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# Conquer Testing Complexities With Automation And AI

A FORRESTER CONSULTING THOUGHT LEADERSHIP PAPER COMMISSIONED BY KEYSIGHT, MARCH 2022

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## Executive Summary

In technology development, companies collect great amounts of data, but they typically store it in functional silos, which creates artificial barriers to making holistic, agile design processes. By using data integration, analytics, AI, and machine learning (ML) both on-premise and in cloud-based environments, firms can fulfill long-standing promises in DevOps and TestOps. These promises are: 1) correlate performance through the development process from early design to manufacturing to field deployment and close the loop back to design; 2) enable rapid collection and reformatting of data, faster debugging of new product design, anticipation of manufacturing issues, and improved product quality; and 3) shift the way teams work through data-driven decisions.

In December 2021, Keysight Technologies, Inc. commissioned Forrester Consulting to evaluate data integration, analytics, AI, and ML. To explore this topic, Forrester conducted an online survey with 406 decision-makers in product or process design testing, measurement, debugging and/or design/test team data/analytics technology support at manufacturing and testing organizations in North America, EMEA, and APAC.



## Key Findings

### **Testing can't keep pace with the increasing complexity of products and testing.**

Eighty-four percent of surveyed test engineers said half or more of new validation and tests involve complex, multilayer subsystems or integrated systems. While respondents reported relatively high satisfaction with their organization's variety of testing methods, very few use an automated test approach or AI for integrating complex testing.



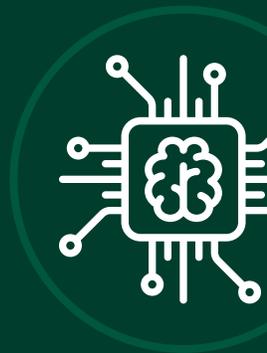
### **Complexity affects accuracy, coverage, and length of tests.**

Testing complexity has not only increased the number of tests, but also the length of the tests. Many types of tests cover much more than they need to, which leads to extended testing cycles. Accurately finding bugs/issues is a challenge that arises because of over-testing and complexity. Overall, this increases security risk and costs and extends product time-to-market.



### **Companies are interested in moving to more automated approaches and using AI for integrating complex test suites.**

Respondents said they understand making this move will increase their organizations' productivity, simulate product function or performance, and shorten design cycles. This reduces product time-to-market, yields higher customer satisfaction, and increases product sales or revenue.



## The World Of Testing And Validation Is Increasingly Complex, But Are Firms Keeping Up?

American football coach Vince Lombardi once said, “Perfection is not attainable, but if we chase perfection, we can catch excellence.” Product development and testing is a world in which perfection is not only difficult to achieve, but also one that is constantly shifting. Test engineers must constantly balance the desire for a perfect product with the practical and painful realities of time-to-market, cost, and change. Today, testing operations (TestOps) teams are looking to optimize performance through the development process by connecting developers and test engineers with transparent, data-rich insights on design debugging, manufacturing yields, and improving product quality. This search is characterized by the following elements:

- **Current testing systems have met the challenge — so far.** Test engineers are satisfied with current methodologies. Eighty-six percent of respondents said they are moderately or very satisfied with their organization’s current testing system. The design of any system is about the number of function blocks and how they are connected to form a whole. Test teams take what developers create and thoroughly examine function, form, and interoperability. To date, test engineers have been able to keep ahead of developers by understanding product design goals and methods, by creating simulations and scenarios to break the design, and by rigorously recording bugs, fixes, and testing cycles. But much of that is still done with a combination of tools, human smarts, and perseverance.

### 50% or more

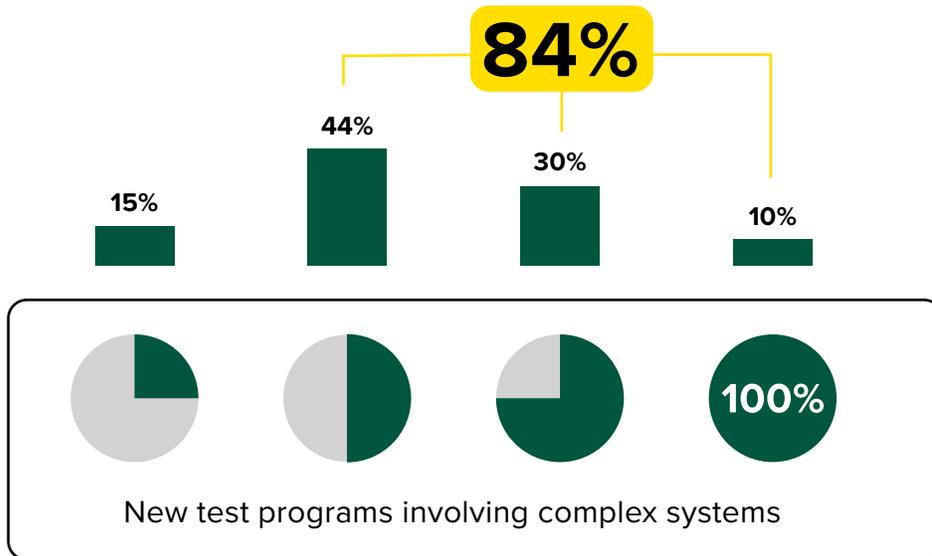
of projects and designs are either complex, multilayer systems or integrated systems, yet only 16% of respondents said their firm’s testing processes use AI for integrating complex test suites.



- **Test teams use a variety of methods to identify and resolve defects, bugs, and issues.** Running integrated testing of components, logging, tracking, and reporting on bug fixes at different levels and running simulations using synthetic data or scenarios are some of the many critical aspects to the validation and testing process. In this study, 84% of respondents said half or more of their organizations’ projects and designs are either complex, multilayer systems or integrated systems (see Figure 1).

**Figure 1**

**“What percentage of new test or validation product projects and designs involve either complex, multilayer sub-systems, or integrated systems?”**



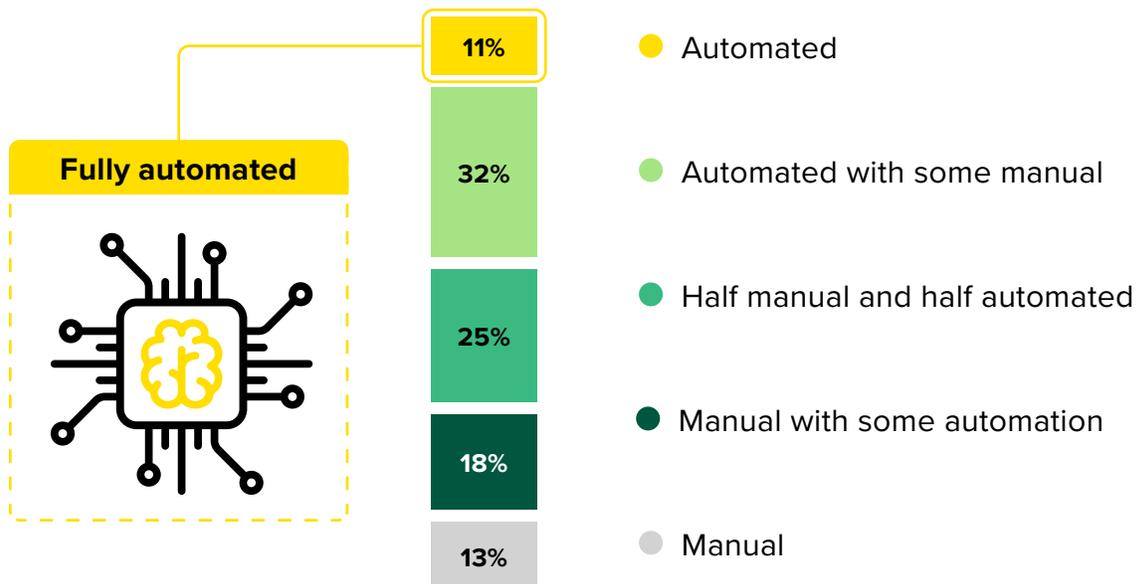
Base: 406 test operations decision-makers at organizations in NA, EMEA, and APAC  
Source: A commissioned study conducted by Forrester Consulting on behalf of Keysight, December 2021

- Testing inefficiencies happen as complexities in testing systems grow.** Test engineers work through complexities with different testing approaches and methods: 13% said their organization uses a fully manual approach and 69% said their organization’s test approach is at least half automated. Despite working with complex systems while applying some form of automation, the testing world isn’t totally on board with AI yet. Just 16% of respondents said their company uses AI to integrate complex test suites today while about one quarter said their company uses no data aggregation at all or uses data aggregation with weak analytics or reporting.

With only 11% of respondents’ companies fully automating testing and using AI for integration, the complexity of testing suites and methods surfaces many challenges (see Figure 2). Test engineers are coping as best they can with more complex products and rigorous demands. But as complexity grows, can current test approaches keep up?

**Figure 2**

**“What test approach does your company use today?”**



Base: 406 test operations decision-makers at organizations in NA, EMEA, and APAC  
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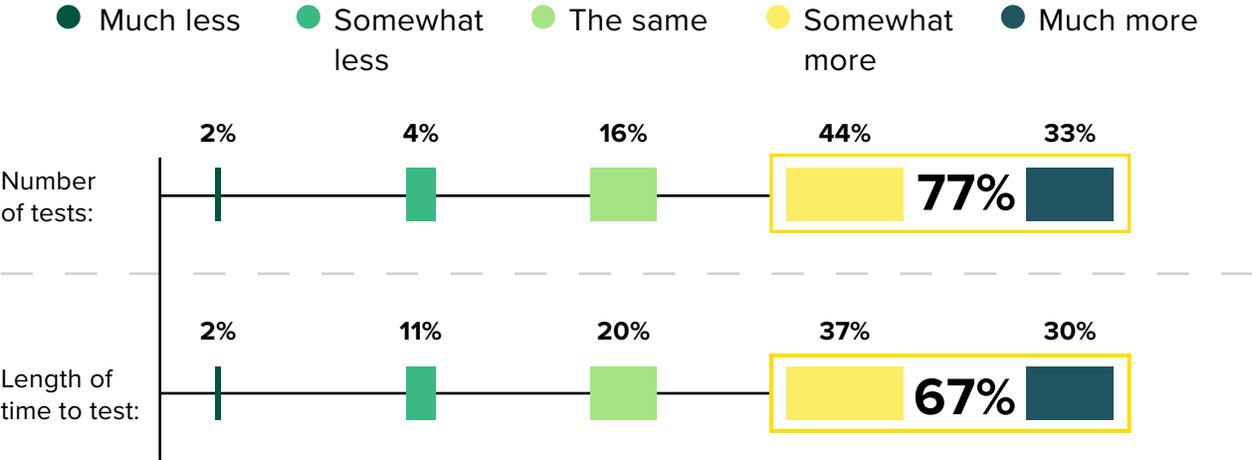
# The Goldilocks Testing Struggle: Too Much, Too Little, Or Just Right?

The members of the testing community within an organization can often feel like they are serving Goldilocks. Can they cover every testing scenario to ensure the product goes out into the world flawlessly? Probably not, and that kind of testing is probably too much. But test teams tend to aim for that anyway. Surveyed testing leaders said their organizations’ test routines cover more than needed across a range of testing types. Test engineers feel the challenge to cover every possible scenario and to avoid releasing faulty products, but that conflicts with the ever-increasing time-to-market challenge. This variety of testing complexities leads to:

- Decreased efficiency.** Complexity of testing has increased the number of tests (77%) and the length of time to test (67%) (see Figure 3). With more tests taking longer, overall efficiencies are decreased (see Figure 4). Respondents said that more than half the time, test routines cover more than needed. And only about one-third of respondents said they consider their organization’s test routines to be just enough. Larger amounts of testing do not correlate to greater bug insights and overall value.

**Figure 3**

**“Given that testing has become more complex in the last few years, what has been the impact on the typical test targets?”**



Base: 406 test operations decision-makers at organizations in NA, EMEA, and APAC  
 Source: A commissioned study conducted by Forrester Consulting on behalf of Keysight, December 2021

**Figure 4**

**Top Technical Testing Challenges**

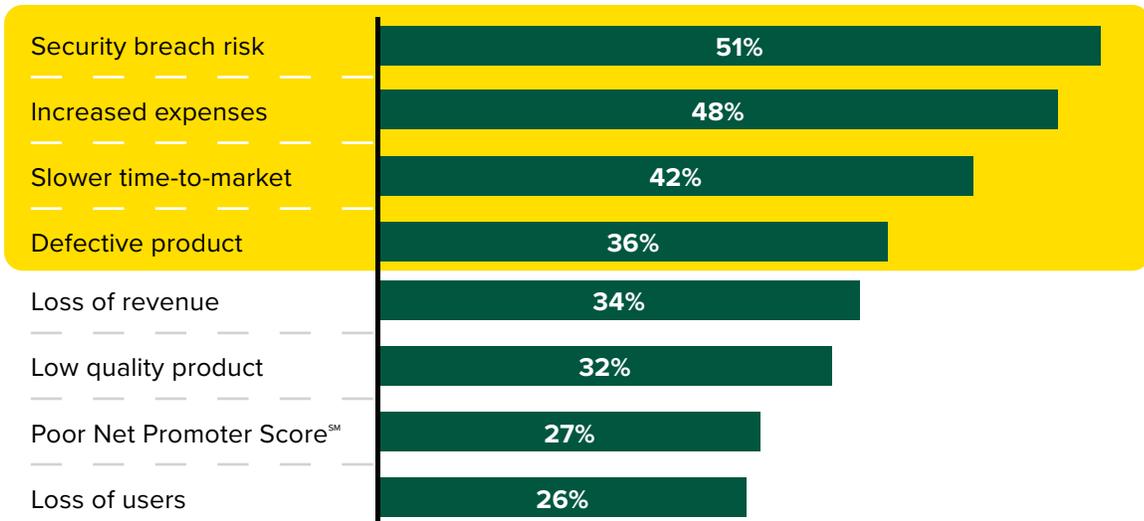


Base: 406 test operations decision-makers at organizations in NA, EMEA, and APAC  
Source: A commissioned study conducted by Forrester Consulting on behalf of Keysight, December 2021

- **Impacts on business results and products.** Testing complexities can have a direct impact on business results, especially when it comes to products and their processes (see Figure 5). As a result of testing challenges, the greatest impact on business results or product development processes are security breach risk (51%), increased expenses (48%), slower time-to-market (42%), and shipping defective products (36%). Testing thoroughly but also efficiently is critical to business success, and companies need to exploit the best testing technology to do so (see Figure 6).

**Figure 5**

**“What impact does your test challenges have on your organization’s business results or its product development process?”**



Base: 406 test operations decision-makers at organizations in NA, EMEA, and APAC  
Source: A commissioned study conducted by Forrester Consulting on behalf of Keysight, December 2021

## Figure 6

### Testing Journeys

#### Manual



- Too much time testing
- Inefficient bug detection
- Slower time-to-market

#### With Automation And AI



- Decreased time to test
- Efficient bug detection
- Faster time-to-market

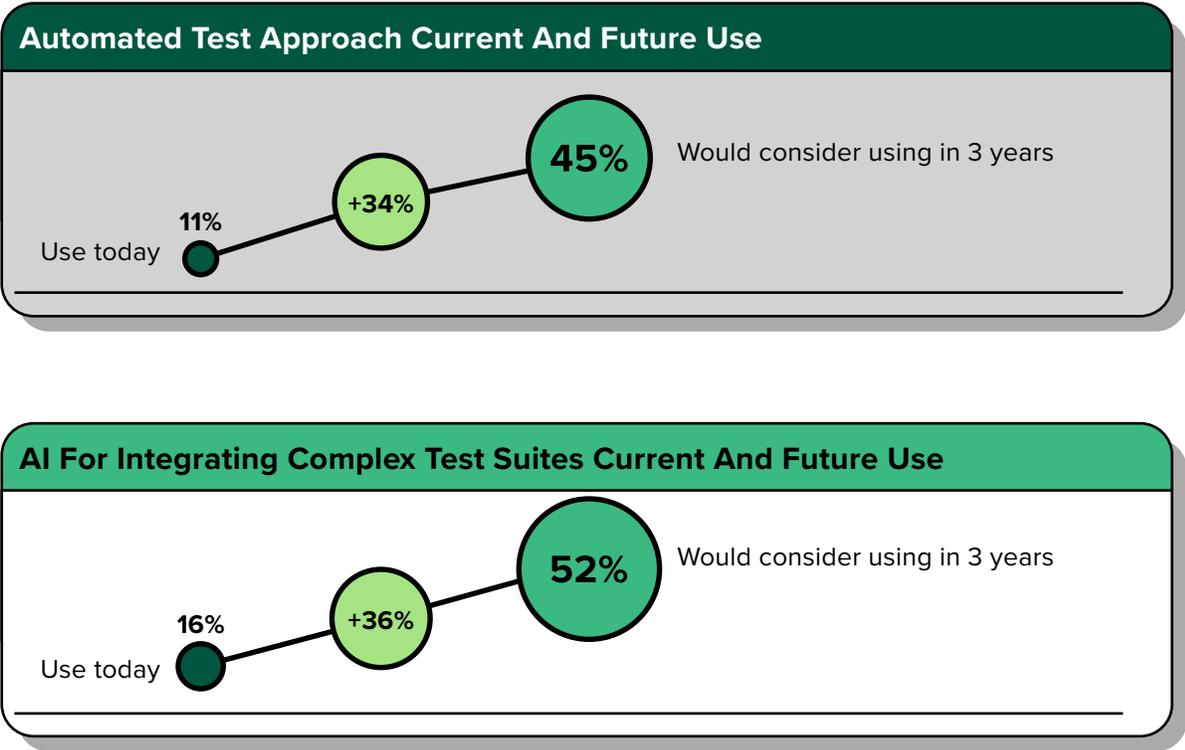
Base: 406 test operations decision-makers at organizations in NA, EMEA, and APAC

Source: A commissioned study conducted by Forrester Consulting on behalf of Keysight, December 2021

# Find 'Just Right' With Automation And Artificial Intelligence

The balance of comprehensive testing and speed can be achieved by using automation and AI for integrating and managing complex test suites, and moves companies to a more efficient development cycle. Forty-five percent of respondents said that in three years, their company would consider using a fully automated test approach compared to 11% who said their company's approach is automated today. That's a 34-point increase. And 52% of respondents said their company would consider using AI for integrating complex test suites in three years, compared to 16% who said their company uses AI today (see Figure 7).

Figure 7

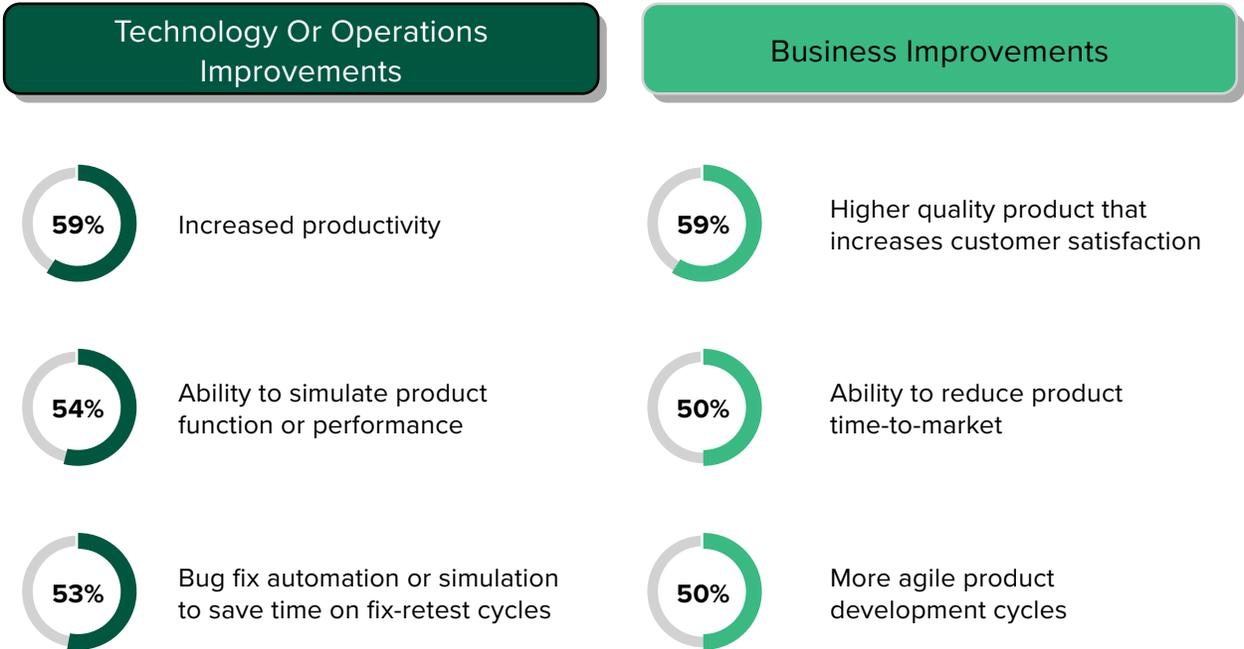


Base: 406 test operations decision-makers at organizations in NA, EMEA, and APAC  
Source: A commissioned study conducted by Forrester Consulting on behalf of Keysight, December 2021

Decision-makers understand this migration will:

- **Improve technology and operations capabilities.** Surveyed testing leaders said that by investing in new testing technologies, they expect their organizations to increase productivity (59%), improve their ability to simulate product function or performance (54%), save time on fix-retest cycles (53%), implement defect discovery across full product suites (48%), and shorten design cycles (46%). All of these improvements will help organizations find problems more accurately and more efficiently, which supports agile product development (see Figure 8).
- **Show business-specific benefits.** Improving the product development process will in turn yield business improvements. Respondents said they expect business benefits like higher quality products that increase customer satisfaction (59%), more agile product development cycles (50%), and increased product sales or revenue (46%) (see Figure 8).

**Figure 8**  
**Improvements From Investing In New Testing Technologies**



Base: 406 test operations decision-makers at organizations in NA, EMEA, and APAC  
Source: A commissioned study conducted by Forrester Consulting on behalf of Keysight, December 2021

- **Reduce time-to-market.** The ability to reduce product time-to-market is a critical benefit that respondents said they expect from improved testing automation. When asked to select the single biggest lever on reducing time-to-market, 23% of respondents selected “better analytics on current test and measurement data,” 18% selected “integrated software tools across the product development lifecycle,” and 18% selected “improved ability to share data across teams.”

## Key Recommendations

Striking the balance between perfect testing and the business realities of increasingly complex product suites, limited resources, and the pressure of time-to-market means test organizations must invest in automation and AI. Forrester's study yielded the following recommendations:

### **Reinforce the cost savings of moving to more automation.**

Automating mindless tests doesn't just reduce testing costs. It frees resources to be used better elsewhere.

### **Use AI for integrated testing.**

Using intelligent, integrated testing provides better (but not necessarily more) testing coverage and the ability to support agile product development and release.

### **Reduce over-testing rates.**

Firms need to get better at identifying what truly needs to be tested (and no more than that) to increase efficiencies.

### **Augment human test engineers; don't replace them.**

Humans are still critical to the testing process, which requires a diversity of knowledge, identification of context, and handling a highly variable set of inputs. Automation will transform human jobs by taking the most rote tasks off their plates.

### **Facilitate integration between hardware and software.**

Automation and AI can ensure complicated, multi-environment product suites work from end to end, from hardware through to software. In the testing ecosystem as well, procedures and routines that require both hardware and software can further complicate the testing scenario and create further complexity.

### **Form a tighter relationship to holistic business results.**

Forrester sees an opportunity for test teams to make a compelling business case for implementing the culture and process/technology changes noted.

## Appendix A: Methodology

In this study, Forrester conducted an online survey of 406 test operations decision-makers at organizations in North America, EMEA, and APAC to evaluate current testing capabilities and to hear their thoughts on investing in automation (including AI). Questions provided to the participants asked about their organizations' current testing environments, future investments, challenges, and expected outcomes from testing automation. The study was completed in December 2021.

## Appendix B: Demographics

REGION	
EMEA	35%
APAC	33%
NA	31%

EMPLOYEES	
20,000 or more	15%
5,000 to 19,999	23%
1,000 to 4,999	34%
500 to 999	27%

RESPONSIBILITY FOR TESTING STRATEGY	
Final decision-maker	58%
Part of a team making decisions	34%
Influence decisions	8%

POSITION	
IT or technology	57%
Manufacturing	17%
Operations	11%
Product management	7%
Product development	5%
Engineering	3%

INDUSTRIES (TOP 6)	
Technology or technology services	17%
Manufacturing and materials	16%
Telecommunications services	15%
Consumer product goods or manufacturing	13%
Healthcare	11%
Transportation and logistics	10%

LEVEL	
C-level	15%
VP	11%
Director	20%
Manager	42%
Project manager	8%
Full-time practitioner	4%

PLANS FOR TESTING TECHNOLOGY USING AI OR ML	
Planning to implement in the next 12 months	33%
Implemented, not expanding or upgrading	13%
Expanding or upgrading implementation	51%
Decreasing or removing	3%

Note: Percentages may not total 100 because of rounding

## **Appendix C: Supplemental Material**

### **RELATED FORRESTER RESEARCH**

“RQ 2.0: Assess Your Readiness For Artificial Intelligence, Automation, And Robotics,” Forrester Research Inc., October 18, 2021



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