spring
by VMware Tanzu

The State of Spring 2024

Presented by Tanzu

vmware
by Broadcom

Introduction

A lot has changed in the software development world since our previous State of Spring report. The pace of technological change is only accelerating, creating new opportunities and new challenges for anyone who wants to develop great software. AI has opened new application possibilities and new opportunities for accelerating development.

With so many exciting changes, it's more important to keep software up to date than ever, but it's becoming increasingly difficult for stakeholders to keep pace with releases. While 55% are running the latest version of Spring Boot, 41% are still running Spring Boot 2.7.

This report explores the trends that are shaping the future of software development—from Gen AI to Kubernetes to scale to zero—and looks at new Spring projects and open source technology trends. *Testcontainers* are taking off—more than half (53%) of stakeholders are already using them—and 54% want to learn more about *application observability.* A significant number of Spring environments (8%) are already taking advantage of Spring AI—our just-released module that streamlines incorporation of AI in Spring apps—and 73% are moving to adopt AI-supported development tools.

This report is divided into four sections:

"Spring"ing into the Future

Architectural marvels and tech wonders

Blossoming Projects

Spring's hottest innovations

AI Evolution

Navigating the future of development

Spring is your Oasis

Essential resources for developers facing change

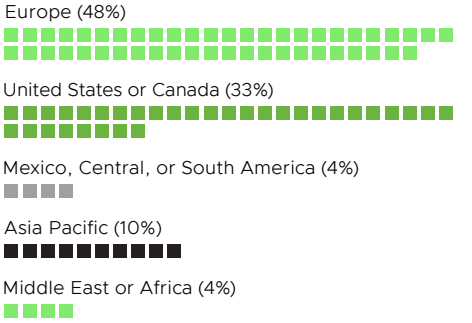
Demographics

VMware commissioned Dimensional Research to conduct this study to understand the experiences and attitudes of individuals responsible for adoption and use of Spring. Our study surveyed active Spring developers, architects, and development managers across organizations of different sizes. This year's survey included new questions in emerging areas of interest such as the use and incorporation of Generative AI in development. We also asked about the expected lifetime of a Spring application for the first time. A third (33%) reported the expected lifetime was 2-5 years, with another third (34%), reporting 6-10 years; 9% said 11-20 years.

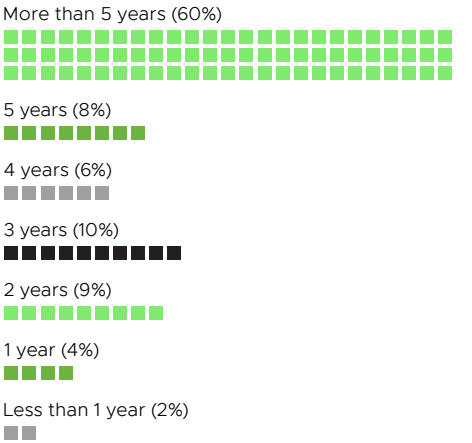
Our 2024 survey included a total of 1,464 qualified individuals. A wide range of roles, regions, and job levels are represented. In particular, 48% of respondents were hands-on developers, 19% were development managers, and 28% were architects, identical proportions to the previous survey. The majority of stakeholders (85%) surveyed had 3 or more years of experience with Spring.

This research covers a wide range of industries including technology (41%) and financial services and insurance companies (16%). All major sectors are represented, including retail (5%), services (6%), government (6%), and healthcare (4%).

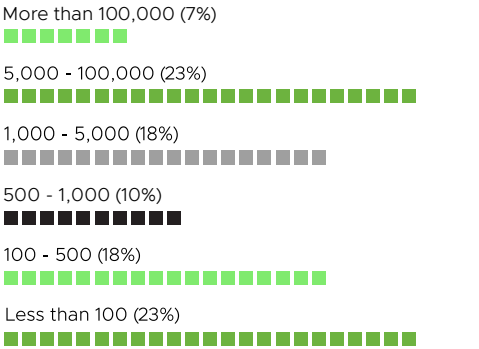
REGION



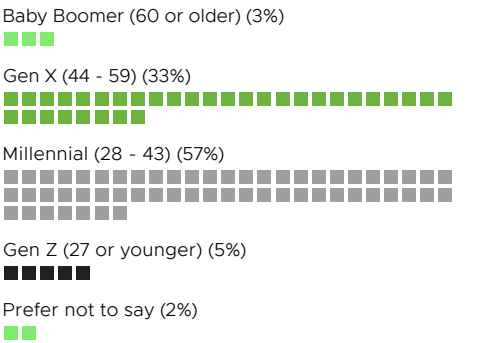
YEARS OF SPRING BOOT EXPERIENCE



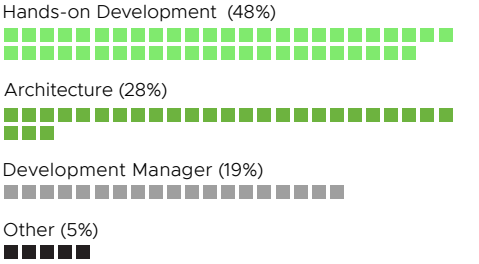
COMPANY SIZE (NUMBER OF EMPLOYEES)



AGE

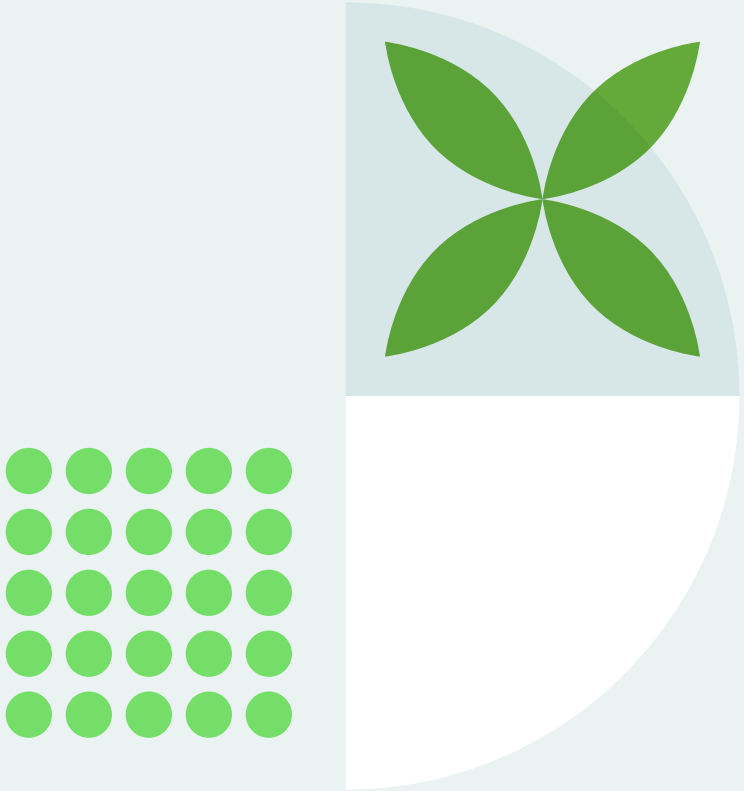


ROLE



“Spring”ing into the Future

The pace of change in the technology world only increases with every passing year. It’s as big a challenge for the Spring team to keep up with everything that’s happening as it is for our stakeholders. One of the primary goals of this survey is to help us understand what the big trends are from the perspective of the Spring community, so we know where to invest our time. This year, we see Gen AI coming on fast, Kubernetes in Spring environments maturing, and increasing challenges on the upgrade upfront.



2024
2022
2021

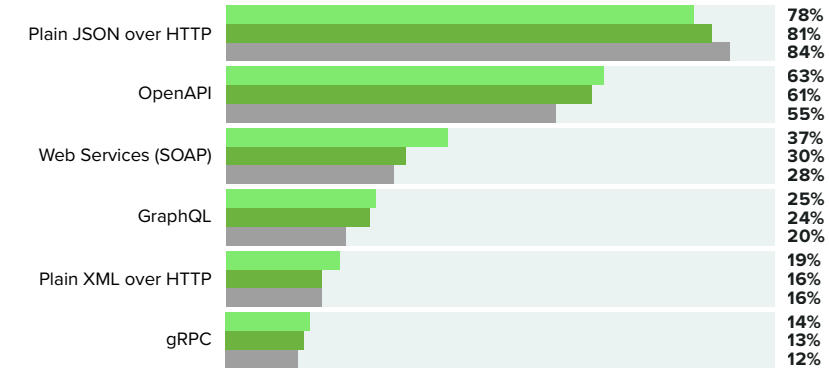
Generative AI debuts as an important new application type

The dominant Spring application types continue to be *expose APIs to internal consumers* (chosen by 80%), *expose APIs to external consumers* (70%), and *business applications* (70%). *Plain JSON over HTTP* remains the most common API type (78%), but it continues to lose ground to more formal types like OpenAPI (63%), *Web Services* (37%), *GraphQL* (25%) and others.

Notable is that a new application type we added to the question this year, *Generative AI*, was chosen by more than one in ten respondents (12%). Given its potential for outsized impact, the incorporation of Gen AI in Spring applications is a trend we'll continue to follow closely.

What types of APIs do you expose to consumers? Choose all that apply.

n = expose APIs to external or internal customers

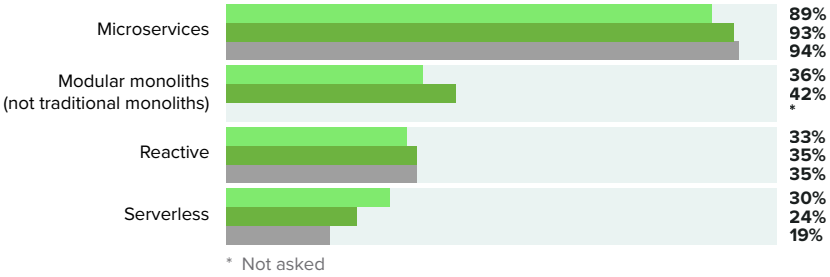


Serverless continues to gain ground

Use of *Serverless* grew 6 percentage points versus the previous report to 30%, making it the only modern architectural style showing growth. While *Modular monoliths* show an apparent decline versus last year, this year we added the qualifier *(not traditional monoliths)* and strongly suspect that this accounts for the difference. Perhaps not surprising, companies that reported using a *mix of modern and traditional architectural styles* are much more likely to use *modular monoliths* (49% versus 26%).

What type of MODERN architectural approaches do you use when working with Spring? Choose all that apply.

n = use modern architectural approaches with Spring



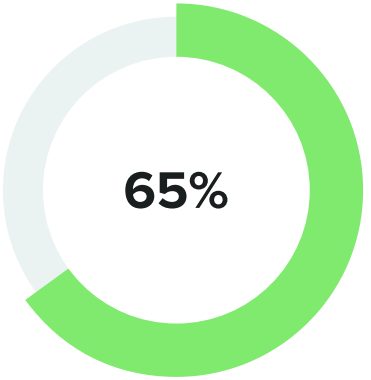
* Not asked

2024
2022

Kubernetes in Spring environments is maturing

Kubernetes use in Spring environments continued to grow this year, reaching 65% of respondents. More than half (52%) run a *Kubernetes distribution (DIY, TKG, Rancher, EKS, etc.)*, a third (33%) use a *platform based on Kubernetes (OpenShift, TAP, etc.)*, and more than a quarter (26%) use a *non-Kubernetes based platform (CloudFoundry, Heroku, etc.)*. We find the fact that half start with a *Kubernetes distribution* rather than a more complete platform a little surprising since so much extra work is required.

Most (91%) use Kubernetes *for long-running apps/web apps, 37% run ephemeral applications/Kubernetes jobs*, and 32% use Kubernetes to support *serverless, scale to zero, or Function* workloads. While 90% still say they want additional Spring features to support Kubernetes, the top three requested capabilities have all seen substantial drops since last time, suggesting many are becoming more comfortable with Kubernetes and Spring. Those already using Kubernetes as part of their Spring environment feel that the addition of Spring-specific features for Kubernetes is less important than those who don't.

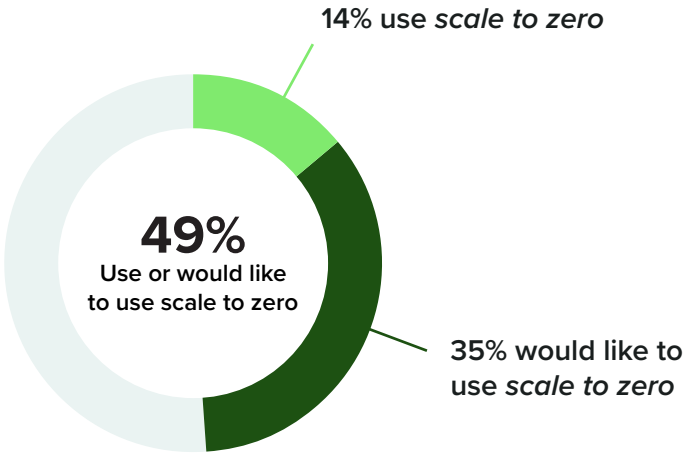


Use Kubemetes in their Spring environments

What Spring features would help to deploy Spring on Kubernetes?
Choose all that apply.
n = Kubernetes is part of Spring environment

Scale to zero

We added several questions to the survey regarding *scale to zero*, the ability to release resources when not needed to reduce costs. Almost half (49%) of stakeholders use or would like to use the technology. Of the 14% already using *scale to zero*, 38% use it to support *autoscaling of regular applications*, 32% use it to support a *serverless platform*, and 26% use it for both *serverless and autoscaling*. About a quarter (26%) were not (yet) aware of the technology.



Spring and VMware Tanzu: Better Together

VMware Tanzu Platform is a modular, cloud native application platform that enables you to speed up app delivery and bring out Spring's best. Here are five ways Tanzu Platform boosts Spring development:

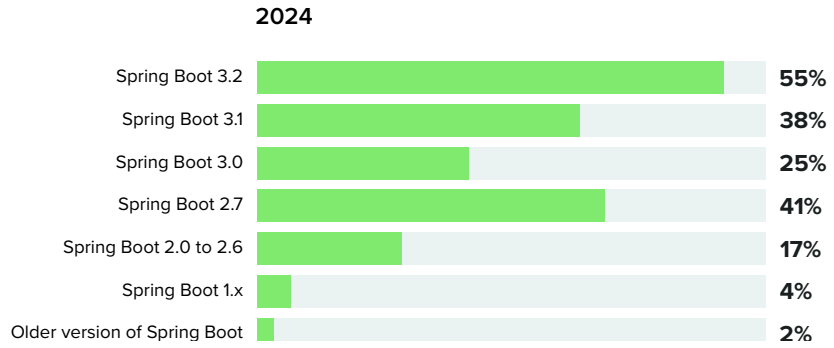
- **Streamlined operations.** Tanzu Platform integrates with the Spring portfolio, simplifying the process of deploying and managing Spring applications.
- **Accelerated Innovation.** Tanzu Platform supports and encourages experimentation, facilitating rapid prototyping and iterative development.
- **Seamless transition to microservices.** Advanced orchestration capabilities enable Spring developers to transition monolithic applications into highly scalable, resilient microservices applications in less time with less effort.
- **Ensured security.** Tanzu Platform offers built-in security features that integrate smoothly with Spring's own security capabilities.
- **Enhanced Scaling.** With robust services for orchestrating, monitoring, and managing containerized apps, Tanzu Platform can scale your applications to adapt to dynamic workload demands and changing business needs.

Tanzu Platform is more than just your average, vanilla platform; it's a game-changing environment that brings out the best of Spring, a framework known for its productivity, simplicity, and performance features. Read the blog Five Ways VMware Tanzu Platform Makes Spring Even Better for more details. You may also want to learn more about the power of Tanzu Spring.

Failure to upgrade

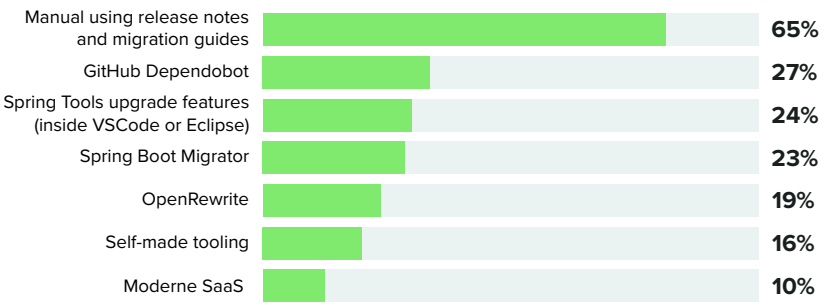
The rate of change is increasing across the board, with new Java releases—and new Spring Boot releases—every 6 months. Recent framework upgrades have also been more aggressive with upgrades to baselines. Jakarta EE jumped from Java 11 to 17, while Spring itself went from Java 8 to 17. Java 21 is already out, and Java 25 is on the horizon. And it's not just Java itself, other software in the Java ecosystem such as Hibernate release on intervals of six months or less.

Stakeholders face increasing challenges staying up to date. While Spring Boot 3.2, the latest version, is in use by 55% of stakeholders, Spring Boot 2.7 appears to have become a sticking point, with 41% still running this version. *Unable to prioritize* remains the top reason for not upgrading (chosen by 48%). However, as more companies face the upgrade from Spring Boot 2 to Spring Boot 3, *incompatible non-Spring libraries* has risen sharply as a barrier to upgrading, moving from just 4% last time to 13% this time.



Time to modernize?

Similar to the way code integration has moved from a periodic thing to a continuous cycle, upgrades have reached the point where a significant shift is necessary, and the tooling is available to make that shift a reality. However, when we asked what tools people use to keep Spring applications up to date, the majority (65%) reported they still do upgrades manually. The next leading result was *Github Dependabot*, used by 27%. More robust offerings like *OpenRewrite* didn't even crack 20%. And the results were largely independent of company size, although large companies were slightly more likely to use *self-made tooling*.



Upgrade your upgrades

Spring has a variety of options to help you move forward with confidence.

- **Tanzu Platform.** Tanzu Platform is designed to streamline your Spring application development workflows. Ensuring efficiency, security, and scalability.
- **Spring Consulting.** Consulting directly from the stewards of Spring. Mitigate the risk of running outdated software by ensuring a seamless migration to the latest version. Our experts leverage deep knowledge and automated tooling to ensure your applications are future-proofed, secure, and aligned with industry standards.
- **Tanzu Platform Spring Essentials.** Experience comprehensive discovery, enhanced visibility, and powerful observability features tailored to seamlessly manage extensive business application estates.
- **Spring Academy.** Learn from the experts with free sessions dedicated to upgrades...or almost anything else Spring-related that you want to learn. Material is available to suit the needs of all learners from beginner to expert.

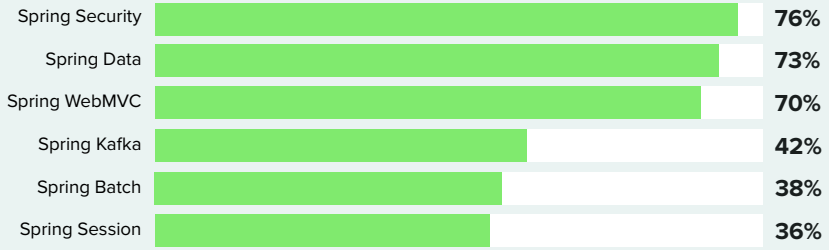
Blossoming Projects

Spring continues to track the latest technology trends with the introduction of new Spring modules and by incorporating the latest open source innovations. Spring offers the breadth to provide the right tool for any job. This year, we explore one of our latest new modules, *Spring AI,* and note continued adoption of *Spring Modulith* and the various public cloud integrations. We also see signs that governance and compliance are playing an increased role in how stakeholders decide what tech to use.

Top projects for 2024

The top Spring Projects for 2024 remain *Spring Security* (76%), *Spring Data* (73%), and *Spring WebMVC* (70%). *Spring Session*—which simplifies managing user sessions in web applications and enables them to be persisted using external databases—saw significant growth this year, increasing 6 percentage points to 36% from the prior report.

What Spring modules do you use in your environment?
Choose all that apply.



Spring AI is the hot new project

We asked about two additional Projects this year, Spring Modulith and Spring AI. Both have been adopted by 8% of stakeholders. Our previous report noted that Spring Modulith was in the experimental phase. Intended to help developers build well-structured, modular applications, the project was fully released in August 2023.

Spring AI, which enables Spring apps to incorporate AI with less effort, just graduated from the experimental phase in early 2024. The 1.0 release was not yet out at the time of this writing, demonstrating substantial—although perhaps not unexpected—early adoption.

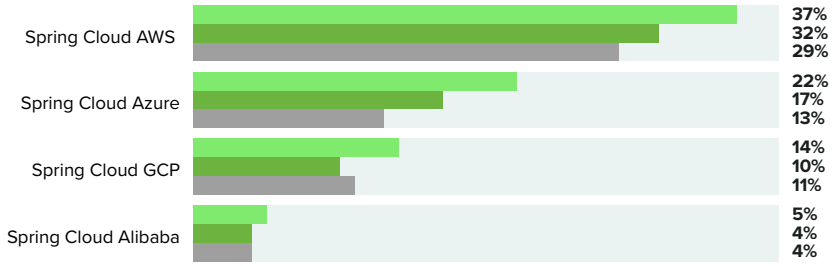
What is Spring AI?

The Spring AI Project aims to streamline the development of applications that incorporate artificial intelligence without adding unnecessary complexity. The project was founded with the belief that the next wave of Generative AI applications will not be only for Python developers but will be ubiquitous across many programming languages.

Spring AI provides convenient integrations with large language models (LLMs)—like the model that makes ChatGPT possible—and tools to support retrieval augmented generation (RAG), which allows an LLM to retrieve and utilize data from an outside source. Companies typically use RAG to give an LLM access to proprietary data that was not part of its training set. For instance, a chatbot might combine an LLM and RAG to access data from a customer support knowledgebase.

Steady growth for Spring's public cloud integrations

Our public cloud integrations continue to demonstrate steady and substantial growth from one report to the next. More than three-quarters (78%) of Spring stakeholders run Spring applications in the public cloud.

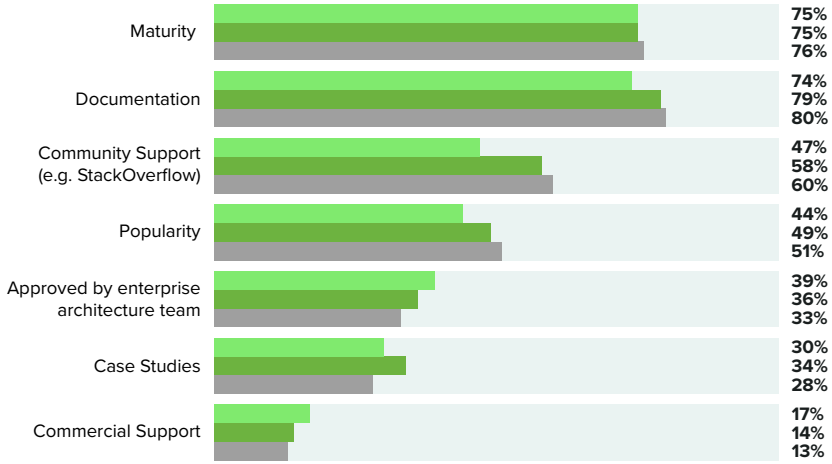


Project selection criteria trend toward governance and compliance

It's important for the Spring team to understand what factors influence your decisions to adopt new technologies. When we asked which criteria are considered important when deciding to use a Spring module, *maturity* (75%), and *documentation* (74%) remained at the top, with *community support* in third.

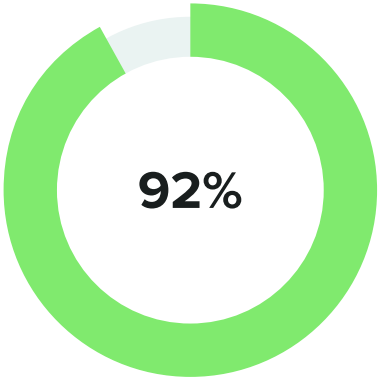
Gaining ground this year were *approved by enterprise architecture team* (up three percentage points from 36% to 39%) and *commercial support* (up three percentage points from 14% to 17%). The larger the company, the more important these criteria become. Almost two-thirds (61%) of companies with over 100,000 employees require architecture team approval, and 30% require *commercial support*. We believe this demonstrates the growing importance of governance and compliance in software development. Given the impact of security breaches, more rigor is being placed around the consumption of open source software.

What criteria do you consider when deciding to use a new Spring module?
Choose all that apply.



Testcontainers most popular “new” technology

In the last report, Project Loom was at the top of the heap (more on Loom below). This year, *Testcontainers* jumped onto the scene as the hottest new JVM technology. Stakeholders had a more positive view of *Testcontainers* than any other technology—92% have an opinion that is either *very positive* or *somewhat positive*. More than half (53%) are already using it and another 18% plan to do so, while just 7% *never heard* of the technology. This speaks to the utility of *Testcontainers* and the relative ease of deployment.



Have a positive opinion of Testcontainers

What are Testcontainers?

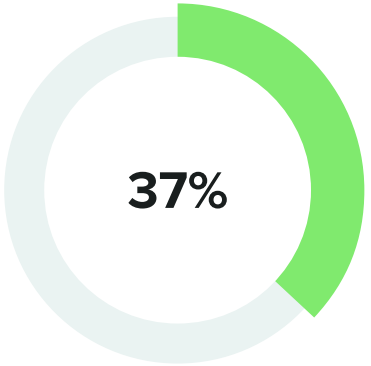
With Testcontainers, the name is largely self-describing. Originally created in 2015, Testcontainers is an open-source library that allows you to run integration tests against real dependencies, ensuring your code behaves as expected in a production-like environment. Testcontainers can run lightweight containerized instances of databases, message brokers, web browsers or any other software service you need to test against. This simplifies testing, leads to faster and more reliable tests, and eliminates the need for mocking and complicated environment configurations.

There’s been support for Testcontainers in Spring Boot for some time now, but Spring Boot 3.1 and later versions have substantial improvements that make Testcontainers easier to use for both integration and development work.

2024
2022

Project Loom

Project Loom (virtual threads) was our top technology last time. Apps that use blocking I/O benefit from its lightweight virtual thread model, reducing the memory footprint and/or increasing concurrency. This year Loom dropped to number two, with 91% viewing it positively. More than a quarter (28%) are making use of the technology, while 37% *plan* to use Project Loom, the largest of any technology we surveyed.



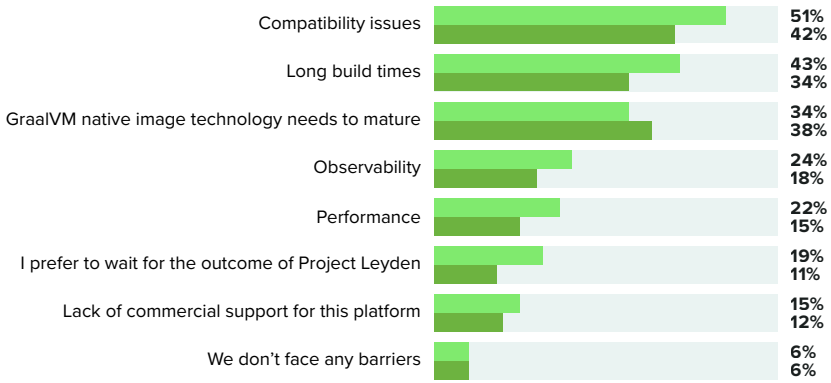
Plan to use Project Loom, more than any other technology covered in the survey

Native remains a niche technology

GraalVM and native compilation are still receiving a lot of attention in the Java world. However, only about a quarter (24%) are making use of the technology now versus 17% last time, and it remains the number two technology that people *plan to use* at 29%. In other words, almost as many people are still thinking about the technology as are actually using it in any capacity, with just 11% running it in production.

The fact that native remains a niche technology is surprising given all the buzz. It may be due to some technical challenges, including *compatibility issues* (51%) and *performance challenges* (22%). Some (19%) are waiting for the outcome of Project Leyden. In addition, *poor memory usage*—one of the issues that native compilation helps address—appears to be less of a challenge. It's declined from a high of 38% to just 23% in the current survey.

What barriers do you face adopting native?
Choose all that apply.



Native compilation: GraalVM vs. Project Leyden

Java applications are typically compiled to run on the JVM, which includes an overhead of its own when compared with natively compiled binaries. Compiling Java applications to native executables reduces startup latency and reduces memory footprint by an order of magnitude. Here are two related technologies you should know about:

- **GraalVM.** GraalVM Native Images provide a new way to deploy and run Java applications as natively compiled binaries. Compared to the Java Virtual Machine, native images can run with a smaller memory footprint and with much faster startup times. They are well suited to applications that are deployed in containers and may be especially interesting when combined with serverless aka "Function as a service" platforms.
- **Project Leyden.** Unveiled in 2022, Project Leyden is an OpenJDK project that aims "to improve the startup time, time to peak performance, and footprint." It intends to explore all the options for achieving this goal, including native compilation (referred to as *static runtime images*). The project also builds on **AppCDS** a JVM feature that reduces startup time and memory footprint. Spring already has support for AppCDS.

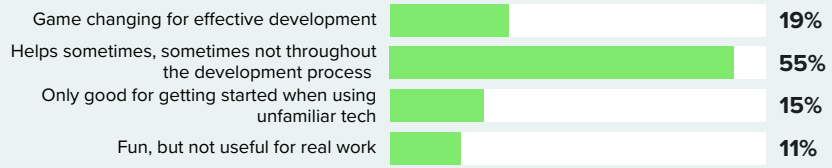
AI Evolution

Since our previous report, the use of Generative AI tools to assist with coding has emerged as one of the hottest trends in software development. For this year's survey, we dug deeper to understand how Spring stakeholders feel about AI development tools, what their plans are, and how they want new AI tools delivered.

Opinions about AI tools are mixed

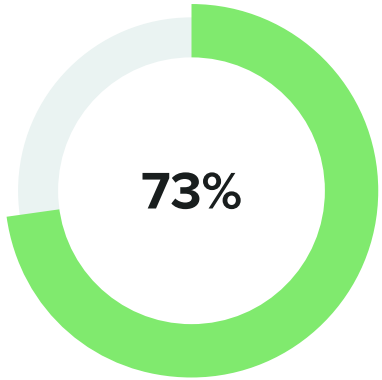
While Spring stakeholders are generally positive about the use of AI to accelerate development, they have some reservations. More than half (52%) feel it only *helps sometimes,* while another 15% believe it is *only good for getting started when using unfamiliar tech.* Just 19% think AI is *game changing for effective development.* Of course, these numbers could change in the coming years as AI-supported development tools continue to improve and stakeholders gain greater familiarity. Stay tuned.

Which of the following most closely represents your opinion of AI-supported development tools?
Choose the one answer that most closely applies.



Most will be adopting AI tools

Mixed sentiments don't appear to be a barrier to adopting AI tools for development. Almost three quarters (73%) plan to use AI-supported development tools in the next 12 months, with *GitHub CoPilot* and *ChatGPT* being the most popular choices.

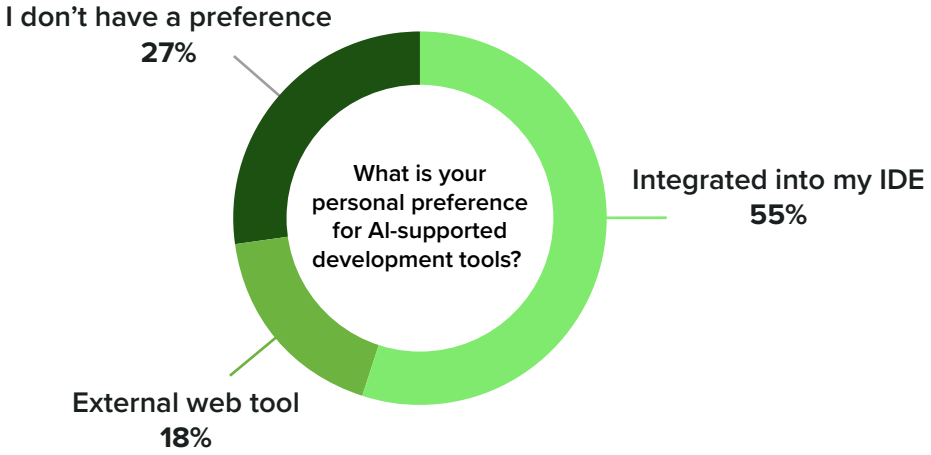


plan to adopt AI-supported development tools in the next 12 months

Developers want tools integrated into their IDEs

More than half of developers say they would prefer that AI tools are *integrated into my IDE,* while 18% prefer to use an *external web tool* and 27% *don't have a preference.*

Those that prefer IDE integration have a more favorable impression of AI-supported development tools overall, with 24% believing they are *game changing* (5 percentage points higher) and 58% saying they *help sometimes* (6 percentage points more).



Spring is IDE and AI tooling agnostic

Because Spring is IDE agnostic, your organization is free to choose whatever IDE and AI-supported development tools you prefer and be assured that they will work with Spring. In late 2018, Spring introduced Spring Tools 4, a completely re-architected set of IDE extensions that support various coding environments, ranging from Visual Studio Code and Eclipse Theia as lightweight code editors to cloud IDEs like Codespaces as well as Eclipse as a full-featured desktop IDE. You can continue to use your preferred environment and add great Spring tooling to it—plus your preferred AI tooling.

Spring is your Oasis

As tech moves faster, keeping up becomes harder and education and training become that much more important. It helps the Spring Team tremendously to find out every year where stakeholders are getting their information and what they most want to know. Gen AI and Spring Academy are the new information sources on our radar this year, and *application observability* is the number one thing people want to learn about.

Top 5 information sources

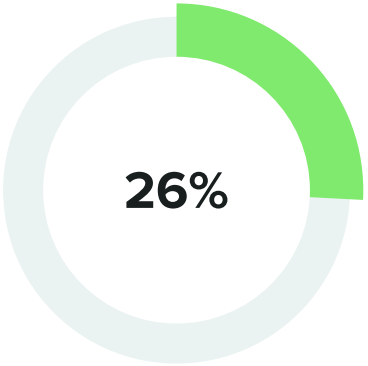
When we asked about sources of information, *Spring.io* remained at the top, chosen by 69%, followed by *reference documentation* (68%). Documentation edged out *Stackoverflow* (66%) this time, while *Internal experts* continued to gain ground, chosen by 28%. Josh Long earns an honorable mention again this year along with our two other developer advocates, Dan Vega and DaShaun Carter who host the Spring Office Hours podcast.

Where do you get information about Spring?
Choose all that apply.

New challenges, new sources

This year, we added two new items to the list of information resources we asked about: *Generative AI* and *Spring Academy. Generative AI* is now being used as an information source by 26% of stakeholders. It seems that, in addition to direct coding assistance, AI can be a good alternative to search engines (still used by 65%) for people seeking general knowledge on a topic.

Last time we introduced readers of this report to *Spring Academy,* which offers courses from Spring experts to help you learn. While 15% said they used Spring Academy as an information source, we are continuing to enhance the program to ensure that it gains traction. Those who have tried Spring Academy love it...just not enough have tried it yet.



Now use *Generative AI* as an information source

Spring Academy is now free!

Spring Academy courses ensure that you learn the most accurate and up-to-date information, with a hands-on learning experience that allows you to apply what you've learned and gain the skills necessary to create robust, scalable, and maintainable applications.

As of April 2024, Spring Academy Pro no longer requires a paid subscription. It is available here to everyone who registers a work, vocational, or educational email address.

Got questions? Learn more here.

Spring docs continue to improve

Good documentation is one of the top three things that people like about Spring (67%). Just 8% say that *poor documentation* is a challenge when using Spring, down 4 percentage points since last time. Those that said *poor documentation* was a challenge were most vexed by *ability to find relevant information internally* (41% of them said it was an area for improvement versus just 30% of the group as a whole.) **We recently re-introduced site search for the documentation to respond to this community concern.**

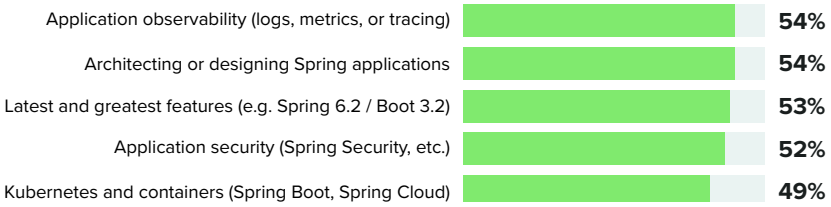
We're always seeking to improve. The top 3 areas of the documentation that stakeholders said need improvement this year were *Tutorials and guides* (47%), *documentation on how Spring works* (34%), and *ability to find relevant information internally (e.g. from within the docs site),* chosen by 30%.

Everyone is motivated to learn more about Spring

No matter how much time you've spent working in the Spring ecosystem, there's always more to learn. One of the things the Spring team loves about the Spring community is that 99% of you want to keep learning. The top 3 hot topics that survey respondents were interested in learning about are *application observability* (54%), *architecting or designing Spring applications* (54%), and *latest and greatest features* (53%).

We added four options to this question for this year and saw a significant shift, with two of the new options, *application observability* and *architecting or designing Spring applications*, jumping to the top. The Spring team has invested a lot in observability over the past few years. We really want to understand the gap between what engineers think they should measure and what's truly meaningful. Another new option, *AI/ML*, came in at a strong 35%, while *GraphQL* was of interest to 28%. Expect to see more information on all these topics in the coming year.

What are you interested in learning more about Spring?
Choose all that apply.



Observability is hot

If you want to know why application observability is such a hot topic, just check the recently released State of Observability 2024 report. It makes clear that, *"applications are growing in number and complexity, and the amount of telemetry data that applications produce has more than doubled in the past two years."* As modern architectures like microservices and serverless become prevalent and applications grow in complexity, it's harder to quickly troubleshoot problems. Observability tools are needed to keep up.

Tanzu Observability collects all your metrics so you can quickly navigate and isolate production issues and collaboratively troubleshoot incidents using shared live views and a range of advanced capabilities:

- Proven AI and ML automatically identify "unknown unknowns" and get to an incident's root cause more quickly.
- Smart Alerts dynamically filter noise and capture true anomalies.

With SaaS and self-managed options, Tanzu Observability offers a solution for every use case.

Summary and recommendations

Modern architectures and platforms. It feels like modern architectures and Kubernetes have entered the mainstream of Spring development. More than half (52%) run a *Kubernetes distribution,* a third (33%) use a *platform based on Kubernetes,* while just slighly more than a quarter (26%) use a *non-Kubernetes based platform. Serverless* continues to gain ground, with 30% using it. *Scale to zero* is catching on to control resource costs as *serverless* and public cloud continue to grow in popularity. A third (32%) rely on Kubernetes to support serverless, *scale to zero, AWS Lambda, or Function* workloads.

Multiple AI use cases. Generative AI made an appearance in every section of this report.

- **Incorporating AI in apps.** A significant fraction (12%) are already incorporating AI in Spring applications. That's a higher percentage than report using Spring AI (8%), our recently debuted AI module, suggesting that many didn't wait to get started.
- **AI-supported development.** While opinions about AI-supported development remain mixed, 73% plan to adopt it in the next 12 months.
- **AI as an information source.** A quarter (26%) now use AI as a source of information, distinct from visiting websites, reading documentation, or doing a search.

Upgrade challenges. Stakeholders are struggling to keep up with software upgrades, with 41% still running Spring Boot 2.7. Although automated upgrade tools exist, the majority (65%) still do upgrades manually.

Governance and compliance. We've noticed upticks this year in several of the criteria that stakeholders use to select Spring projects. *Approved by enterprise architecture team and commercial support* both climbed three percentage points. The larger the company, the more important these criteria become. Almost two-thirds (61%) of companies with over 100,000 employees require architecture team approval, and 30% require *commercial support.* With cybercrime on the rise, companies are being more careful about potential sources of risk.

Recommendations for Spring decision makers	Recommendations for Spring users
• Consider adopting a platform that helps streamline application development versus integrating everything with a Kubernetes distribution. This also helps address governance and compliance objectives. • Learn about the impacts of AI supported development on your teams and the software you deliver. • Modernize and automate your approach to Spring upgrades using one of the tools mentioned earlier.	• Learn about *Testcontainers, Spring AI, Spring Modulith, and application observability.* • Understand how Project Loom and native compilation can enhance different aspects of application performance. • Use AI-supported development tools to enhance your coding ability. • Check out **Spring Academy** to learn more about Spring. It's free.

This annual survey is an invaluable resource as we work with the Spring Community to prioritize new areas for innovation and identify and resolve issues. Thanks for taking time to read this report. If you also participated in the survey, thank you for your feedback!

Visit Spring.io for all the resources, training, documentation, and much more as you continue your journey into the world of Spring.

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