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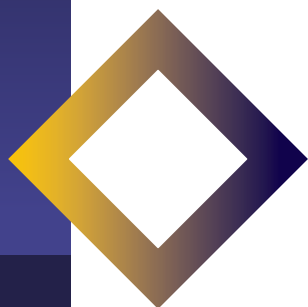
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AI-Augmented DevOps: The Next Frontier

COMMISSIONED BY  Tricentis



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Executive Summary

FOR YEARS, we've heard about the advantages of augmenting DevOps pipelines with artificial intelligence (AI) and its subsets, like machine learning (ML). In theory, it seems obvious. But in practice, we're still early in both the DevOps (r)evolution and the use of AI to optimize software development processes.

Our research aims to explore a few key questions about this coming phenomenon: Do DevOps teams see the potential of AI in their development pipelines? If so, where do they expect the greatest impact? And are there differences in expectations of value from AI-infused DevOps based on DevOps maturity level or geographic region?

To answer these and related questions, [Techstrong Research](#) and [Tricentis](#) partnered on a global survey of more than 2,600 DevOps practitioners and leaders across a wide range of roles and industries (see Demographics, p 19). Our research and analysis found:

1. Organizations of all sizes and across all DevOps maturity levels are anticipating significant benefits from AI-augmented DevOps. Respondents are overwhelmingly optimistic: AI-augmented DevOps promises to provide substantial value and improve DevOps operations and testing. Nearly 90% of respondents said

AI-augmented DevOps promises to provide substantial value and improve DevOps operations and testing.

they're aware of significant potential benefits of AI-augmented DevOps.

2. AI-infused DevOps addresses significant business and technical challenges. The top anticipated business benefits include: Reducing the skills gap by making it easier for junior employees to perform more complicated tasks, improving customer experience and reducing costs. Top anticipated technology benefits include: Improving software code quality and increasing release frequency. Notably, for many, this optimism is rooted in the high value they are already receiving from their current AI investments across the DevOps pipeline.



Our research indicated that the Asia-Pacific region (APAC) was the most optimistic about the anticipated impact of AI in DevOps, followed by North America (NA) and Europe, the Middle East and Africa (EMEA).

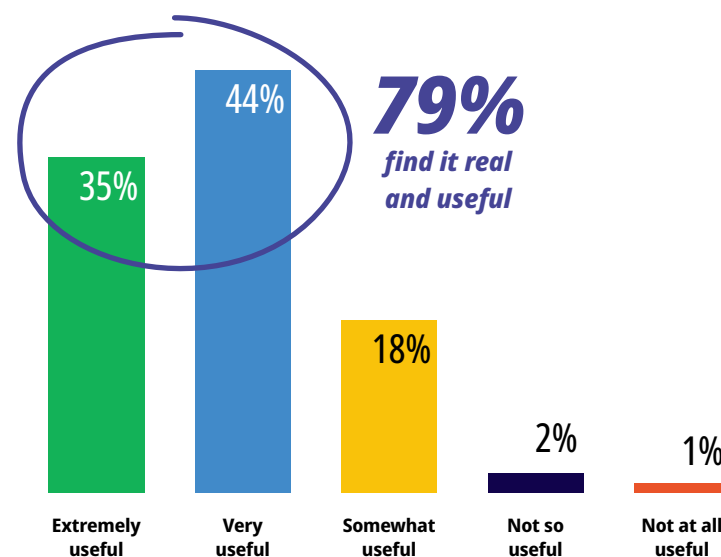
3. Most DevOps groups expect AI-augmented DevOps to have the greatest impact on testing. Not surprisingly, we found that respondents are eager to apply AI-augmented DevOps to areas they're struggling to automate. Nearly two-thirds (65%) said functional software testing is especially well-suited to and would benefit greatly from AI-augmented DevOps. Why is testing poised to see the greatest benefits from AI? The answer is simple – DevOps success requires test automation at scale, which generates massive amounts of complex test data and requires frequent changes to test cases – perfectly aligning with the capabilities of AI to identify patterns in large data sets and offer insights that can be used to improve and accelerate the testing process.

Early AI Investments Expected to Have a Significant Impact on DevOps

Intuitively, leveraging AI/ML (AI)¹ within a DevOps pipeline makes sense, given the increasing complexity of digital landscapes and the opportunity and need for optimization. AI is pretty good at making sense of seemingly disparate numbers and finding patterns across very large data sets. But intuition and solid evidence are two different things.

We set out to back up our gut feeling—to see if AI was, in fact, making a difference in the operations of DevOps. We first looked at the trailblazers, or early adopters. In terms of DevOps, these mature companies are marked by the progress they've made in streamlining their software development capabilities over the past five to seven years, and their mature and refined pipelines and processes. These DevOps organizations are cloud-native and use DevOps workflow pipelines, toolchains, automation and cloud technologies. Moreover, they use infrastructure-as-code (IaC) to deploy a flexible infrastructure, further realizing value from software development excellence. We figured these large organizations (52% of the mature respondents had over 10,000 employees) would be the first to leverage AI since they've been working for years to refine and optimize their processes. It turned out we were right; mature organizations are embracing AI within their DevOps processes, with 79% reporting that is extremely or very useful to them today.

Do Mature DevOps organizations find AI-augmented DevOps real and useful today?

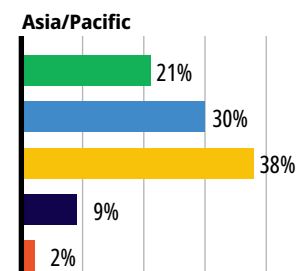
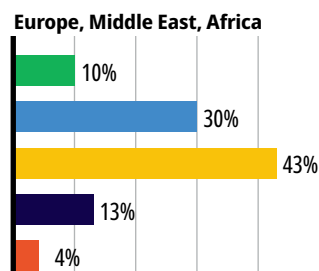
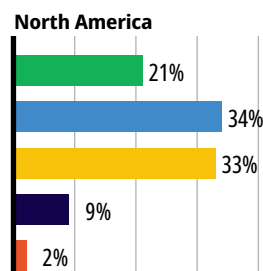


¹ML is a subset within AI, which has risen to prominence both because of advancements in machine learning algorithms (supervised, unsupervised and deep learning) and the cloud has enabled massive increases in the ability to aggregate data and apply ML algorithms (primarily unsupervised). In this report, we'll use the abbreviation AI, but we're referring to the broader category of techniques that includes machine learning.

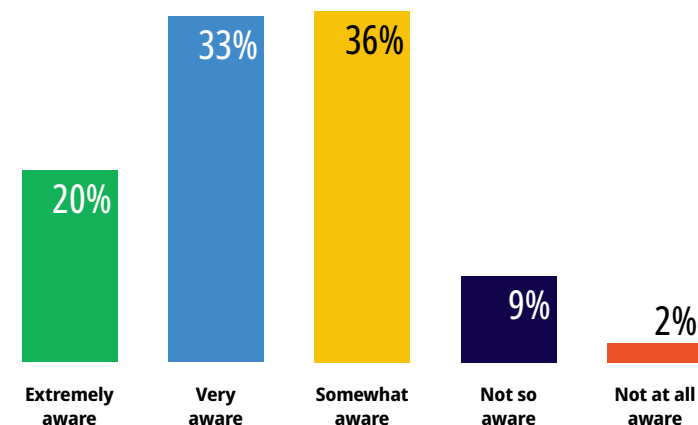
But what about teams that aren't as far along in their DevOps maturity journeys? Will they embrace the value that AI can bring to DevOps?

The answer here is also yes. While these organizations were less likely to report that AI is useful to them today, it is clear that many see the potential. Across all DevOps maturity levels, more than 50% of respondents said they are extremely or very aware of the positive impact AI can have. So what can we make of the significant number of respondents who said they are only “somewhat aware” of the benefits? AI-augmented DevOps technologies are still fairly new, and most organizations are still in the early stages of adoption and implementation.

If we break down this question by region:



Rate your current understanding of the benefits of AI to improve your DevOps process



When asked about their understanding of the benefits, North American and APAC respondents have a similar level of awareness, with EMEA lagging slightly behind. That tracks with DevOps adoption in general when counting tech hubs like India in the APAC region.

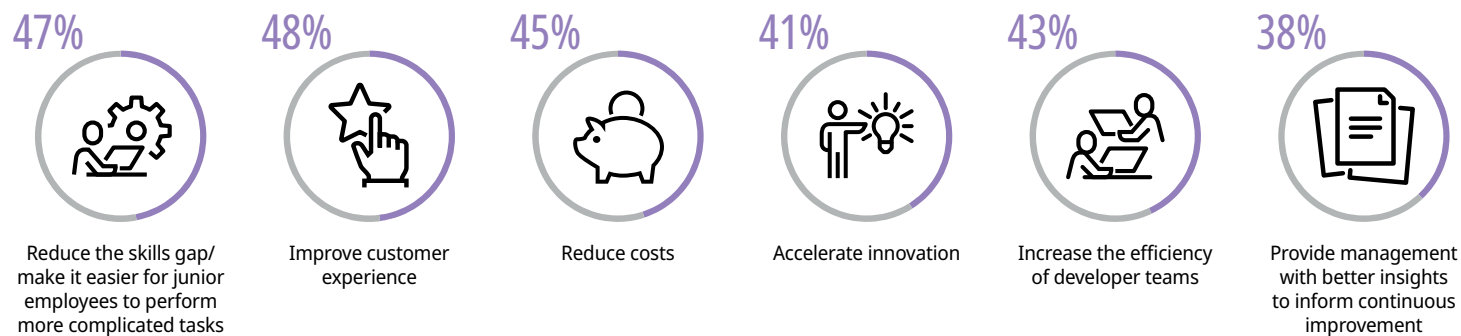
AI-Infused DevOps Addresses Significant Business and Technical Challenges

Ultimately, DevOps organizations are interested in technologies that help create higher-quality software and deliver better business outcomes. Across the board, survey respondents had high hopes that AI-infused DevOps would deliver meaningful benefits in various crucial technology and business areas.

Another indication that we're in the early stage of AI-infused DevOps adoption is the lack of clarity about the specific business problem(s) addressed by the technology, as evidenced by the roughly equal ranking of the answers. When we asked which challenges they hoped AI could help them address, respondents said they expect the technology to help across the board, addressing issues such as improving customer experience, recognition of patterns across large amounts of data and making it easier for junior employees to perform more complicated tasks.

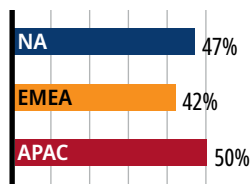
DevOps brings with it significant levels of automation across workflow pipelines, each of which continuously generates a high volume of data. Most often, organizations start their DevOps journey by implementing continuous integration and continuous delivery (CI/CD), automating repetitive unit, functional and regression testing, and implementing continuous monitoring tools. These process changes generate large caches of results data built up over repeated CI/CD runs and the associated automated test cycles. As DevOps practices mature and release velocity increases, the volume of data can quickly become unmanageable, creating a valuable but often untapped cache of data. Artificial intelligence and machine learning algorithms can help DevOps teams mine this data to generate valuable insights that inform continuous improvement across the entire DevOps lifecycle.

What business challenges do you expect AI-augmented DevOps will address?

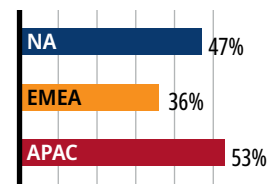


The perceived business challenges don't vary significantly based on region, though there is some skepticism on the part of North Americans regarding the ability of AI-infused DevOps to increase efficiency. Both NA and EMEA questioned whether AI would provide better insights, which is a bit counterintuitive given the value of machine learning in most other contexts to provide insights not available using manual analysis. As evidenced above, APAC is very optimistic about AI's impact on DevOps across the board.

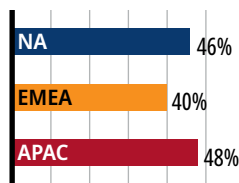
Reduce Skills Gap



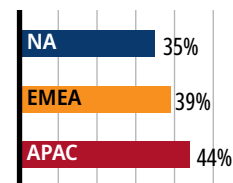
Improve Customer Experience



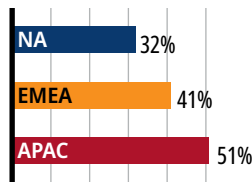
Reduce Costs



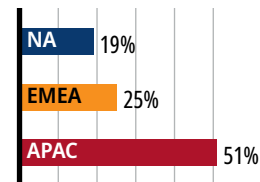
Accelerate Innovation



Increase Efficiency



Better Insights



Survey respondents weigh in on their expectations of AI-augmented DevOps

It could be a great way to automate standards and best practices.

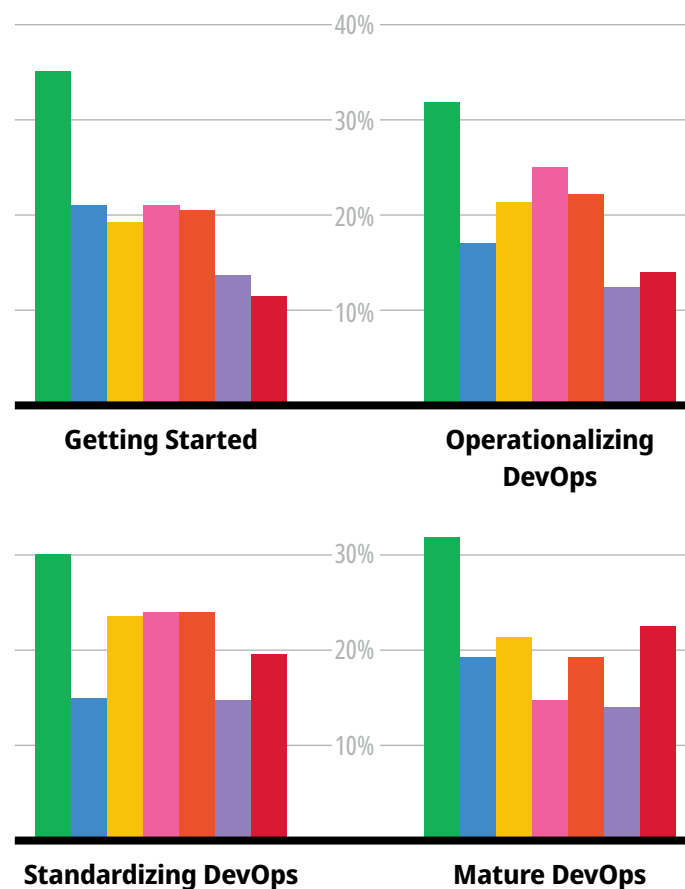
Improve overall efficiency in the software development process and reduce the timeframe for rollouts.

Reduce toil, help team members (not only developers) to focus on value-added activities, support teams in managing huge volumes of data and eliminate false-positive or redundant alerts...

AI should analyze all CI/CD workflows and merges and suggest fixing workflows that do not match 'standard' operations or do not meet desired security criteria. It should suggest whether a merge request may cause regression/omission issues of these standards (security, deployment, etc).

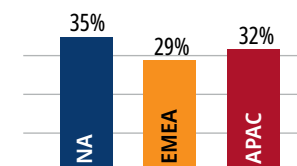
What about the technical challenges facing DevOps teams? Across all levels of maturity, the expectation is that AI will have the biggest impact on increasing software code quality. The speed improvements from using DevOps principles result in the delivery of new, extremely valuable capabilities to the business. As the DevOps environment scales, manually writing test automation code is not sustainable. Thus, organizations are seeking AI-enabled approaches to help testing keep pace with the increased rate of change and accelerated delivery speed.

What technical challenges do you hope/think AI-augmented DevOps will address? (key at right)

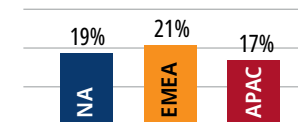


If we look at the regional breakdown of this data, it seems that all three regions have similar expectations of AI-infused DevOps to solve technical issues. An increase in code quality is the top-ranked expectation, followed by problem diagnosis, codifying knowledge and increasing the velocity of releases.

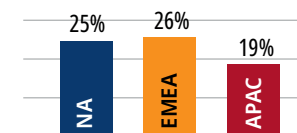
■ Increase code quality



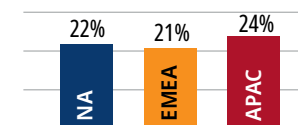
■ Defect prevention



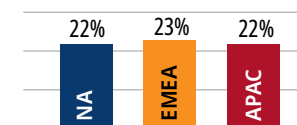
■ Problem diagnosis



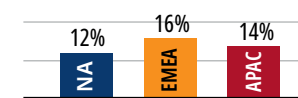
■ Increase velocity of releases



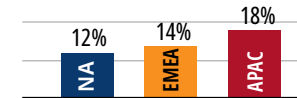
■ Codifying knowledge



■ Reduce misconfigs



■ Spot security vulns earlier



AI-Augmented DevOps Will Have the Greatest Impact on Test and Build

Across all survey participants, testing is where organizations are expecting the greatest value from AI-augmented DevOps, with nearly 70% of respondents rating the potential of AI-augmented testing as extremely or very valuable.

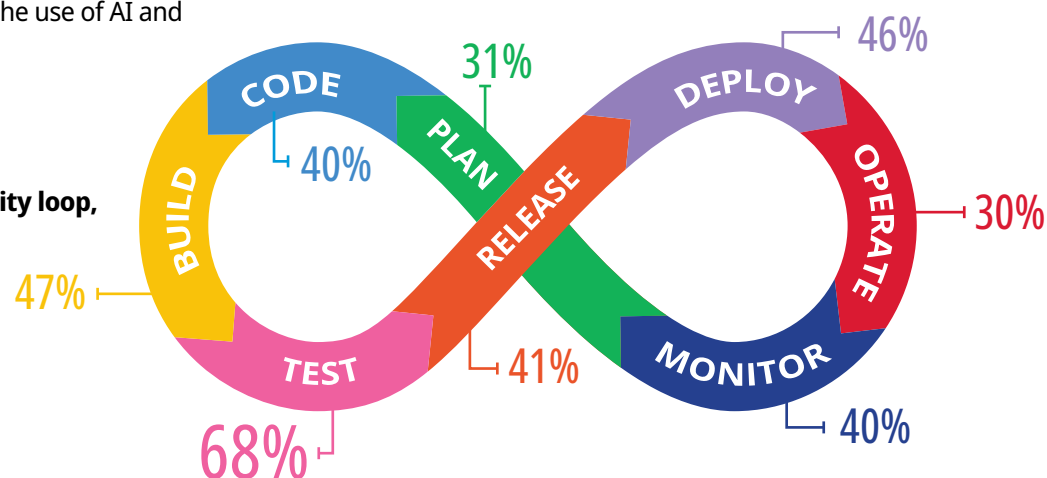
This should come as no surprise: Testing involves large amounts of complex testing scenarios and test data and many organizations struggle to scale test automation to the level their DevOps environment requires. This presents a major pain point for DevOps organizations. Given that quality is critical and testing can be a bottleneck, leadership is keen to apply new technologies like AI to help improve testing speed and scalability.

The build process can also benefit greatly from the use of AI because these steps involve many repetitive tasks that can be made more efficient through the use of AI and

machine learning. AI can also improve the effectiveness of automation by quickly identifying and resolving issues with the build and prioritizing the resulting alerts.

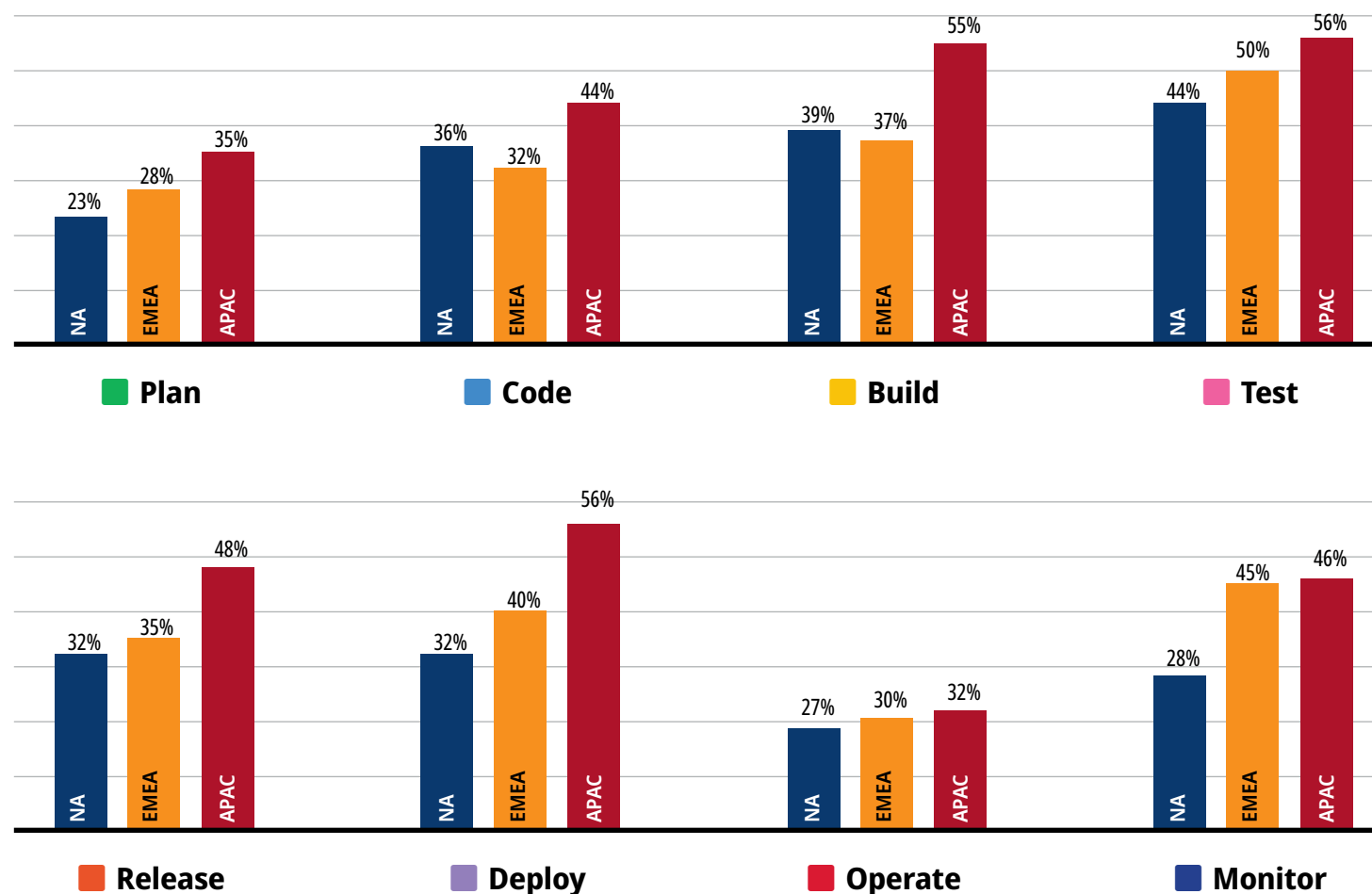
Additionally, 54% of mature DevOps organizations said AI is highly valuable for monitoring compared to just 40% across all respondents. Why do mature DevOps organizations see more value in monitoring? Many DevOps teams are overwhelmed by the volume of alerts and monitoring data that their software systems produce. AI can enable DevOps engineers to leverage the untapped pools of log, tracing and alerting data, enabling them to detect, prioritize and respond to issues more quickly and effectively – and give them more time to focus on the creativity and innovation required to sustain an advanced DevOps practice.

When you look at the DevOps infinity loop, what areas do you expect to see the greatest impact from AI?



Regionally, the expectations are consistent with the answers to previous questions, with APAC being the most optimistic regarding the impact of AI on DevOps. North America had marginally fewer expectations and EMEA was closer to North America than APAC.

In all regions, it's expected that AI-infused DevOps will have the greatest impact on testing.



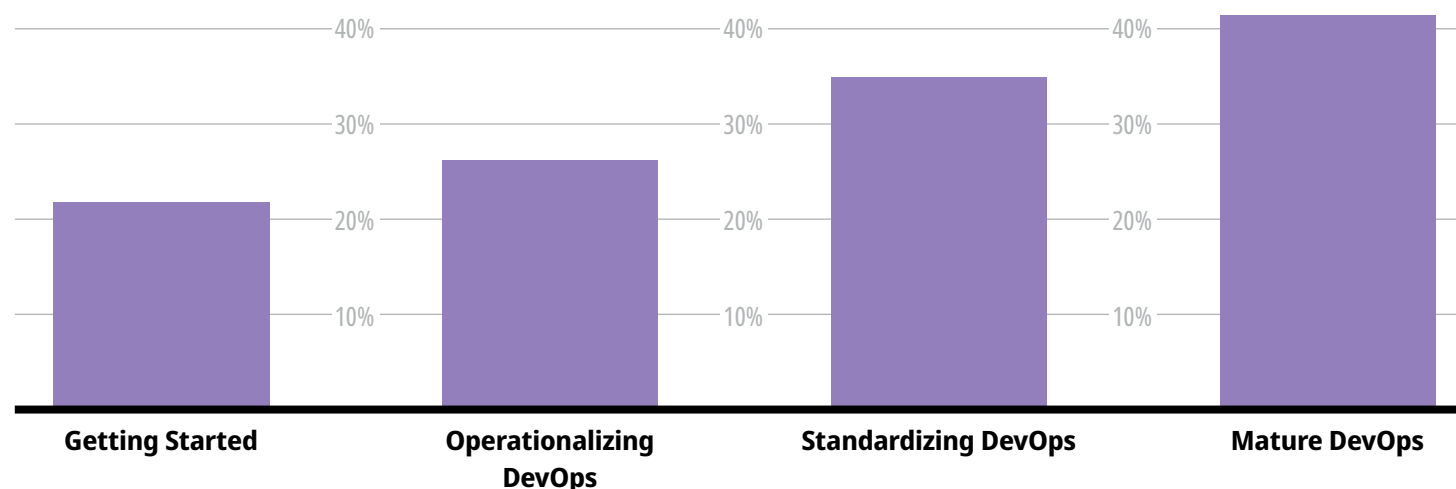
Test Automation, DevOps Maturity and the Potential of AI

Many organizations believe that AI-augmented DevOps is best suited to time-consuming and labor-intensive tasks. As release velocity increases, the pipelines need to process a greater volume of data at a higher frequency, which puts pressure on all aspects of the process—especially testing.

As organizations mature and scale their DevOps practices increasing levels of test automation become a necessity. But that is easier said than done; even in mature DevOps organizations, testing often remains the number-one bottleneck.

In this survey, only 21% of respondents getting started with DevOps reported that they have automated more than half of their software testing efforts. For mature DevOps organizations, the percentage is 40%—nearly double. Clearly, increasing test automation is an indicator of DevOps maturity, yet there is still a long way to go. Even in these mature DevOps organizations, most teams are still automating less than half of their testing.

Respondents in each DevOps maturity level who have automated more than half of all testing

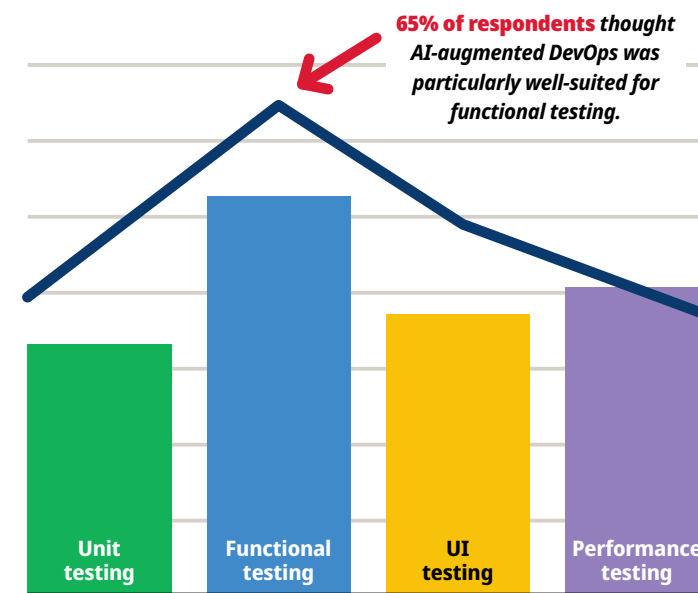


Predictably, respondents ranked testing as both the most valuable application of AI technology today and the most promising for the future, across all DevOps maturity levels.

But not all testing is the same. When we asked respondents what types of testing they were struggling to automate most—and where they thought AI-augmented technology could help the most—functional testing ranked first.

What types of testing do you think AI-augmented DevOps is well suited for automating?

What types of testing are you struggling to automate?



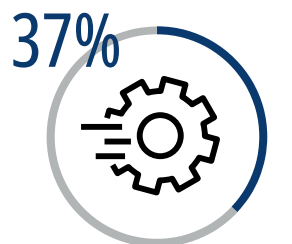
How AI in DevOps Augments Testing

"AI can be leveraged to augment software testing in many ways. Most organizations today, including mine, still depend heavily on manual testing; mainly because traditional automated test scripts require too much time to maintain and quickly become unreliable. Today, AI-augmented DevOps is well-suited for automating specific types of testing including unit testing, functional testing, UI testing and performance testing. The big advantage is the time saved – thanks in part to the ability to create automated tests without the need for code, which saves valuable time for all teams involved. With emerging AI technologies enabling vendors to create and offer unique, innovative software testing solutions, the entire process of testing can evolve over time, eliminating many of the common problems and bottlenecks."

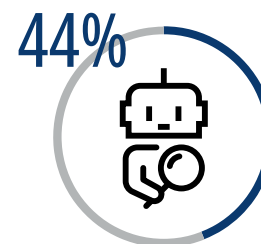
—A DevOps leader in a U.S.-based financial services organization

How are you using AI to augment the testing process?

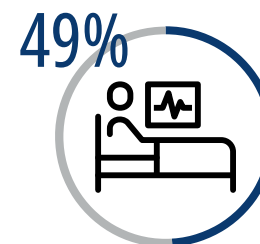
Let's dig deeper into the impact of ML/AI on testing. We asked respondents if they are able to customize testing based on code changes. If we look only at those respondents using ML/AI to select the most appropriate tests based on those changes (25% of respondents), they felt that AI augments testing by reducing test case maintenance (49%), focusing testing on the highest risk areas (44%) and identifying the root cause of failed tests (43%).



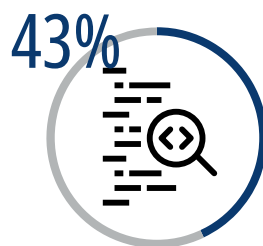
Accelerate the creation of automated test cases



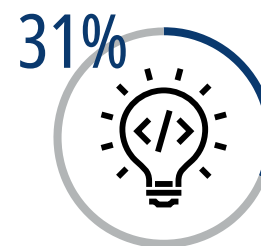
Focus testing on the highest risk areas



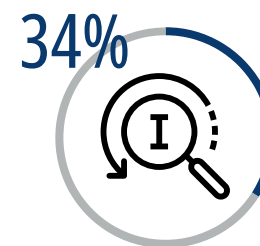
Reduce test case maintenance with self-healing



Identify the root cause of failed tests



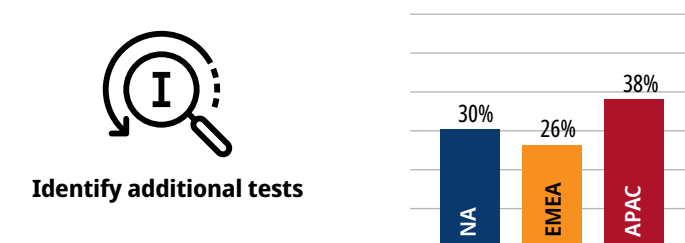
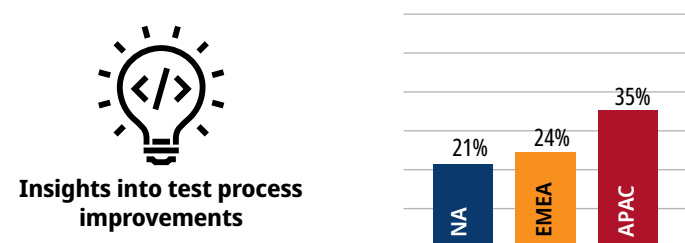
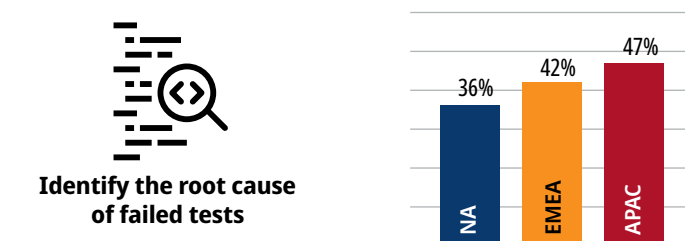
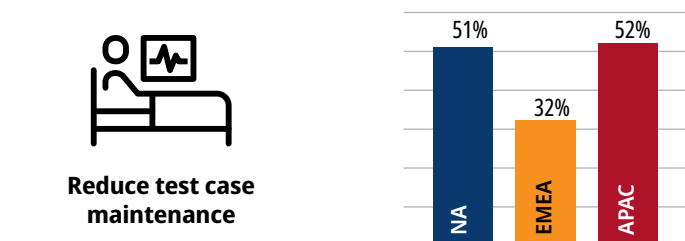
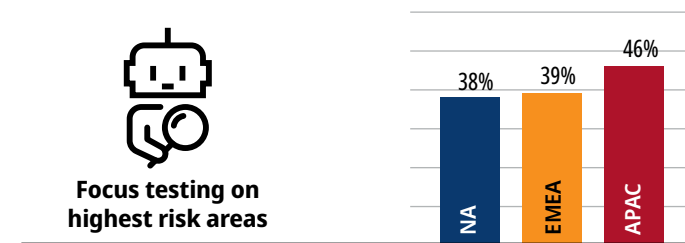
Provide insights into test process improvements



Help identify the tests to run based on changes in the application

**Respondents using ML/AI to select the most appropriate tests*

If we look at this regionally, APAC is well ahead in their usage of AI to customize testing based on code changes. APAC also realizes significant value in all examples of using AI to augment the testing, which once again, shows that APAC is forward leaning regarding integrating AI into DevOps.



Challenges to Overcome

As with any new technology, there are challenges that can derail the success of even the most promising use cases and technologies; AI-infused DevOps is no exception. Far and away the biggest issue is the lack of AI skills (44%), followed by sufficient budget (25%) and tool selection (19%). And the lack of AI skills is consistent across DevOps maturity levels.

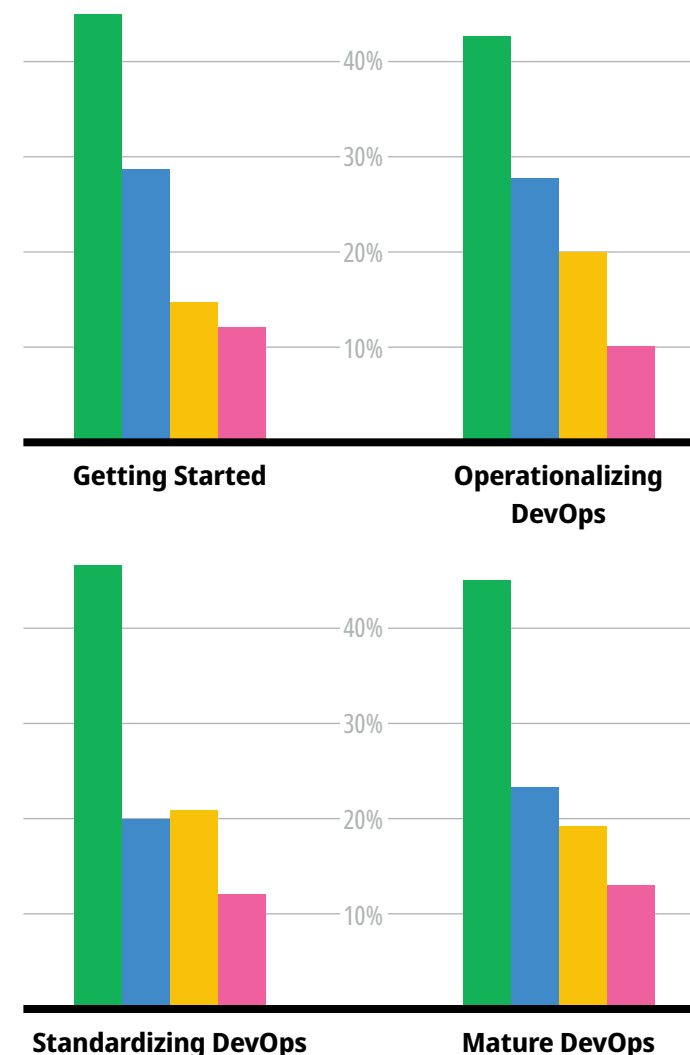
To address the gap, organizations will be counting on both their vendors and internal resources to help them implement AI-augmented DevOps. In fact, respondents' preferences in this area are very evenly split. This is further evidence of an early market; neither internally sourced nor the use of software/service providers are favored because it's not yet clear what each party can bring to the table.



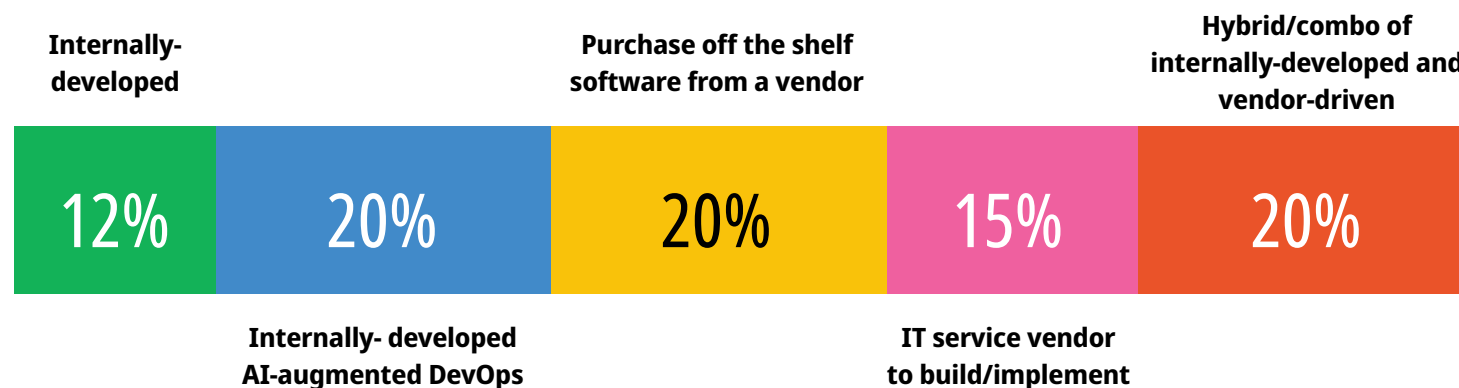
believe the lack of AI skills is the biggest challenge to overcome.

- Lack of data and AI skills
- Budgeting
- Tools selection
- Organizational structure

What is your biggest challenge to implementing AI-augmented DevOps?



What approach(es) are you currently using, or do you expect to use, to adopt AI-augmented DevOps?



Interestingly, organizations with less-mature DevOps programs indicated they will buy a vendor solution or use internally-developed AI-augmented DevOps at a higher rate than using a hybrid approach involving both vendor-driven and internally-developed solutions. Yes, mature DevOps organizations clearly believe hybrid is the way to go for them, indicating they know how challenging it is to both manage DevOps at scale and build and maintain analytics. They'll pragmatically leverage whatever resources they can muster, whether internal or external, to make progress.

Conclusion: AI Will Fuel the Next Wave of DevOps Innovation

ORGANIZATIONS of all sizes around the globe can agree on one thing: They expect AI in DevOps to provide significant value across the entire DevOps cycle. Faster and more efficient DevOps will ignite a wave of innovation driven by organizations shipping better code faster.

As AI-infused DevOps offerings mature, this technology will be essential to helping organizations remain competitive. Survey respondents feel that AI-driven improvements at every stage of the DevOps cycle will enable a variety of business and technology benefits like improving customer experience, closing the skills gap of junior employees, accelerating innovation and reducing costs. Notably, respondents think AI has the highest impact when applied to the most time-consuming and repetitive stages of the DevOps loop—testing and building.

Companies and their workforces need to keep evolving and carefully consider how AI and DevOps can continue to mature together. The lack of AI skills is a major stumbling block. Thus, investing in upskilling for employees and reshaping organizational culture will prepare your company to use AI in DevOps to its fullest potential and follow the best practices engineered by mature DevOps teams.

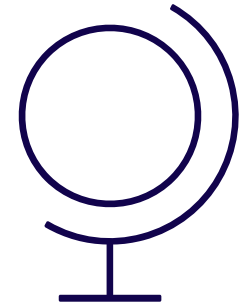
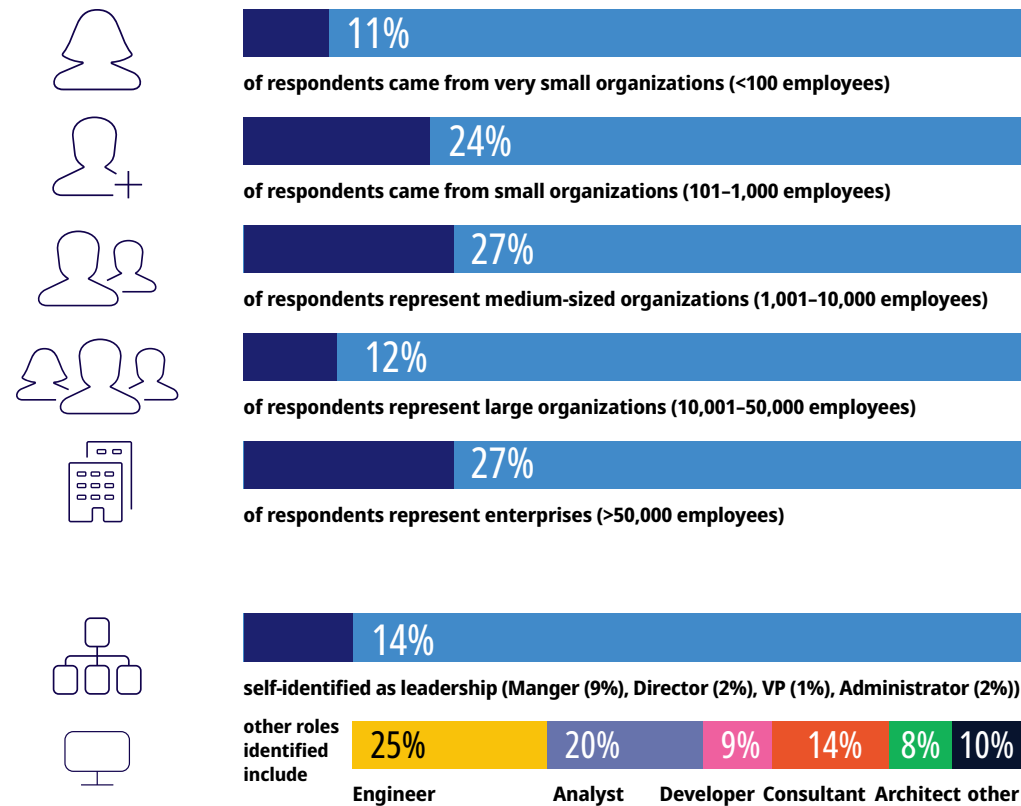
Total transformation can't happen alone. A full 80% of respondents indicated they will rely on IT service and software vendors—or will take a hybrid approach with some internal development—to infuse their DevOps efforts with AI.

It's clear that AI has the potential to revolutionize DevOps practices. Companies at every stage of maturity are primed to begin incorporating AI technology into their software planning, development, deployment and operations practices.

Survey Demographics

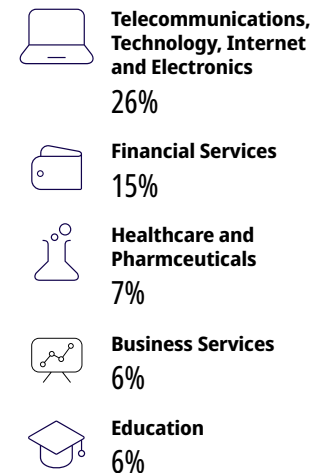
Techstrong Research conducted a global study on AI augmentation in DevOps environments. The survey was conducted during May and June of 2022. A total of 2,670 respondents from over 60 countries participated in the study, with more than 1,550 completing the survey

Respondents hold a variety of roles and come from a broad range of organizational sizes:



Survey responses came from a global cross-section of 89 countries in three major regions: **North America (47%), Europe (31%), APAC (15%)** and **LATAM (6%)**.

Twenty industries were surveyed, including:



About the authors



MIKE ROTHMAN is the GM of Techstrong Research, bringing 30+ years of experience as a research analyst and security leader and is recognized as a voice of reason for business leaders in an often over-hyped and extremely complex security industry. For the past 10 years, his research has focused on cloud security and most recently DevSecOps and securing cloud-native environments, helping organizations navigate this disruptive migration without compromising on information and infrastructure protection. Mike also serves as Chief Strategy Officer for Techstrong Group and appears frequently at industry conferences and on the various Techstrong TV streaming video programs.

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About Tricentis

Tricentis is a global leader in enterprise continuous testing, widely credited for reinventing software testing for DevOps, cloud, and enterprise applications. The Tricentis AI-based, continuous testing platform provides a new and fundamentally different way to perform software testing. An approach that's totally automated, fully codeless, and intelligently driven by AI. It addresses both agile development and complex enterprise apps, enabling enterprises to accelerate their digital transformation by dramatically increasing software release speed, reducing costs, and improving software quality. Tricentis has been widely recognized as the leader by all major industry analysts, including being named the leader in Gartner's Magic Quadrant five years in a row. Tricentis has more than 2,100 customers, including the largest brands in the world, such as McKesson, Accenture, Nationwide Insurance, Allianz, Telstra, Dolby, and Vodafone.

About Techstrong Research

Techstrong Research accelerates the adoption of disruptive technologies that drive business outcomes and provide actionable strategies in rapidly changing markets. We are the only organization serving the needs of IT leaders, practitioners and the industry ecosystem with research, analysis, content, events and education. We bring deep knowledge about today's leading technologies such as DevOps, cloud, data and AI/ML, security/governance initiatives and supporting infrastructure. We offer our customers a holistic business perspective essential to adapt and thrive in the digital economy. The Techstrong Research team has the knowledge, experience and credibility earned by working with hundreds of businesses across many industries to provide consulting, thought leadership and research services.

Techstrong Research is relentlessly focused on the business outcomes of disruptive technologies.

