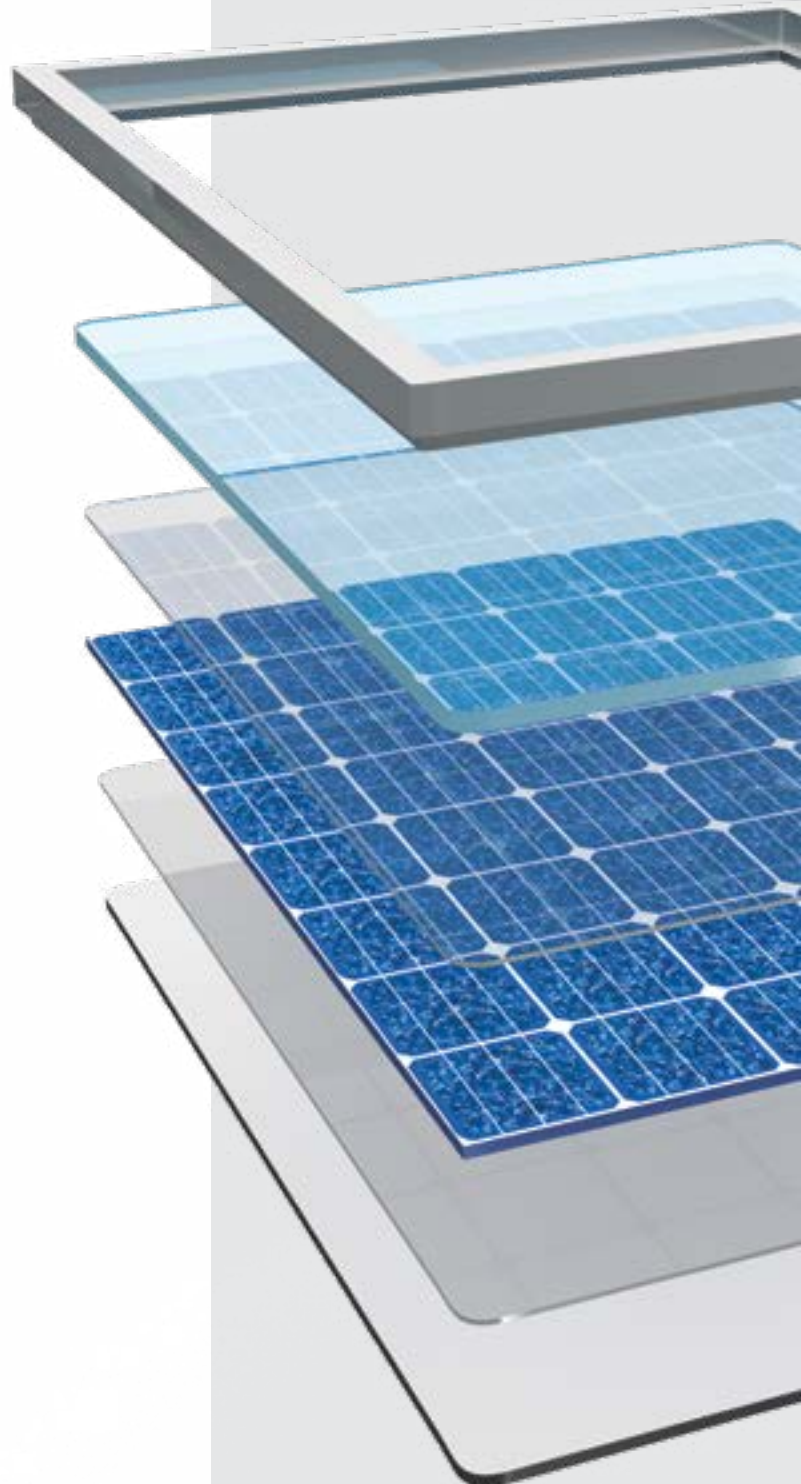
## RECOMMENDATIONS AND SUMMARY

Can QE make a difference? Yes, it can. But not alone. It needs to be part of an organization-wide agenda, with defined priorities and periodic reporting of targets. QE needs to learn to measure and report new metrics and bring its existing engineering view to look at how things can be done better, and how its existing approach to metrics can be used. It is an incredibly positive sign that many of those who were interviewed are committed to making IT greener and more sustainable, but we also must be cautious. Greenwashing exists and there is far more to being green than being able to 'turn off a light switch' or report on your impact. Moving to green electricity is a positive step but what comes after that?

Our research leads us to the following recommendations to increase the value from your quality automation initiatives:

- **Have a set of key KPIs or metrics** that can be easily understood across the organization. Reward innovation and improvements in the KPIs. Ensure regular reviews of the KPIs, and ensure they remain effective in driving improvements.
- KPIs need to be considered not just in QE&T but through requirements gathering, production support, and working with external vendors. They need to be included in your strategies and roadmaps. They also need to be realistic and achievable.
- **Sustainability needs to be part of the whole lifecycle**, included as a non-functional requirement, tested for as a requirement, and reported on against the success (or not) of that compliance.
- Know your **green success factors** and ensure they are part of your strategy, your education, your procurement, and your hiring processes so they become an integral part of how you operate.

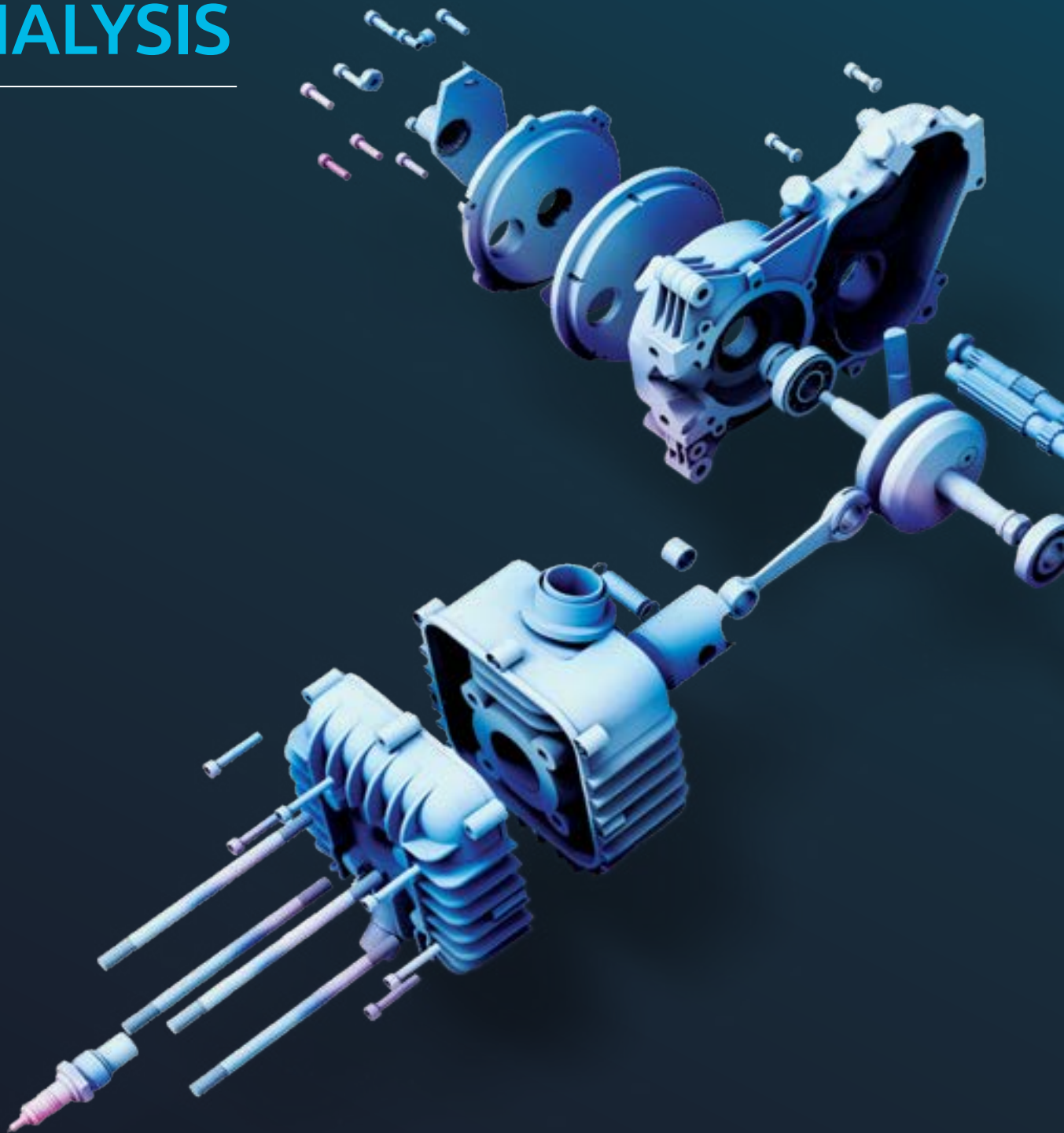
A final thought. Writing data to the cloud and retrieving it is an energy-intensive process. Good practices such as data hygiene and reducing unnecessary data storage can be good for you, for your customers, for privacy compliance, and for our planet.

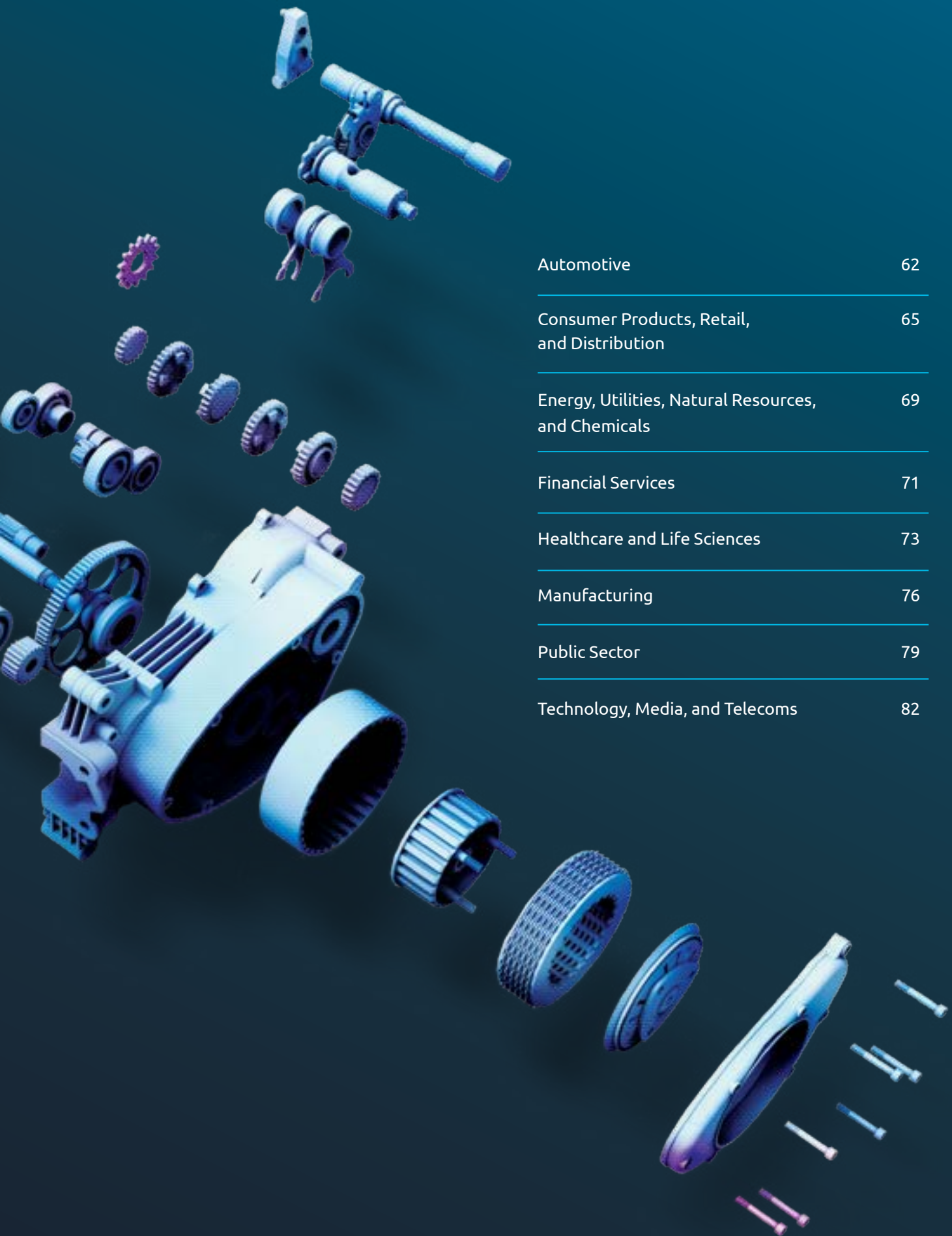


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# SECTOR ANALYSIS

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Automotive	62
Consumer Products, Retail, and Distribution	65
Energy, Utilities, Natural Resources, and Chemicals	69
Financial Services	71
Healthcare and Life Sciences	73
Manufacturing	76
Public Sector	79
Technology, Media, and Telecoms	82

## QUALITY IN MOTION:

How evolution in hardware and software is impacting the automotive industry

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Speed, lifestyle, and exclusivity define and drive the automotive industry, which has witnessed some incredible technological transformations over the years. And it continues to innovate and evolve its product range, which isn't limited to cars anymore.

Today, it encompasses an array of mobility services that often involve two interdependent, yet different areas - firstly, the sales and after-sales services; and secondly, the connectivity and autonomous mobility services. The former revolves around selling the car and the latter is related to experiential elements including autonomous driving, connected car services, etc. that turn your car into a mobile on wheels!

Supported and regulated by international safety standards and sustainability mandates, we are seeing a choice of automotives like never before. But what sets this industry apart is that when you buy a product, you're not only paying for the product but also for the guarantee that it will serve you the way and when you need it.

For the first time, we are also seeing a trickle-down effect of this on public transport- a case in point is the launch of Germany's unlimited railway access pass for citizens and visitors this year.

Things definitely seem like they are changing for the better, but as we witness these dynamic shifts we must ask – what must remain constant and why?

## MAKE SPACE, DATA. SOFTWARE IS NOW A CLOSELY GUARDED SECRET TOO!

Data reliance and the need for substantial research and development are prompting reputed original equipment manufacturers (OEMs) to transition from a dealer-dependent model to an agency model for better customer data management.

The modern automotive landscape places a premium on software as the primary driver of innovation leading automotive manufacturers to invest in in-house software development teams converging the embedded software and IT software competencies. This move has prompted cloud and quality management experts to harness their knowledge of electrification, automation, and digitization, and elevate the company's overall software competencies. It also responds to the rapidly increasing competition in the automotive industry, wherein we see many players seeking to reinvent the holistic mobility experience.

Nonetheless, this shift amplifies the demand for quality, with customers expecting automotive companies to hit it out of the park with every product they release into the market. The aim is to guarantee each component seamlessly integrates with another. Beyond rigorous quality checks, having experts advocate for a customer's needs helps the OEMs focus on the user, rather than just the functional aspects of the software and the hardware.

## SO, WHAT DOES THAT MEAN FOR QUALITY ENGINEERS IN THE AUTOMOTIVE INDUSTRY?

Today, quality engineering is largely being shaped by two aspects:

1. Time-to-market: Aligning the start of production to software readiness to allow testing to begin as soon as the build starts and prevent losses due to a mismatch of timelines.
2. Quality before customer: A customer-centric approach to ensure the car works as the customer expects it to work.

A quality engineer today must have a comprehensive understanding of software testing and hardware engineering ensuring a holistic perspective and end-to-end testing for efficient execution. This approach is vital for delivering the best possible customer experience. However, quality testing is not only reliant on an experienced quality engineer but also on the infrastructure required for testing – an end-to-end test factory/ecosystem and a virtual testing environment that carries out simulations using real-life scenarios that evaluate every point of concern in the vehicle.



## IS EV THE NEXT BIG THING? AND HOW IS SUSTAINABILITY IMPACTING QUALITY?

Despite the increasing popularity of electric vehicles, innovators and OEMs are still unsure whether EVs are the final step, or whether gas motors and other alternatives like hydrogen will prevail. Experts are of the opinion that when it comes to embracing sustainability in the automotive industry, companies need to focus on the idea of mobility and the lifestyle of the customer, rather than the car itself.

Given that manufacturing EVs requires cleaner power than we currently have, there is an increased push for harnessing green alternative power sources like solar and wind energy. But just like Rome wasn't built in a day, addressing a customer's needs means stepping in for the long game. Initiatives like the free combustion car rental policy by Volkswagen go a long way in helping customers experience the best of both worlds while largely curbing carbon emissions.

However, while most discussions still revolve around the future of mobility, the discussion for quality must not take a back seat. Now more than ever, with the automotive industry focusing on innovation, quality testing is paramount, paving the way for a safer, more efficient, and eco-friendly future.



### Survey Watch

82%

Respondents said they will consistently invest in AI solutions to improve quality processes

68%

Respondents chose Embedded testing as the most important test activity to their industry

41%

Respondents said lack of skills is the major roadblock to automation

47%

Respondents named C#/Java/SQL/Python as the top skill for QE associates



## QE IN THE CONSUMER SECTOR

A Glimpse into Our Future 'Shelves'

- **LAUREN OUART**

Vice President, Global Account Executive,  
Capgemini USA

The global pandemic and ensuing disruptive geopolitical events fundamentally changed everything about retail and consumer products. The industry has had to constantly reinvent itself to make up for the unpredictability of the supply chain, demand forecasting, and more.

Even as erratic global developments, quality, and IT transformations gripped the globe, organizations in the consumer sector stayed resilient and bounced back by infusing innovation into how they work.

Over the past three years, the focus zeroed in on manufacturing products more efficiently to recover profits lost during the pandemic. While in the short run, a steep price-hike strategy seemed to have helped, it has proved to be counter-productive in the longer run. Another challenge that the industry struggled with in the past and which remains is the availability and reliability of consumer data that can be put through AI to get conclusive and decisive insights for manufacturing.

## THE WELLNESS TRIANGLE – CONSUMER PRODUCT, THE INDUSTRY AND HEALTH

As the world fought the COVID-19 virus, the importance of mental and physical health seeped into everyone's consciousness, which has had a direct impact on the demand for connected products/ wearables like smart fitness trackers. Concurrently, we saw a rise in citizen developers who employed Low-Code No-Code platforms to chase innovation and propel the world forward amidst uncertainty. In response to this development, most organizations have begun adopting advanced automation solutions and have even proceeded to the pilot testing phase.

While a weariness in the market has set in, which mostly stems from having to tackle constant changes, it is consumer trends and innovations like these that made and continue to make things fast-paced, thrilling, and dynamic!

## OUT OF STOCK BECAME A TREND IN ITSELF!

No matter which part of the world you lived in, all of us dealt with frenzied panic-induced buying during the pandemic. It is 2023 and we still feel the lingering effects of the global shortages we experienced.

We think this is also where quality started being hailed as the 'Robin Hood' of production – a critical game-changer, often perceived as a challenge. However, an additional challenge surfaced – tight supply chains and tighter timelines. This is being addressed through the recognition that the quality of a product is inversely proportional to the delay in products hitting the market and the waste generated. The production of better-quality goods implies less energy usage, less scrap, and less pollution even with the same production levels! This also had a direct cascading effect on IT, manifesting as a surge in the use of cutting-edge AI-based tech, and a renewed interest in sustainability.

## BACK TO THE FUTURE WITH AI!

We now see organizations trying to leverage the power of AI, however, not many of them have established AI at scale yet, and some still only employ it in pockets. Many have strategically refused to employ "technology for technology's sake," and all decisions are being driven by the desired business outcomes.

We see Web 3.0 technology, especially the metaverse as another promising tool that can brilliantly execute efficient manufacturing and negate the need for price hikes. Its ability to create an immersive digital environment would enable teams to run plant simulations that tackle the problem of low-supply and high-demand situations. Imagine being able to create an entire factory in the metaverse and recreating multiple scenarios that can reduce your time, labor, and costs associated with real-world experimentations!

All of this hinges on the quality of data. Rapidly changing customer trends, tastes and preferences, and global instability, are a challenge to the availability and reliability of consumer data. The predictability of questions like which product will consumers want and when and where do they want it delivered, requires extensive research by market experts. The resultant surplus of operational and strategic data is impacting how organizations streamline their resources and efforts, leading them to develop a 'divide and rule' policy without really working in silos. Some experts are forecasting a rise in the adoption of a federated model of working, which focuses on striking a balance between a centralized and decentralized approach. Multiple teams or units work independently but collaboratively towards a shared goal, yet each agile team is responsible for overseeing the quality of its own product or processes. Under such a model, each function becomes closely intertwined and interdependent, which makes developing multidisciplinary skills a must, especially for quality engineers who need to wear multiple hats of coders as well as testers.



## SUMMARY

There's a tremendous scope for innovation in the consumer industry, with new products being developed and processes being perfected every day. According to the 2023 WQR survey, higher productivity and an improved customer experience are the quality outcomes organizations are focusing on. The pandemic redefined everything from what a physical store meant and could do, to reinventing the retail experience for customers. Even the first step of delivering an end-to-end customer experience has transformed, with sales and branding leveraging the tech tools at their disposal. While we are still figuring out the ethical implications of every step we take toward the future, the shopping cart can't stop rolling – it's the consumer industry after all!

### Survey Watch

**80%** Respondents said they will consistently invest in AI to improve QE processes

**50%** Organizations say only 1%-25% of their organizations have adopted Quality Engineering

**76%** Organizations are using traditional testing centres of excellence to support agile projects

**73%** Respondents said it is very important to test the impact of failure events on applications running on cloud especially using chaos engineering

# ENERGY AND UTILITIES : FUELED BY QUALITY

Probing the potential of the Energy and Utilities QE ecosystem

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We could have the most brilliant ideas, but without energy, they remain unactionable. Be it manufacturing consumer goods, finding cures for diseases, or creating technologies like Web 3.0 and blockchain modules, the energy and utilities sector is the driver that makes it all happen.

In the post-pandemic era, we saw this sector adopting market trends like cloud integration, digitization, and using decentralized modes of IT processes.

This year, we are witnessing a shift towards artificial intelligence (AI), automation, and an increasingly agile approach to quality engineering (QE). So where is the conversation headed?

## DIFFERENT BATTLES, COMMON TOOLS

We see that critical functions like enhancing the performance of power plants, reducing energy losses during transmission, or improving the reliability of utility services are now being made possible due to smart QE models.

However, the utilization of QE seems to vary significantly. While some organizations focus on using QE throughout the value chain, there are others that apply it individually on downstream, upstream, or sometimes mid-stream functions.

Interestingly, this split usage is the most evident among the three major sub-sectors: oil and gas companies, oilfield services (OFS) companies, and engineering, procurement, and construction (EPC) companies that have drastically unique testing landscapes.

Oil and gas companies earlier developed their own testing systems, but later resorted to commercial ones that could be purchased and automated as per enterprise-specific requirements. While this seemed lucrative initially, commercial testing products failed to integrate functional/regression testing, create test beds, or even automate test scripts to drive the desired results. These companies eventually resorted to adding a layer on top of off-market products which changed the game!

On the other hand, when it comes to OFS, their core focus is to continuously build technology products for the oil and gas companies, and they operate in a different testing ecosystem. Their side of the story would involve functions like building the drilling platforms, providing real-time data integration, and working with sophisticated algorithms to test simulations for oil and gas companies.

Then we have the third counterpart – EPC which are pure-play construction companies and might not even develop their own software products and typically use OEM (original equipment manufacturer) products. For them, testing is more on the core engineering side and might often include creating simulations to validate the integrity of the actual physical models they build.

But in all these interrelated sub-sectors, data is the common denominator.

## DATA – THE UNIFIER

One of the major challenges the energy and utilities sector faces today is the amount of data it must deal with. Additionally, it must also be analyzed in real-time to reach optimal business decisions.

The focus today is to create data analytics tools that could, for instance, extract real-time data from drills to analyze seismic activities in the layers and sediments below the surface to make the exploration more effective, and so on.

And we are seeing several technology providers working with intelligent software solutions to aid these quests for oil and gas companies. But again, when it comes to data, moving legacy systems to the cloud and making them work with native capabilities remains challenging.

Having said that, today we see AI going a step further to drive quality and redefine how data is being leveraged in this space.



## STRIKING GOLD

AI and Gen AI are being widely accepted as quality control tools. As expected, it is being used to assess and mitigate potential risks and their impact on the quality of products.

Speaking of AI, we explored the use of digital twins in the manufacturing chapter, and we think it could add a lot of value in this sector too. It might be uniquely beneficial to EPC and OFS companies, where they can use AI to create digital twins.

This could offer a platform for engineers to collaborate and test product hardware to certify the possibility of successful integration of systems and software before developing the product physically – thus efficiently managing cost, time, and resources.

It might also play a hand in weaving sustainable practices within the energy and utilities ecosystem

## DELIVERING BIG RESULTS, BUT NOT AT THE COST OF THE PLANET!

There's no denying that if there is any industry that continues to be a major concern for the environment – it is this one. But we think that effective QE can truly transform how sustainability is viewed, adapted, and integrated in this sector.

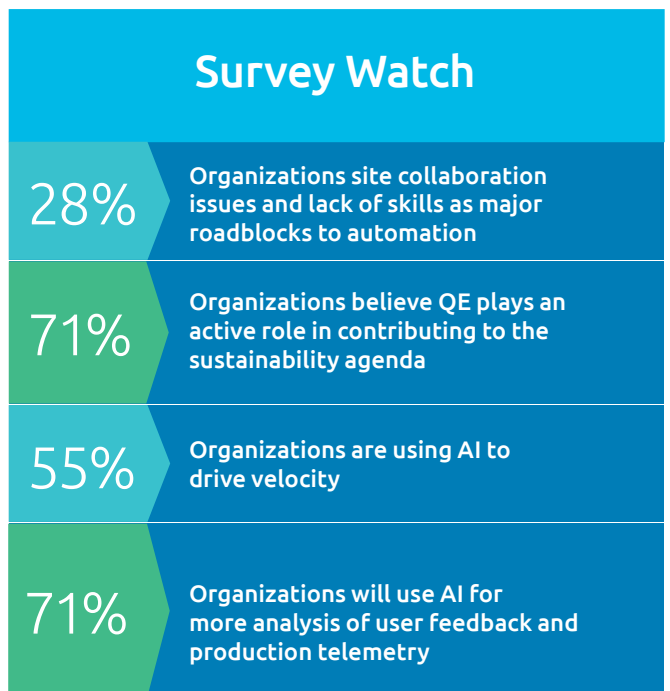
Off the top of our heads, here are a few ways a robust QE system can enable sustainability:

- Identify sources of waste heat whilst suggesting potential recovery solutions
- Optimize transport routes or operations and monitor air quality as a part of bigger greening projects.
- Determine appropriate equipment that is energy-efficient or can further create equipment that might have a similar impact.

We are also seeing ample use cases where AI solutions like open cascade and digital twins are being used to actively contribute to carbon capture and storage technologies which can also be remotely operated with minimal human intervention, ensuring consistent and reliable performance. Most importantly, it is heartening to see how IT is playing a crucial role in improving the accuracy of sustainability reporting data, addressing the challenge of greenwashing, and aiding in regulatory compliance.

## BECKONING A NEW ERA

As the biggest players adopt an agile approach to streamlining their business operations, we predict other companies to follow suit. With the advent of AI and Gen AI, we also see a lot of potential to transform QE at a fundamental level within the industry and not only mitigate potential risks but go a step further to eradicate them completely.



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## THE FINANCIAL SERVICES INDUSTRY – INVESTING IN DELIVERING SUCCESS

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- **LISHA RAKESH**

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- **NILESH YEOLA**

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From introducing the concept of the barter system to regulating complex business and global transactions, the financial services sector has come a long way today. In last year's report, we established that even though Artificial Intelligence being in the fray has made transactions simpler, the discussion over its overall integration in the end-to-end processes largely remains complex. This year, we are trying to assess and explore if we are doing enough to keep our financial systems and processes safe and the skills that will help Quality Engineers stay relevant tomorrow.

## UNTAPPED RICHES TO BE UNLOCKED

In the quality landscape, the focus that was initially on automating functional testing has now shifted to non-functional testing, prompting us to revisit the basics of business and modernize them. The next chapter belongs to Generative AI and its effects on lifecycle automation. But how important is Quality Engineering in a world that is increasingly becoming reliant on AI?

The financial services industry, traditionally one of the most heavily regulated industries in the world, is displaying a growing appetite for AI. Every organization is talking about quality

and AI, in some shape or form. With higher productivity and speed being the top two contenders for AI-driven quality outcomes (WQR Survey, 2023), there are some organizations that are still exploring the potential benefits of employing AI. There are some organizations that are still exploring the potential benefits of employing AI. Their approach to the same depends on two aspects:

1. The level of maturity of an organization, which decides its willingness to embrace the latest trends and move ahead of companies that lag.
2. Data security and privacy concerns and the readiness to mitigate them, that largely determine the extent of AI and cloud adoption.

The pace of full-scale migration of applications to the cloud has not yet seen significant acceleration. Governments and international institutions are engaging in discussions about the policies and compliance necessary for regulating the use of AI. While it remains to be seen how the FS sector tackles extra regulations, increased collaboration with cloud providers to navigate heavy regulations may help.

Nevertheless, most organizations have begun implementing it internally and have shown interest in the opportunities that arise by embracing AI. While the insurance industry is showing growing enthusiasm about the benefits of Gen AI in process automation and customer engagement, most banks are adopting automation at an accelerated pace to reduce risks and live defects. With a lot of innovation queued up for the future, one key challenge lies in arranging the right test environments and the right test data to establish a successful ecosystem for quality testing. This demands major infrastructural changes like the transformation of legacy systems to modern applications and addressing the skill gap – both challenges being identified as impediments to automation and QE in this year's WQR survey. Consequently, it encourages major infrastructural changes and equips a single tester or quality engineer with a diverse skill set that encompasses both quality testing and automation domains.



## “SUSTAINABILITY? IT’S A CHECKBOX IN EVERY PROPOSAL!”

A substantial area of progress has also been made in Green IT and sustainability through infrastructural optimization and automation. With an environmental impact generated by IT, and a carbon footprint larger than that of the airline industry, switching to Green IT has become an important investment and strategic discussion, with its overall role in quality testing yet to be explored.

Quality is not a mere function, but a part of the bigger picture. The FS industry has been observing steady growth in the direction of digital transformation, yet every step needs to be vetted to prove the positive effects of automation. Despite multiple challenges and milestones that are yet to be achieved, we can start with a comprehensive top-down approach to identify areas for automation in the process lifecycle. It’s a journey of continuous improvement and exploration, and our only trajectory from hereon is upwards!

### Survey Watch

75%

Respondents said they are using or plan to use advanced automation solutions like No Code/ Low Code or AI based automation frameworks

50%

Respondents said they have used AI a lot for test environment provisions

80%

Respondents say that 25%-50% of their automated testing is integrated to delivery pipelines

82%

Organizations support agile projects through a traditional Testing Center of Excellence



## QUALITY ENGINEERING IN HEALTHCARE AND LIFE SCIENCES: A BOOSTER SHOT

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According to the United Nations, the average worldwide lifespan for adults has nearly doubled since 1950, largely due to groundbreaking innovations in patient-centered treatments and wellness. The Healthcare and Life Sciences industry has played a pivotal role in advancing human well-being through continuous and transformative changes, with technology as its core driver.

The industry continues to make remarkable advances in cutting-edge fields like mRNA technology, which is speeding up biologics, cell and gene therapies, decentralized clinical trials (DCT), connected health, and precision medicine.

Quality is the most important topic for the industry that is built on safety and efficacy. As the industry evolves, so does the role of quality engineering (QE) within it.

## NAVIGATING THE SPEED-SAFETY TIGHTROPE

A significant industry challenge is striking the delicate balance between expediting product development and adhering to stringent safety and regulatory standards. This results in extended processes for Installation Qualification (IQ), Operational Qualification (OQ), and Performance Qualification (PQ) in both product and technology domains.

The Quality Engineering (QE) function is tasked with reducing time-to-market and program costs through the implementation of AI-driven scientific techniques and innovations that streamline the scope and execution of quality-related activities, fostering an automation-centric culture.

However, it is worth noting that the full range of benefits has not yet been realized. There remains significant room for improvement in implementing a comprehensive end-to-end approach to Quality Engineering (QE). While pockets of excellence exist across the enterprise, there are many opportunities for standardization and scalability.

## SLOW AND STEADY SEEMS TO BE THE APPROACH OF CHOICE

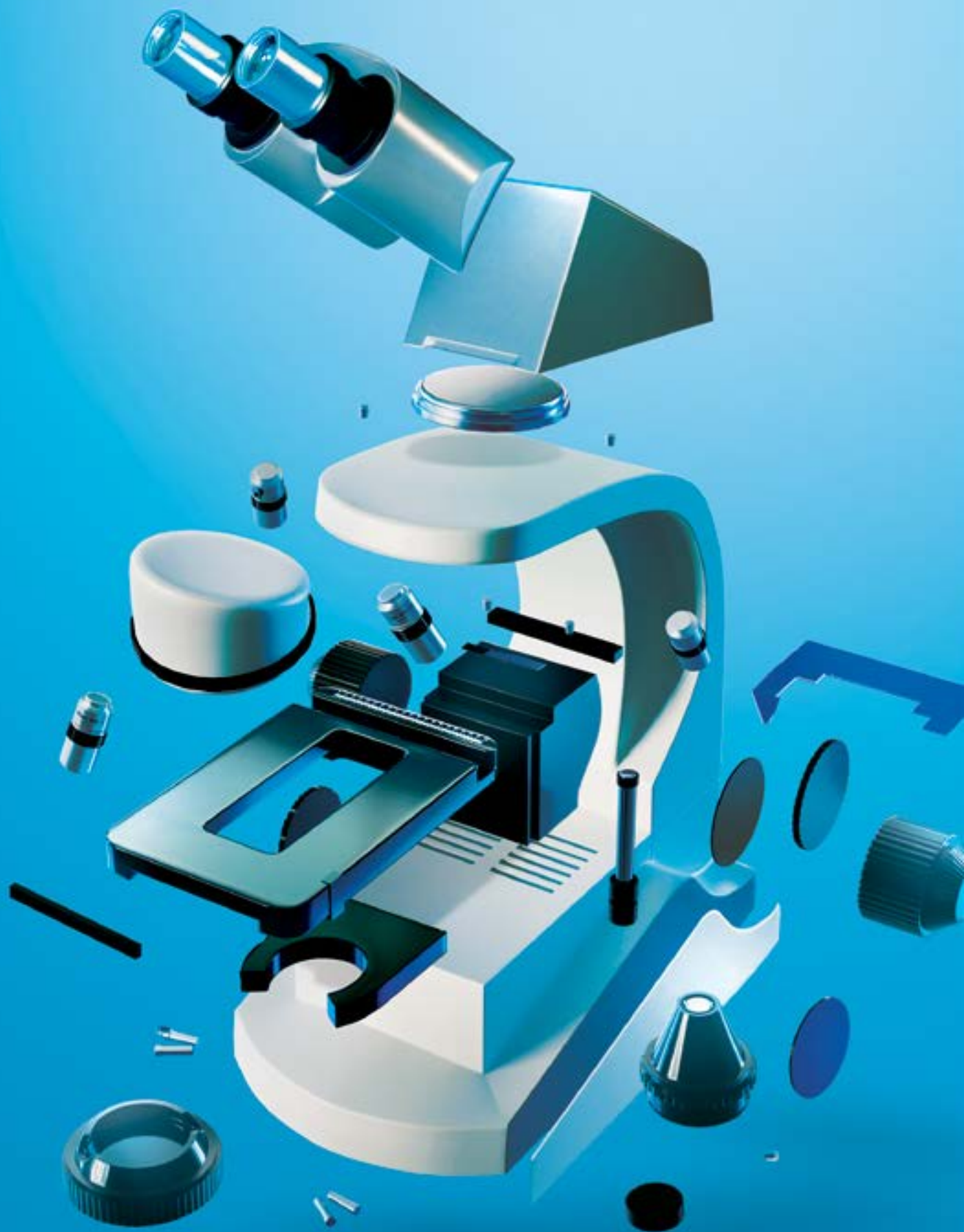
The Healthcare and life sciences industry is heavily regulated by stringent GXP guidelines (Good Manufacturing Practices, Good Clinical Practices, etc.). These regulations, although vital, can frequently add complexity, especially when seen through the lens of Quality Engineering (QE). This tendency to err on the side of caution has long been the norm, and we see no significant shift in this mindset even today.

Unlike other industries that readily embrace disruptive technologies, Healthcare and life sciences tend to proceed with caution. There is a consistent preference for substantial proof of the new approach's value before committing to significant changes, which places a considerable burden on the "Proof of Value" concept.

Based on our experience, even industry leaders in this field exhibit a high degree of skepticism and prudence when considering something new. They often opt for small-scale test runs to solidify their understanding of the value in practical application.

This approach frequently leads to two main challenges. Firstly, the pace of implementing innovative ideas and tools in Quality Engineering (QE) is notably slow, resulting in a low speed to realize value. Secondly, there are often hurdles in transitioning from the proof-of-value stage to broader enterprise adoption.

Furthermore, the industry relies heavily on domain-specific enterprise off-the-shelf applications, hindering the cohesive deployment of innovative ideas.



## EMBRACING INEVITABLE CHANGE

There are a few critical trends in quality engineering that are gaining prominence.

AI's ascension was predicted, and as expected, we see AI, particularly Generative AI, gaining prominence. In the quality engineering space, optimizing the scope of quality activities as prescribed by AI is gaining momentum. We are now witnessing broader adoption across the enterprise following the successful 'proof of value' phase. Conversations and pilot projects focused on Generative AI, particularly in the context of generating test requirements, are gaining significant momentum.

Quality Engineering (QE) is playing an increasingly vital role in empowering business users to enhance their Performance Qualification (PQ) efforts, enabling them to shift their attention back to core business operations. QE is anticipated to introduce a level of business acumen, acting as a surrogate for business users, streamlining efforts, and providing tailored guidance to drive product and software quality.

Sustainability principles are gradually transitioning from strategic planning to tangible initiatives. While sustainability within technology programs is gaining recognition among senior stakeholders, it remains in its infancy at the operational and tactical levels. We are currently observing preliminary discussions regarding the potential involvement of quality engineers in integrating sustainability considerations into quality-related activities.

Despite its initial stages, we anticipate that the role of quality engineers in this regard will become more defined in the years ahead.

## DIAGNOSING THE DRIVERS OF FUTURE

While the pace of Quality Engineering (QE) transformation in this industry may be gradual, the direction is unquestionably clear. We recognize that maintaining a delicate balance between safety, compliance, and progress remains an ongoing challenge, and QE plays a pivotal role in this endeavor. The influence of QE in Healthcare and Life Sciences is steadily expanding into areas traditionally outside its scope. This necessitates the development of an enterprise-wide quality strategy, comprehensive quality education, increased collaboration across the organization, and the effective utilization of the latest in technology.

At the heart of this transformation are skilled quality engineers who possess a deep understanding of the industry, regulations, and technological solutions. They are capable of crafting industry-specific models, rigorously evaluating them on a smaller scale, and ultimately implementing them across the entire enterprise to provide high-quality, safe solutions to patients worldwide.

### Survey Watch

81%

Organizations have confidence in the accuracy of data used to train AI platforms

56%

Organizations have occasionally used AI for test case design

58%

Organizations use Automation to improve test efficiency

56%

Respondents stated BDD/TDD as the most critical skill for Quality Engineering associates

# EVOLUTION OF QUALITY IN THE MANUFACTURING INDUSTRY

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Sales Leader, Manufacturing sector, Capgemini Americas

- **ATUL JADHAV**

Director ERD, Engineering, Capgemini India

The manufacturing industry runs on hundreds of precariously interlinked functions and a discrepancy of even 0.001-millimeters can wreak havoc.

So naturally, quality by default becomes central to it all.

Manufacturers today are expected to maintain brand legacies while adapting to the latest trends and ensure rigorous standards of reliability, performance, and safety while optimizing resource use, which is a herculean task!

As the manufacturing industry experiences profound shifts, driven by the convergence of operational technology (OT) and information technology (IT), we are seeing the landscape of quality engineering (QE) evolving in a whole new direction.

## SO, HOW IS MANUFACTURING FARING THIS YEAR?

Every organization has its own set of hyper-customized quality checks. Where QE cannot replace quality checks it is helping in reducing the amount of work and blockages instead. Test engineering today is remodeling and redefining test design techniques.

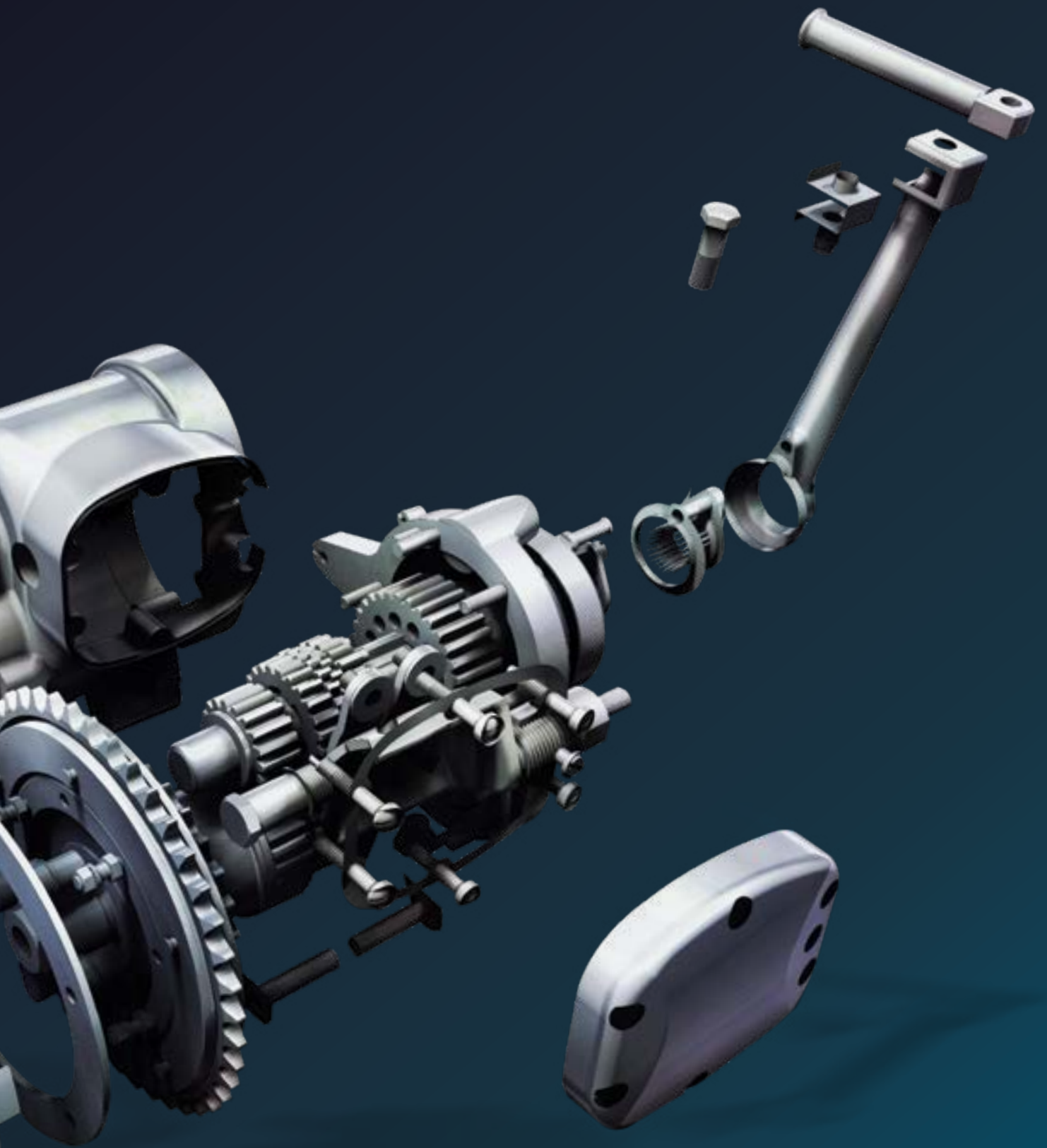
Over the years, we have noted that despite the need for rapid transformations, manufacturing takes on innovation and modern technology with skepticism.

Even when it came to digitization, the focus was more on digitizing existing processes, to optimize or speed them up, rather than transforming entire process lifecycles.

If it were not for the COVID-19 pandemic, the manufacturing sector would not have been propelled to adopt digital innovation. Amid the pandemic, manufacturing sites finally embraced Jira, and Kanban boards to optimize repair tools and processes. Automation extended to lunch orders, spurring interest in broader applications like CI/CD (Continuous Integration and Continuous Delivery) and Selenium.

Having said this, we understand the skepticism because we have worked with century-old brands that have been world leaders in specific product categories. Here, replacing entire systems wouldn't just be difficult, but also counterproductive! Old legacy systems often have extremely unique characteristics that cannot be completely reproduced.





## THIS EXPLAINS THE RAMPANT USE OF DIGITAL TWINS (DT) IN MANUFACTURING

We touched upon it last year as well, and we only see its usage growing with time. DT replicates processes digitally which allows manufacturers to experiment and test innovations without it interfering with existing production.

Organizations now realize that testing requires changes and updates - and building something from scratch is a time-consuming, expensive, and sometimes impossible process. You cannot always test specifics. You cannot crash an airplane 10 times to test how durable it is, and a hybrid (part physical, part digital) setup could be a lifesaver in such cases.

It allows you to note how a specific piece of hardware PLC will interact when you scale it up into a big system and then the DT can do the rest of the work - making it a near-perfect solution.

## WE CAN SEE SIMILAR TRENDS FOR AUTOMATION, ARTIFICIAL INTELLIGENCE (AI) AND GENERATIVE AI AS WELL

AI is being widely used to create test cases, mock situations and find defects in systems. By exponentially expanding the world of test cases and possibilities, AI is helping mitigate test regressions to come to terms with specific quality levels.

Parallely, we are also seeing increased usage of hyper-automation which involves streamlining code delivery by automating complex tasks.

But there's a catch – while much can be automated, human input is needed to create initial test cases. In certain fields like defense and medicine, manual intervention remains essential.

This is yet another challenge that we will have to address in the coming years.

## CAN THESE TECH INTERVENTIONS CONTRIBUTE TO SUSTAINABILITY IN MANUFACTURING?

If you look at sustainability in physical products, you will note it's quickly resorting to calculating CO2 emissions, but we think sustainability is much more than that.

From a QE point of view in Manufacturing, sustainability can also come through circularity-closing loops.

In IT we could resort to energy packetization for a similar net result. It is an interesting concept because it consists of internet connections and data, going back and forth, with packages that power an energy-driven world.

For instance – we could instruct HVACs in a manufacturing unit to coordinate with a central system to manage energy demand units by receiving energy packets for cooling, with flexible timing. This could balance energy peaks and grid congestion while integrating flexible timing for tasks thereby reducing overall energy consumption effectively.

But again, to make a real difference, these use cases will have to become mainstream, and organizations will have to adopt an end-to-end approach to incorporate sustainable processes throughout the chain.

## SO, WHAT ARE OUR RECOMMENDATIONS?

- Use QE throughout product lifecycles to eliminate unnecessary quality checks, improve the test environment, and optimize overall output.
- Utilize DTs and hybrid setups strategically to preserve brand legacy while reaping the benefits of tech innovation.
- Explore sustainability in terms of QE circularity and use a top-down approach to boost net impact.



# WILL QUALITY FINALLY STEAL THE SPOTLIGHT?

Deepdiving into the public sector's QE trajectory

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The public sector has always been the binding force to bring economies, administrative authorities, technologies, and the people together. It is often critiqued and perceived as defiantly snail-paced, yet remains one of the most innovative and resilient sectors.

Over the last few years, public sector IT has had to deal with cloud migrations, the explosive growth in data, and the rise of AI. It has to deliver its services faster and better - while also dealing with unique geopolitical and economic events like COVID, and economic recession, among others.

This year we continue to see increased adoption of automation, artificial intelligence (AI), and agile by public sector organizations as they seek to identify and bridge the quality gaps to improve the services they provide.

As adoption and the complexity of the use cases increase, we look at the current trends and understand the future of QE across the whole of the public sector.

## A DATA LANDSCAPE LACED WITH UNIQUE COMPLEXITIES

One of the trends we see is the acknowledgment of the value behind data. This sector clearly understands the power of storing, analyzing, and controlling the data with the right set of people and organizations while also dealing with the increasing complexity of data privacy.

The data ecosystem in the public sector is extremely complex because it has tax and customs, defense, welfare, security, justice, healthcare, and public administration, all in different systems, different technologies, and at different stages of maturity. The public sector must constantly engage in a balancing act between leveraging data for decision making, being cautious about the sovereignty of data, and being respectful of privacy concerns.

Data sovereignty remains a critical concern in the public sector, as governments try to define who owns and controls data and deliver trusted services to citizens while adhering to rules around data privacy.

## LEVERAGING AGILE, AUTOMATION, AI

While many public sector organizations have been using the agile approach for years, the adoption of agile practices varies from country to country and across different government departments.

The introduction of agile has driven a shift towards more product-based organizations, where cross-functional teams take ownership of IT services and systems and break away from massive, monolithic multi-year waterfall programs.

Quality engineering has also been increasingly seen as a strategic asset and is being factored in right at the start of any project or initiative paving the way for automation of processes and systems.

The public sector has a diverse landscape of departments and agencies, each responsible for various aspects of governance which means difficulties in legislation, coordination, and ensuring the end-to-end quality of implementations. Automation tools have helped in streamlining processes, especially in areas such as document processing, improving overall experiences thus aiding government reliability.

We are seeing impressive results of automation in some of the social benefit calculations that involve tax agencies. Automation is also aiding the move towards interoperability and the "once only" principle, where citizens provide information only once and it is shared across government departments, which cuts down complexity and facilitates modernization efforts. We saw this firsthand in migration processes in some Western European countries where automation helped migrants, public servants, and cross-border organizations work together to create a seamless, hassle-free experience for everyone involved.

The combination of agile, automation, and AI tools is birthing intelligent systems, that have healthy infrastructure and processes on which we can run analytics, detect anomalies, and decrease costs while using the time of the workforce optimally.

We expected these transformations to drive fundamental changes in the role of quality engineers in the public sector and they have. Testers are now closer to the engineers and coding processes, blurring the lines between testing, development, and support of the systems.







## CREATING PRODUCT CHAMPIONS OUT OF QUALITY ENGINEERS

While the changing dynamics in this QE ecosystem might look exciting, a big challenge is the lack of IT champions who can represent IT at the highest levels in organizations – something that can hold back innovation and introduce risk to programs and the wider organizations and their customers.

We are in serious need of peer-level engineers in the boardroom, making sure that the views of testing and the rest of the IT functions are heard and understood. They need to have a say and the authority to make decisions around core IT services.

What would help is to take technical experts and convert them into product owners for the technology to have relevant conversations and make meaningful contributions.

In fact, this approach can also help in building non-functional characteristics like sustainability alongside reliability, scalability, and availability.

When product champions are involved in the decision-making, they can integrate sustainability into the development process from the beginning, thereby reducing public sector organizations' environmental impact.

We know that gratifying the various agencies of the public sector is not easy, but we have ample evidence to show that the sooner we adapt to these principles and technologies, the better it is for everyone.

With the rise of AI and the disruption that it is already bringing, we see product champions who understand the technology are making a difference and this is starting to be recognized in the public sector, a trend we hope to continue to see in the years to come.

### Survey Watch

**83%** Respondents denoted 25-50% of their organizations have adopted QE

**60%** Organizations said the top-most issue in agile adoption was lack of time to test

**43%** Respondents said that cloud and infrastructure testing is not followed as a standard practice

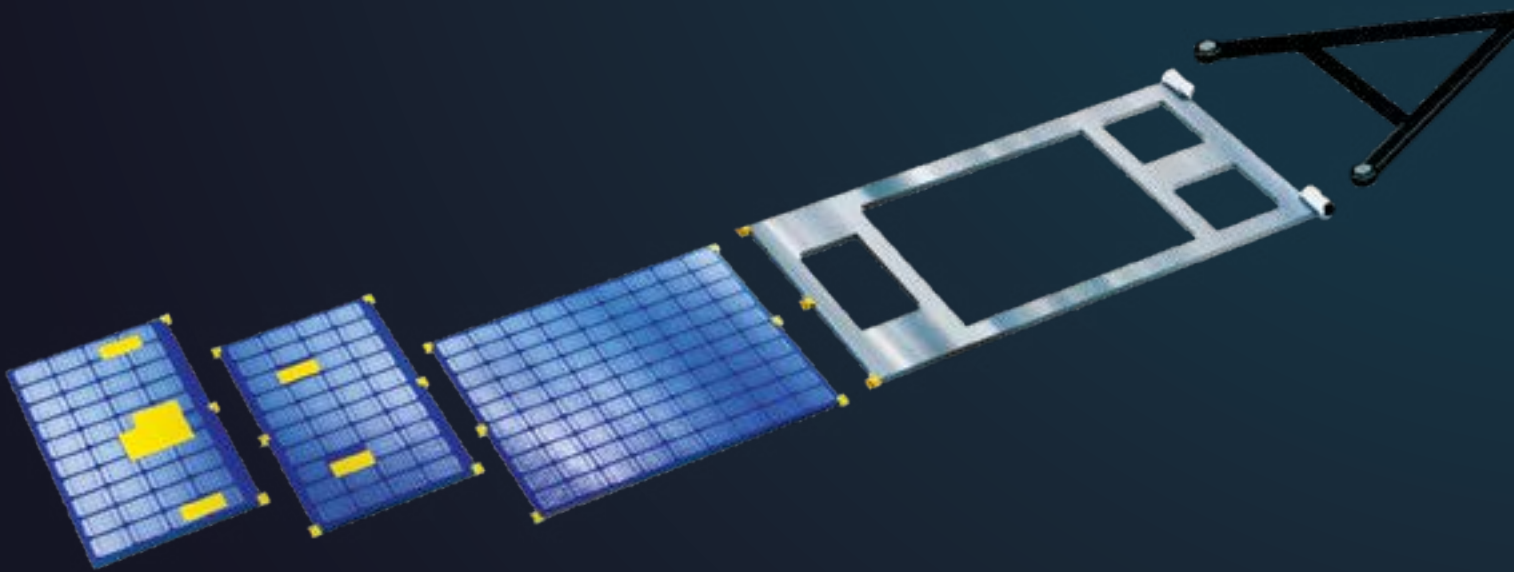
**59%** Organizations think QE&T can play a huge role in achieving sustainability goals

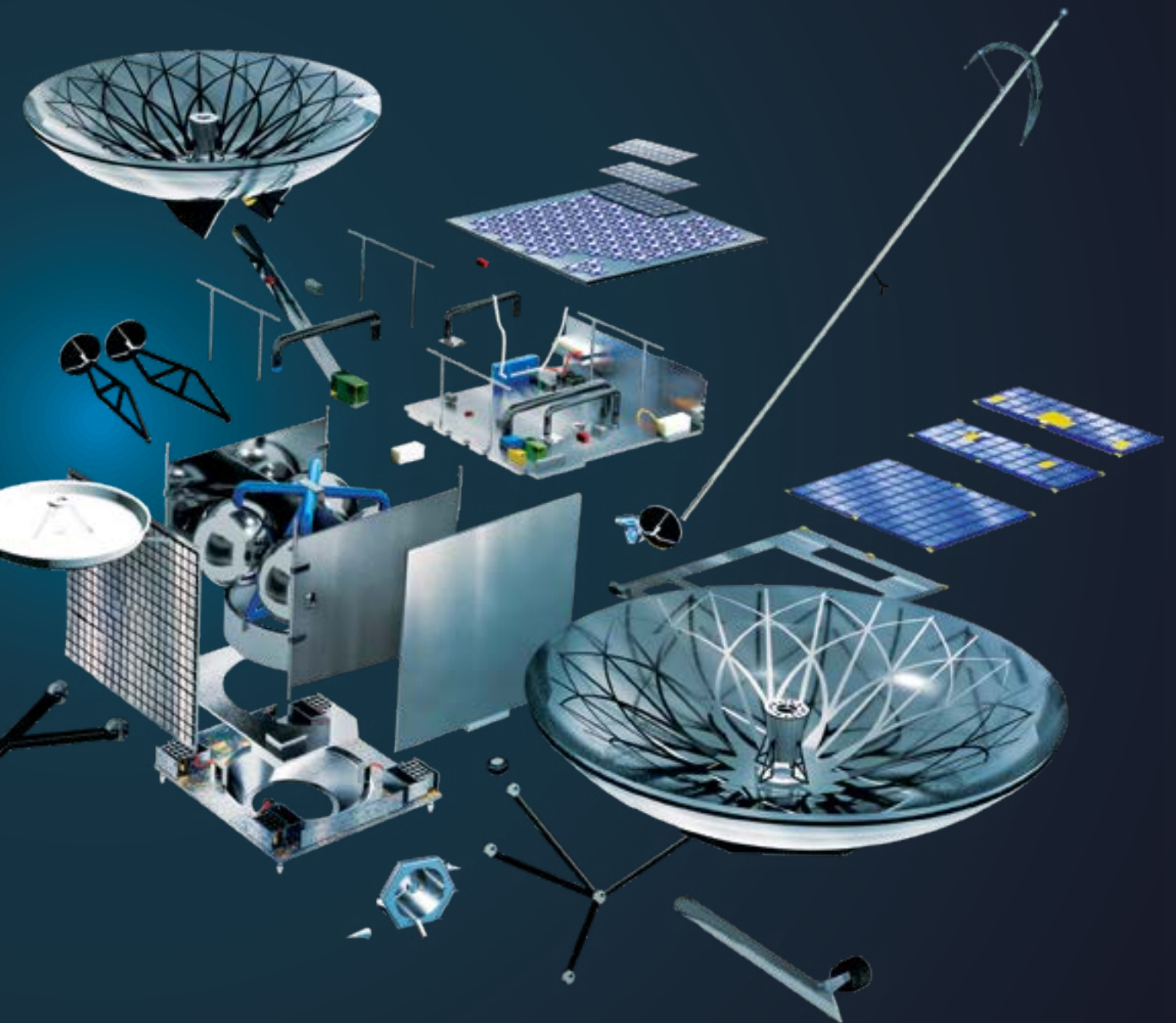
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# TELECOM OF TOMORROW

How invested is media and telecom in QE?

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Vice President, Head of Telco, Capgemini UK

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Capgemini USA

Did you know that there are more mobile subscribers today than people on this planet? A recent report by the International Telecommunication Union (ITU) revealed that there were approximately 7.9 billion mobile cellular subscriptions worldwide and this number continues to grow rapidly each year.

The telecom sector is the backbone of the globally interconnected ecosystem we live in, and quality engineering (QE) plays a critical role in creating and maintaining the innovative technologies on which the industry relies.

Through this year's World Quality Report (WQR) survey we wanted to understand how artificial intelligence (AI) and automation are increasingly becoming mainstream, and how the industry is adopting newer trends in data management, customer centricity, and sustainability.

## ARE WE WITNESSING THE GLORIOUS REIGN OF AI?

Given the fiercely competitive nature of the industry, telcos now are hyper-focusing on things that really matter. Many market leaders are seeking ways to eliminate unnecessary transactions and reduce operational complexities through the strategic use of AI and automation.

Both these technologies are being used as tools to optimize processes or even completely redesign and reimagine business processes when required. We saw this coming, considering how these technologies have delivered exemplary efficiency, predictability, and cost savings.

In our opinion, even though telcos are cautiously investing in this space, especially in Generative AI, we think it is poised to become an indispensable part of their toolkit in the next three to four years.

But it is not a uniform industry-wide trickle-down effect. While some regions such as the United Kingdom and Europe are early adopters of technology in telco, others comparatively lag.

As early adopters pave the way for innovation, we notice that most of their decisions revolve around migrating features and even offshoring some roles to optimize processes, highlighting a shift from cost-focused decision-making. Today, the need seems to lean towards a nuanced approach that combines automation with process redesign.

Interestingly, this trend is being driven by telcos that are increasingly collaborating with startups and incubators to find technology-driven solutions that can replace manual processes to reinvent how the industry functions.

## ARE BUREAUCRACY AND RED TAPE IMPEDING THE MOMENTUM?

Telecom is notoriously characterized by its caution and budget constraints. Known for their conservative approach to spending, they are hesitant to disrupt existing systems that, while not perfect, are functional. This makes perfect sense given the industry's complex decision-making processes that often involve multiple stakeholders and consulting companies, result in much longer timelines for implementing changes.

Yet, despite the cost-conscious environment, it is incredibly reassuring to see telcos making significant investments in software and subscription-based services. This reflects a shift toward delivering products and services faster to the market, embracing high-tech product life cycles, and focusing on the entire value chain, including testing.

## A WAVE OF TRANSFORMATION

Like many other sectors, testing functions in this space are now being decentralized. Telcos are realizing the need to distribute testing functions across different regions, enabling them to harness local expertise and streamline processes.

The industry is also in the process of re-evaluating several quality benchmarks and defining quality drivers by including test data, data validation, cloud platforms, and orchestration.

Interestingly, we are also noticing a shift away from end-to-end testing platforms towards domain-based testing. With a focus on integration with development, large-scale, in-house testing centers of excellence (Data Governance Center of Excellence) are diminishing, especially in the United States, in favor of integrated domain-specific testing approaches.

Parallely, the decoupling of media and connectivity is emerging as an important part of the conversation. While telecom previously integrated media as a part of the business, we think it is now time for platform players to focus on B2B, provide connectivity services, and align with hyperscalers to create renewed supply chains and marketplaces instead.

In contrast to these developments, we note that data security and integration continue to be a major threat keeping telcos from unlocking the true value of data for testing and achieving broader business purposes.

And as far as broader business purposes are concerned, awareness regarding sustainability and efforts to make it an active element of business models are coming to the forefront.

“Overall, we know that cost-consciousness is what drives telcos to optimize their digital supply chains, but surprisingly, it is also what is enhancing sustainability efforts along the way.”

There has been a growing emphasis on green quality engineering and testing to contribute to sustainability goals in telecom. It is refreshing to see how the industry acknowledges quality and testing as essential components in achieving compliance and sustainability goals.

In fact, automation has been repeatedly highlighted as a key factor directly contributing to cost savings and indirectly to sustainability by reducing time cycles for product releases in our client discussions.

## IN CONCLUSION

We think in order to thrive, businesses must invest in Automation and AI, cultivate innovation through collaborations, strategically partner to optimize supply chains, and harness data ecosystems for enhanced testing and valuable business insights. But while these measures hold the possibility of a promising future, only those who strategically apply them and transform with changing times stand to reap rewards. After all, as the legendary Chinese philosopher Kong Fuzi (Confucius) once said, “Only the wisest or the stupidest refuse to change.”





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# ABOUT THE STUDY

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## *World Quality Report 2023-24*

The World Quality Report 2023-24 is based on research findings from 1,750 interviews carried out during June and July 2023 by Coleman Parkes Research. The average length of each interview was 30 minutes and the interviewees were all senior executives in corporate IT management functions, working for companies and Public Sector organizations across 32 countries.

The interviews this year were based on a questionnaire of 46 questions, with the actual interview consisting of a subset of these questions depending on the interviewee's role in the organization. The quantitative research study was complemented by additional in-depth interviews to provide greater insight into certain subject areas and to inform the analysis and commentary. The main themes for all survey questions remained the same, though a few objective responses were also added for the first time this year. Quality measures were put in place to ensure the questionnaire was understood, answered accurately and completed in a timely manner by the interviewee.

Research participants were selected so as to ensure sufficient coverage of different regions and vertical markets to provide industry-specific insight into the quality assurance and testing issues within each sector.

To ensure a robust and substantive market research study, the recruited sample must be statistically representative of the population in terms of its size and demographic profile.

The required sample size varies depending on the population it represents – usually expressed as a ratio or incidence rate. In a business-to-business (B2B) market research study, the average recommended sample size is 100 companies. This is lower than the average sample size used for business-to-consumer (B2C) market research because whole organizations are being researched, rather than individuals.

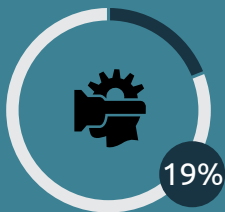
As mentioned above, the B2B market research conducted for the World Quality Report 2023-24 is based on a sample of 1,750 interviews from enterprises with more than 1,000 employees (23%), organizations with more than 5,000 employees (33%) and companies with more than 10,000 employees (35%). The approach and sample size used for the research this year enables direct comparisons of the current results to be made with previous research studies conducted for the report, where the same question was asked.

During the interviews, the research questions asked of each participant were linked to the respondent's job title and the answers he/she provided to previous questions where applicable. For this reason, the base number of respondents for each survey question shown in the graphs is not always the full 1,750 sample size.

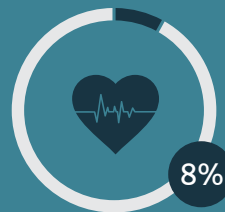
The survey questionnaire was devised by Quality Engineering experts in Capgemini, Sogeti, and OpenText (sponsors of the research study), in consultation with Coleman Parkes Research. The 46-question survey covered a range of software quality engineering and digital assurance subjects. The analysis of the survey results was enriched by qualitative data obtained from the additional in-depth interviews.

## INTERVIEWS BY SECTORS

WQR 2023- Global Results



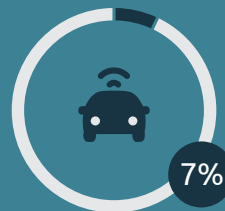
Hi-Tech including start ups, hardware vendors + Aerospace & Defence



Healthcare & Life Sciences



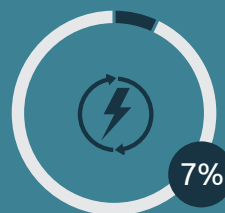
Financial Services industry, including Capital Markets, Banking and Insurance



Automotive - (Manufacturing)



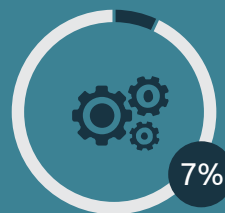
Public Sector/ Government



Energy, Utilities, and Chemicals



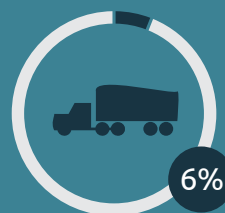
Telecommunications, Media & Entertainment



Manufacturing, (incl. industrial product & excl. Automotive)



Consumer goods & retail/ Distribution & Logistics



Transportation



## INTERVIEWS BY JOB TITLE

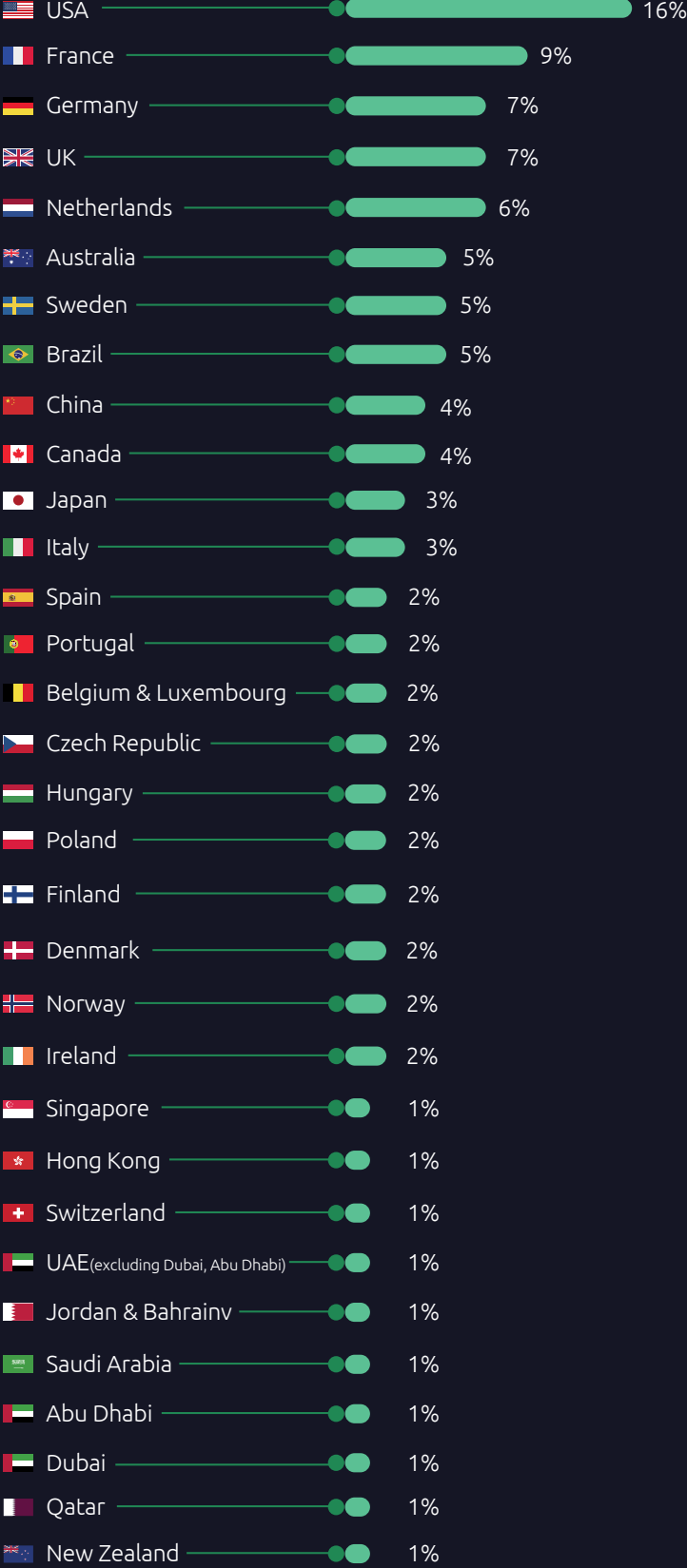
WQR 2023- Global Results



# INTERVIEWS BY COUNTRY



32 COUNTRIES



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# ABOUT THE SPONSORS

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## *World Quality Report 2023-24*

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Part of the Capgemini Group, Sogeti makes business value through technology for organizations that need to implement innovation at speed and want a local partner with global scale. With a hands-on culture and close proximity to its clients, Sogeti implements solutions that will help organizations work faster, better, and smarter. By combining its agility and speed of implementation through a DevOps approach, Sogeti delivers innovative solutions in quality engineering, cloud and application development, all driven by AI, data and automation.

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# THANK YOU

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## Capgemini, Sogeti, and OpenText would like to thank

The 1,750 IT executives who took part in the research study this year for their time and contribution to the report. In accordance with the UK Market Research Society (MRS) Code of Conduct (under which this survey was carried out), the identity of the participants in the research study and their responses remain confidential and are not available to the sponsors.

All the business leaders and subject matter experts who provided valuable insight into their respective areas of expertise and market experience, including the authors of the country and industry sections and subject-matter experts from Capgemini, Sogeti and OpenText.

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# PREVIOUS EDITIONS

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2009-10



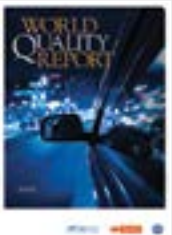
1<sup>st</sup> edition

2010-11



2<sup>nd</sup> edition

2011-12



3<sup>rd</sup> edition

2012-13



4<sup>th</sup> edition

2016-17



8<sup>th</sup> edition

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7<sup>th</sup> edition

2014-15



6<sup>th</sup> edition

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2017-18



9<sup>th</sup> edition

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2019-20



11<sup>th</sup> edition

2020-21



12<sup>th</sup> edition

2022-23



14<sup>th</sup> edition

2021-22



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