2023 State of Java in the Enterprise Report

The enterprise shift to cloud-native fuels Java application modernization

vaadin }>

Java is undergoing a cloud-native resurgence

According to developer surveys, Java is one of the top three programming languages and its use continues to grow. While Java has long been the workhorse language for business applications, there is almost no data available about how enterprises are really using Java. This first-ever State of Java in the Enterprise report uncovers the uses, challenges, and plans for Java in organizations of all sizes.

The **2023 State of Java in the Enterprise Report** highlights that Java is undergoing a transformative resurgence as a cloud-native technology. Enterprises continue to invest in new Java applications, while also modernizing existing Java applications for the cloud. They are increasingly building internet and SaaS applications and deploying them in cloud-native environments. Existing Java applications are being modernized to improve maintainability, and are integrated with modern DevOps tools. Enterprises continue to invest in Java and see it as a foundation for their business applications for the foreseeable future.

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This report is based on a global survey of 879 technology leaders and practitioners in organizations of all sizes across a wide set of industries. The survey was conducted in November and December of 2022. Respondents were Java users sourced from public social media channels as well as Vaadin's database. The respondents are not limited to users of Vaadin's open-source or commercial Java frameworks. In fact, less than half of the respondents (46 percent) use Vaadin. Not all respondents answered every question, so the number of respondents for each question is provided in the results.

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Highlights

The survey uncovered four key findings on the use of Java in the enterprise.

FINDING 1

Java is foundational to enterprise applications

- **Java is used most heavily** for internal apps (64%) and customer-facing apps (62%).

- **Customer-facing apps** are mostly online: 57% of respondents offer customer-facing internet services and 50% sell SaaS products.

- Java is most often used to build *New full-stack Java apps* (70%) and *New Java backends* (69%).

- Most organizations plan to **increase investments** in *Move Java apps to the cloud* (63%) and *Modernize existing Java apps* (63%).

- The **top 3 challenges** in developing Java applications are *Building an intuitive and simple UX* (81%), *Upgrading tech stack* (81%), and *Ensuring app security* (78%).

- *Finding/keeping Java devs* is most likely to be a **significant challenge**. (38%)

FINDING 2

Modernization of Java apps is a top focus

- Almost half (47%) of Java applications **need modernization**.

- Apps needing modernization vary by region. Only 41% of apps in the Americas need modernization vs. 48% in Europe and 50% in the rest of the world.

- The top-ranked **motivation** to modernize apps is *Maintainability* with 32% ranking it as the top reason and 73% ranking it in the top 3 reasons.

- Europe currently **focuses most on modernization** with 60% of respondents modernizing existing Java apps vs. 55% in the Americas and 45% in the rest of the world.

- The Americas region is the most likely to build modern new apps by combining a Java backend with a JavaScript or TypeScript frontend (55%).

Highlights

The survey uncovered four key findings on the use of Java in the enterprise.

FINDING 3

Java applications are shifting to cloud-native

- 82% of Java apps are already **web/browser-based**. Only 18% remain on the desktop.

- 36% of Java **applications** are currently **deployed in a public cloud**.

- Most organizations are deploying at least some Java apps to **cloud-native architecture**s such as *Kubernetes/Serverless* (56%) and *Public cloud* (55%).

- 70% of organizations continue to deploy some Java apps to **on-premise** VMs or servers.

- Among **hyperscale cloud providers**, AWS tops the list (35%), followed by Azure (22%) and Google (11%).

- Among **Kubernetes** options, *On-premise Kubernetes* (29%) is the most popular, followed by *AWS containers* (24%) and *Self-managed Kubernetes* in a public cloud (16%).

FINDING 4

Tech stacks evolve: Spring grows, Swing slows

- The **shift to Java 17** is well underway with 26% already using it and 21% in the process of migrating.

- **Spring remains popular** with 79% using Spring Boot and 76% using the Spring Framework

- A significant minority combine **Java on the backend with front-end frameworks** such as Angular (37%) or React (32%).

- **Older technologies** such as Swing (20%), JSF (16%), and JavaFX (15%) were **used by a minority** and will decrease in use over the next two years..

- Respondents expect to **increase the use** of many technologies, including Spring Boot, Spring, Java, Vaadin Flow, Hilla, React, and Quarkus

- Most organizations are **integrating Java apps** with modern tools for *Logging* (72%), *Observability* (61%), and *SSO* (53%).

Java is foundational to enterprise applications

Released in 1996, Java saw rapid adoption in the early 2000s as the world wide web began to explode. Today Java is ranked as one of the top three programming languages in almost every developer survey and is now a workhorse for enterprise applications. In the survey, when asked an open-ended question about their Java strategy, many respondents chose to highlight the current and ongoing importance of Java in their organizations.

"

Java is the key for backend systems and much of the foundation of our business. Java will stay the most important runtime in the foreseeable future.

—————

"

Java is the default language we use. We only plan to use more Java in the future.

Java is used for many types of apps

Java has been a primary language in the enterprise for several decades. As a result Java is used in many different types of applications. Respondents use Java most for applications that are internal-facing (64 percent) and customer-facing (62 percent).

Types of Java applications
% of respondents

Application type	%
Internal apps	64%
Customer-facing apps	62%
Partner apps	52%
Custom apps for a client	43%

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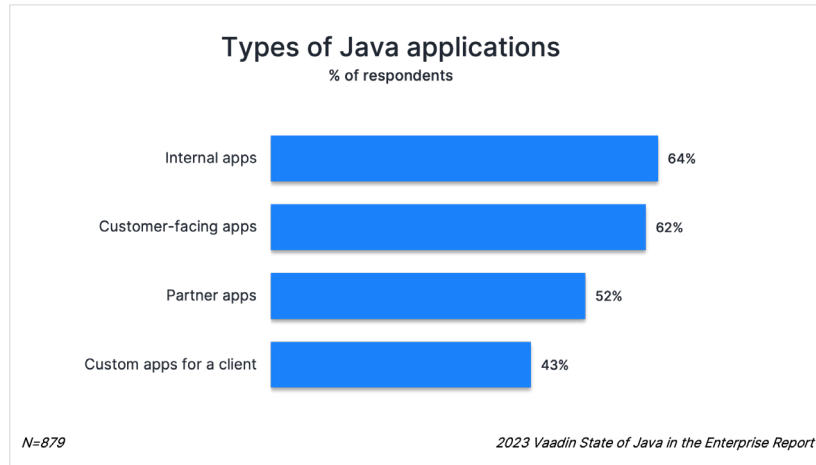
> ❝
> Java is the primary language for all internal and customer-facing development.

Java is not just for on-premise applications

Among those respondents who have customer-facing Java applications, 57 percent are providing internet services while 50 percent are providing SaaS applications. A large minority (44 percent) are using Java to provide on-premise software products.

Types of customer-facing Java applications
% of respondents with customer-facing apps

Internet services for customers	57%
SaaS products	50%
On-premise software products	44%

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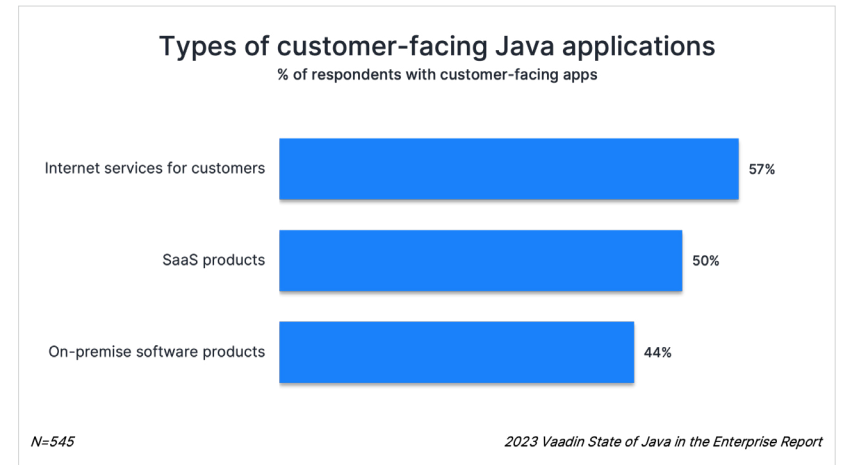
> "
> Without question, Java is an essential requirement for high-end web applications.

> "
> Java is our first choice when choosing a language for new web services.

Enterprises continue investments in Java

Organizations continue to expand their investments in Java with 70 percent building new full-stack Java applications, 69 percent building new Java backends, and 48 percent creating new applications that combine a JavaScript or TypeScript frontends with a Java backend. In addition, a majority (57 percent) are investing in the modernization of existing applications with a significant minority moving existing Java applications to the cloud.

Enterprise investments in using Java
% of respondents

New full-stack Java apps	70%
New Java backends	69%
Modernize existing Java apps	57%
New Java + JS/TS apps	48%
Move Java apps to cloud	36%
New frontends for Java backends	29%

N=818

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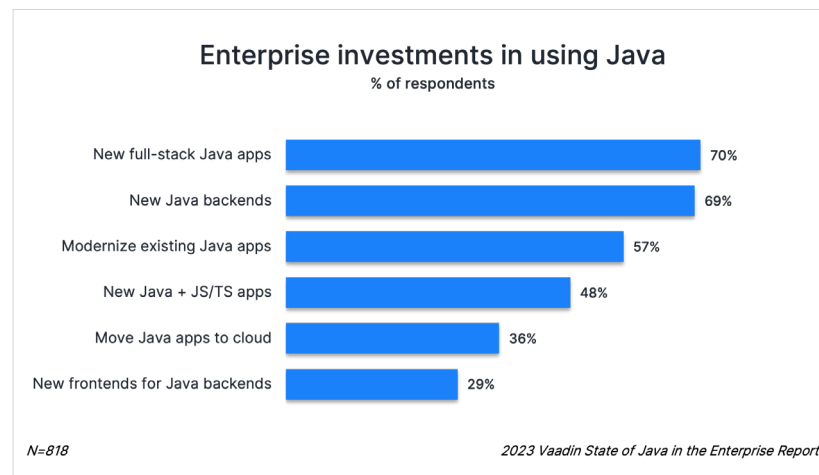
Java as a programming language is core to the development of our internal back-end services.

Enterprises plan to double down on modernization

Over the next 24 months, organizations plan to increase their use of Java in both new and existing Java applications. Modernization is a particular focus area with 63 percent planning to increase investments in modernizing existing Java applications and the same percentage planning to increase their migration of Java applications to the cloud. In addition, a majority plan to build more Java backends and apps that combine JavaScript/TypeScript with a Java backend.

Planned changes in enterprise Java investments
% of respondents changing investments in next 24 months

	Decrease	Stay the same	Increase somewhat	Increase significantly
Move Java apps to cloud	5%	32%	36%	27%
Modernize existing Java apps	7%	30%	37%	26%
New Java backends	4%	43%	31%	22%
New Java + JS/TS apps	9%	36%	34%	21%
New full-stack Java apps	11%	49%	21%	19%
New frontends for Java backends	12%	40%	31%	17%

■ Decrease ■ Stay the same ■ Increase somewhat ■ Increase significantly

N=818

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"

We want to use Java both for backend and frontend.

UX, tech stacks, security, and devs are top Java challenges

While Java will continue to play a key role in enterprise application development, some challenges remain. A large majority of respondents (81 percent) find it difficult to build an intuitive and simple UX. While building a good UX can be a challenge for any application, Java developers who are used to building backends or desktop applications may be less comfortable creating modern web-based user interfaces.

Tied with the challenge of building a great UX, 81 percent of respondents indicate that upgrading tech stacks is a challenge. Ensuring application security is the third most cited challenge (76 percent). Finding and keeping Java developers is most frequently cited as a significant challenge (38 percent).

Challenges in developing Java apps
% of respondents

	Significant challenge	Somewhat of a challenge	Not a challenge
Building an intuitive and simple UX	30%	51%	19%
Upgrading the tech stack	26%	55%	19%
Ensuring app security	24%	54%	22%
Finding/keeping Java devs	38%	38%	24%
Optimizing runtime performance	22%	49%	29%
Testing apps	20%	50%	30%
Building cloud-native apps	22%	43%	35%
Scaling app up/down	18%	45%	37%
Choosing frameworks/tech stack	15%	43%	42%
Moving desktop apps to web/cloud	19%	30%	51%

■ Significant challenge ■ Somewhat of a challenge ■ Not a challenge

N=719   *2023 Vaadin State of Java in the Enterprise Report*

19

Modernization of Java apps is a top focus

With the large number of enterprise Java applications developed over the past few decades, it's not a surprise that many of these applications are slated for modernization. Respondents indicated that their investments in modernization will increase in the coming two years, and shared the status of their modernization efforts and their motivations to modernize.

"

[Our strategy is] updating, modernizing, and improving our current applications.

———————

"

Having a good UX is vital for our employees' productivity, so we keep looking to modernize our applications.

Most Java apps are accessed via a browser

Despite the longevity of Java applications, 82 percent of Java applications are already accessed via a browser. However, there is still a minority of desktop Java applications that need to be modernized.

How Java applications are accessed
% of applications

Desktop applications

18%

Web applications
(accessed via browser)

82%

N=735

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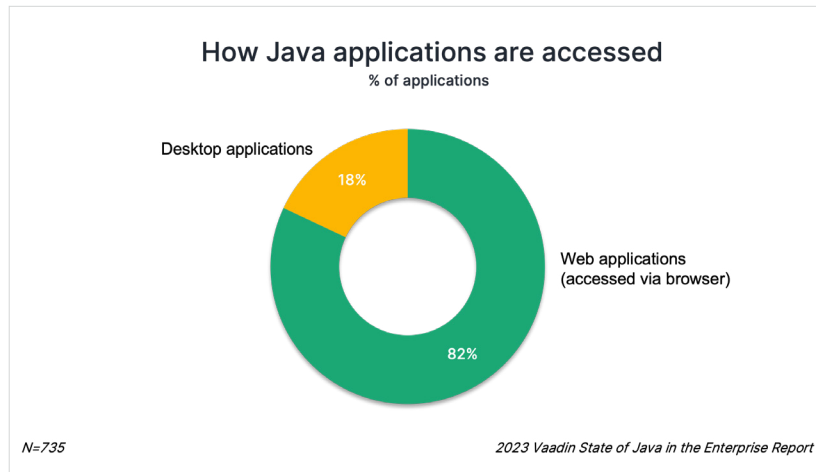
We use Java to develop all our software and are currently modernizing old Swing applications.

Half of Java applications need to be modernized

Despite the fact that most Java applications are accessed through a browser, respondents indicate that almost half (47 percent) of Java applications still need to be modernized. The need to modernize varies across different regions. Respondents from the Americas region indicated that only 41 percent of their Java applications needed to be modernized as compared to 48 percent in Europe and 51 percent in the rest of the world.
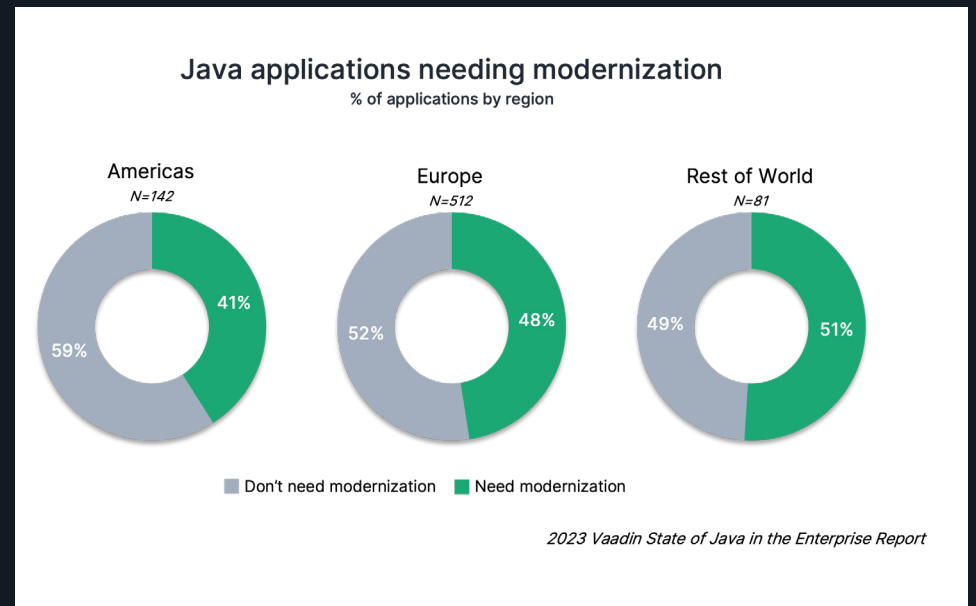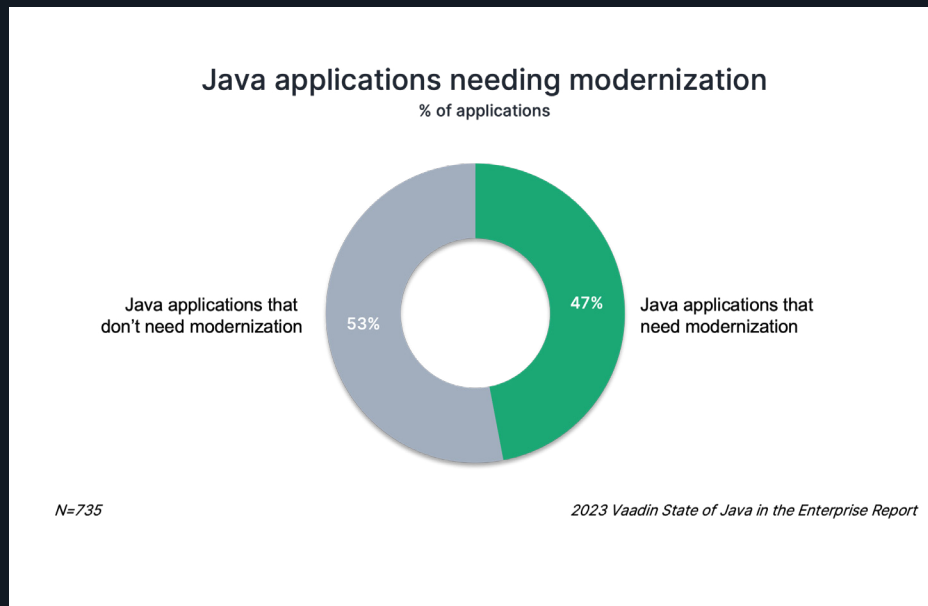
> [Our strategy is] updating, modernizing and improving our current applications.

Java modernization investments vary by region

Among the three types of modernization investments, there was some variation by region. The percentage of respondents moving Java apps to the cloud was similar across all regions. Respondents in Europe were the most likely to be modernizing existing Java applications (60 percent), while respondents in the Americas were the most likely to be building new applications with a Java backend and a JavaScript/ TypeScript front end (55 percent).

Enterprise investments in Java
% of respondents by region

	Americas N=161	Europe N=558	Rest of World N=99
Modernize existing Java apps	55%	60%	45%
New Java + JS/TS apps	55%	47%	45%
Move Java apps to cloud	37%	35%	38%

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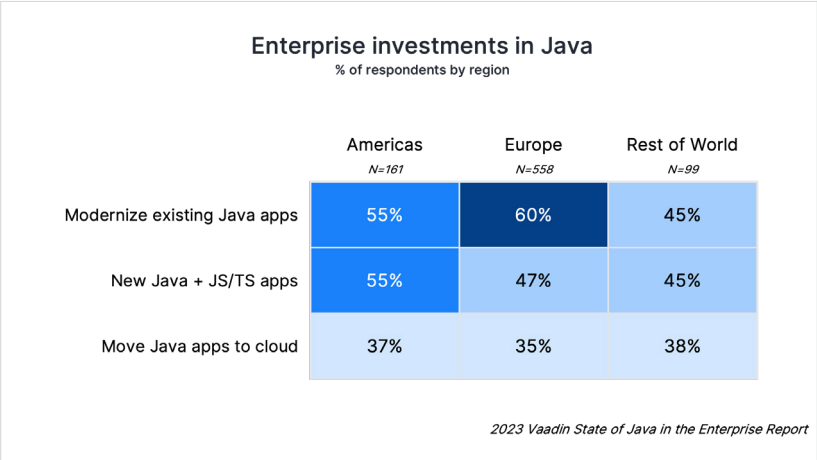
Maintainability and security are top motivations for modernizing

Respondents were given the opportunity to rank their motivations for modernizing their Java applications. A large majority (83 percent) ranked maintainability as one of their top three motivators, with 32 percent of all respondents ranking it as their primary motivator. Security risks were also an important factor with 57 percent ranking it in their top three and 20 percent ranking it as their primary motivator.
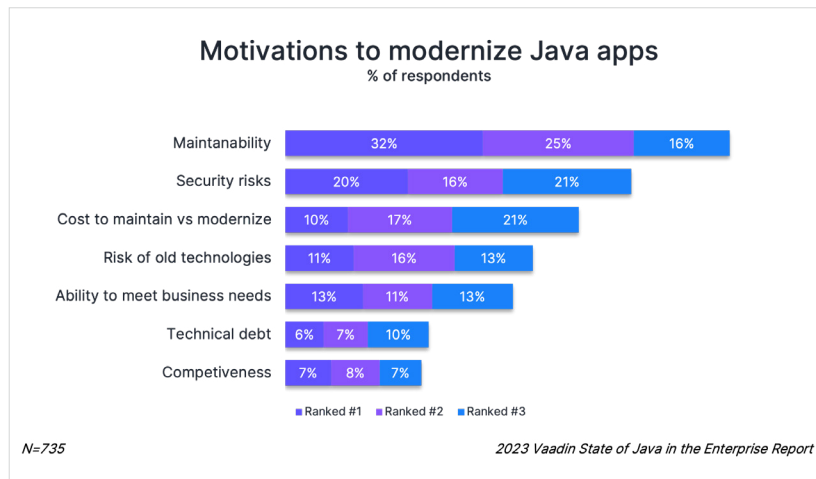
Motivations to modernize Java apps
% of respondents

	Ranked #1	Ranked #2	Ranked #3
Maintanability	32%	25%	16%
Security risks	20%	16%	21%
Cost to maintain vs modernize	10%	17%	21%
Risk of old technologies	11%	16%	13%
Ability to meet business needs	13%	11%	13%
Technical debt	6%	7%	10%
Competiveness	7%	8%	7%

■ Ranked #1   ■ Ranked #2   ■ Ranked #3

N=735   *2023 Vaadin State of Java in the Enterprise Report*

The third most important motivation to modernize varies by region. Respondents in the Americas and Europe identify the ability of Java applications to meet business needs as the third most important factor, while respondents in the rest of the world identify the risks of old technology.

Top motivation to modernize Java apps
% of respondents ranking motivator as #1

Americas N=161	Europe N=512	Rest of World N=81
Maintainability 28%	Maintainability 33%	Maintainability 35%
Security risks 20%	Security risks 20%	Security risks 22%
Ability to meet business needs 14%	Ability to meet business needs 13%	Risks of old technology 22%

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"

Having a good UX is vital for our employees' productivity, so we keep looking to modernize our applications

"

[Our strategy is] updating, modernizing and improving our current applications.

Java apps are shifting to cloud-native architectures

The next step in the evolution of Java applications is the shift to deployment on cloud-native architectures. Java applications are increasingly being deployed on the public cloud, containers, Kubernetes, and serverless environments.
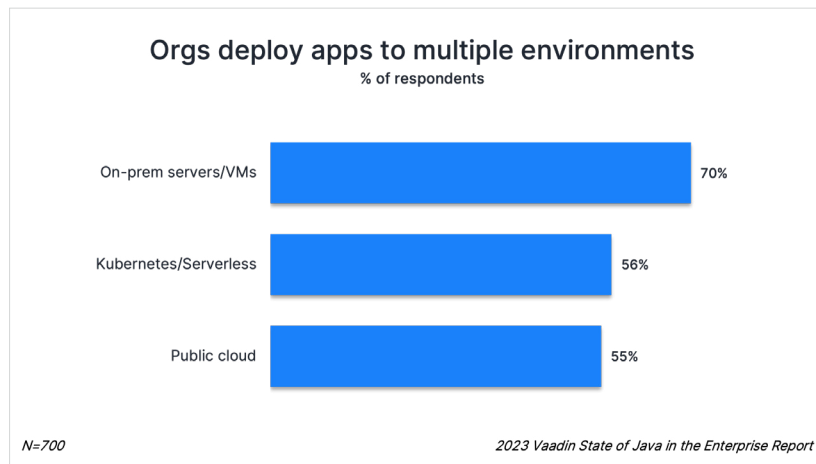
"

[Our strategy is] cloud-native application development.

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"

All our [Java] solutions are running in Kubernetes in the cloud. We are also looking at serverless technologies provided by the cloud vendors.

Cloud-native is becoming the target for Java

The shift of Java applications to cloud-native environments is well underway. While most respondents (70 percent) deploy Java applications to on-premise environments, more than half of respondents (55 percent) are already deploying at least some Java apps in the public cloud. A similar number (56 percent) are deploying to Kubernetes or serverless environments.

Orgs deploy apps to multiple environments
% of respondents

On-prem servers/VMs	70%
Kubernetes/Serverless	56%
Public cloud	55%

N=700   2023 Vaadin State of Java in the Enterprise Report

"
We are heavy users of Java and AWS on EC2 with some serverless. We are going all-in on containers

Public cloud providers used for Java applications

The choice of cloud provider for Java applications mirrors the overall market share for hyperscalers. AWS is used by 35 percent of respondents vs. 22 percent using Azure and 11 percent using Google.

Hyperscale clouds where Java apps are deployed
% of respondents

AWS	35%
Azure	22%
Google Cloud	11%

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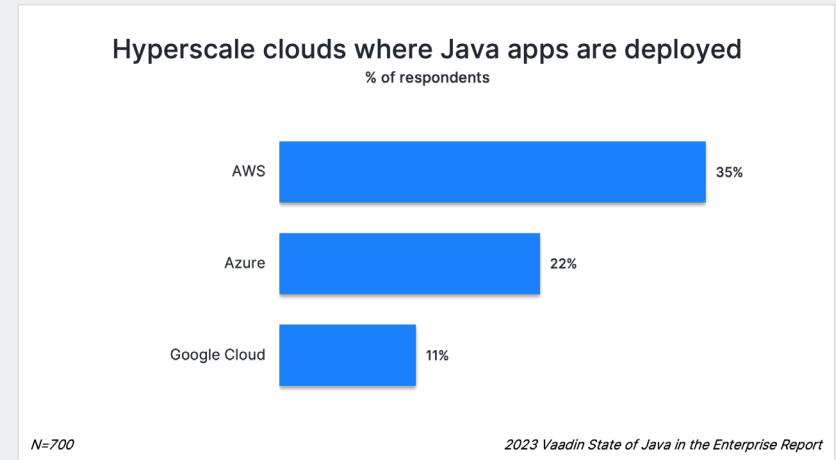
"
We are planning to completely move our systems to AWS."

Java apps are deployed to many environments

While the top deployment option is traditional VMs or servers on-premise (70 percent), Java apps are also deployed to a wide variety of cloud-native environments. The second most popular deployment option is on-premise Kubernetes environments (29 percent), followed by AWS EC2 (25 percent) and AWS containers (24 percent).

Where Java apps are deployed
% of respondents

Deployment	%
On-premise servers/VMs	70%
On-premise Kubernetes	29%
AWS EC2	25%
AWS containers	24%
Self-managed Kubernetes in public cloud	16%
Azure VMs	15%
AWS serverless	12%
Azure containers	11%
Google containers	9%
OpenShift	9%
Google Compute Engine	7%
Azure serverless	4%
Oracle Cloud	4%
Google serverless	4%
Azure Spring Apps	4%

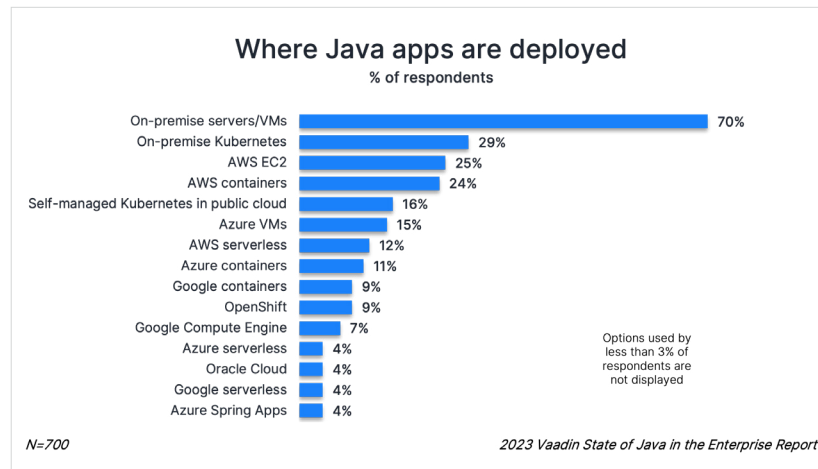Options used by less than 3% of respondents are not displayed

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One-third of Java applications are already in the public cloud

In addition to looking at the number of respondents using the public cloud for any Java application, we also asked about what percentage of their applications were deployed there. Over one-third of Java applications (36 percent) are already deployed in the public cloud.

Where Java applications are deployed
% of applications

Public cloud — 36%
On-prem or private cloud — 64%

N=700

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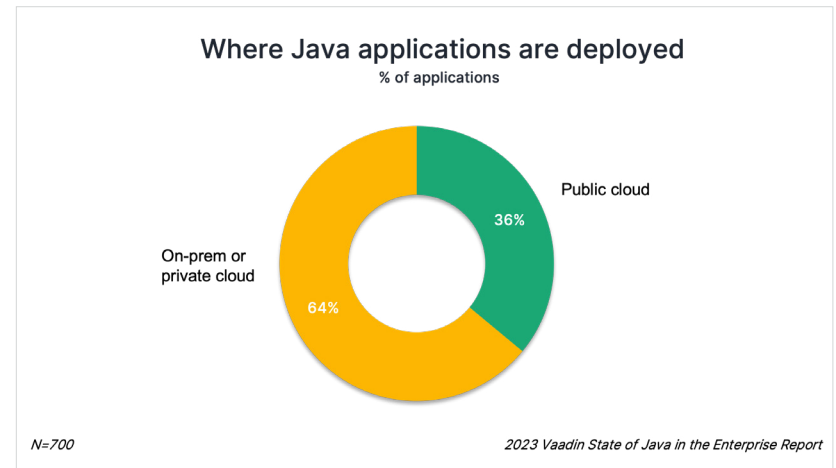
Java will be the programming language for future cloud-based services.

Tech stacks evolve: Spring grows, Swing slows

With the shift to modern web-based user interfaces and cloud-native architectures, the tech stacks used to build or modernize Java applications are rapidly evolving.

"

Java is here to stay, but many apps need updates to newer Java versions and newer technology stacks.

The shift to Java 17 is well underway

Over a year after its release, the shift to Java 17 is now well underway. Over a quarter (26 percent) of respondents are already on Java 17 or a newer version. Another 21 percent are currently upgrading and 26 percent plan to upgrade in the next 12 months. Only 16 percent have no current plans to upgrade.

Enterprise plans for upgrade to Java 17
% of respondents

No current plans to upgrade — 16%
Already on Java 17 or newer — 26%
Currently upgrading — 21%
Plan to upgrade in next 12 months — 26%
Plan to upgrade after next 12 months — 11%

N=700

2023 Vaadin State of Java in the Enterprise Report
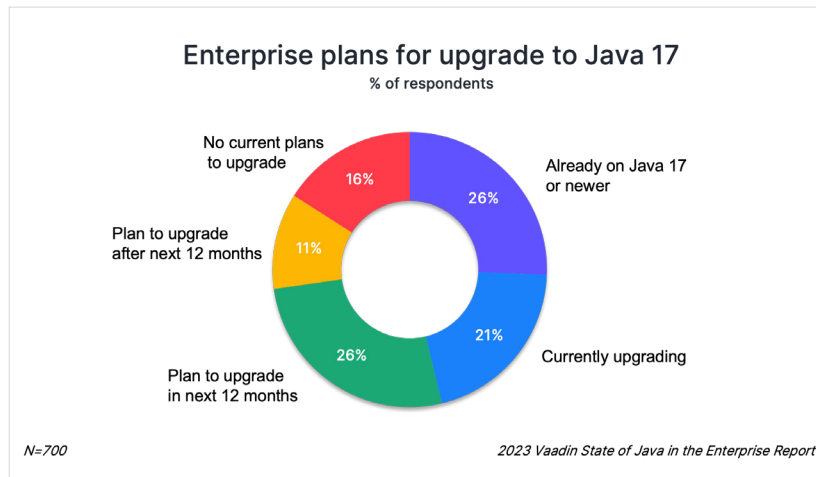
> We have a lot of applications that use Java. Some of them are still on Java 8 with the plan to upgrade to Java 17. The rest are on Java 17.

Spring is a key part of the Java tech stack

There are a wide variety of frameworks used for building Java applications. The most popular framework is Spring Boot, used for Java backends, 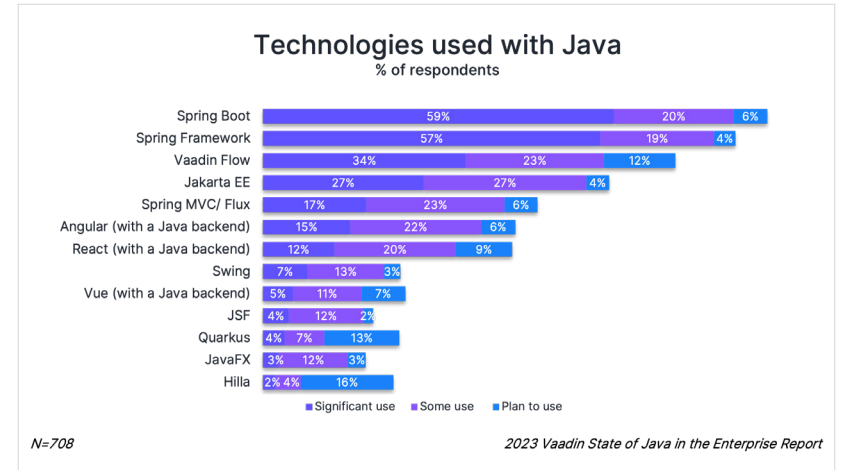with 79 percent of respondents reporting at least some use, and 59 percent reporting significant use. The second most popular framework is Spring Framework, used by 76 percent of respondents.

Vaadin Flow, also used by a majority of respondents, is a full-stack Java framework for building web apps without writing HTML or JavaScript. It works with backend frameworks such as Spring Boot and Quarkus.

The survey also asked about the use of front-end frameworks such as React and Angular specifically with a Java backend. The goal was to identify the prevalence of these frameworks in Java-based applications, not the overall use of these frameworks with non-Java backends. Angular was used with Java a backend by 37 percent of respondents and React by 32 percent.

By examining the number of respondents that plan to use a framework, we can gain insights into its potential future growth. The framework with the highest percentage of planned use was Hilla (16 percent), a framework that combines a TypeScript fronted with a Spring Boot backend. Quarkus, a backend framework from RedHat had the next highest amount of respondents planning to use it (13 percent) followed by Vaadin Flow (12 percent).

Technologies used with Java
% of respondents

Framework	Significant use	Some use	Plan to use
Spring Boot	59%	20%	6%
Spring Framework	57%	19%	4%
Vaadin Flow	34%	23%	12%
Jakarta EE	27%	27%	4%
Spring MVC/ Flux	17%	23%	6%
Angular (with a Java backend)	15%	22%	6%
React (with a Java backend)	12%	20%	9%
Swing	7%	13%	3%
Vue (with a Java backend)	5%	11%	7%
JSF	4%	12%	2%
Quarkus	4%	7%	13%
JavaFX	3%	12%	3%
Hilla	2%	4%	16%

■ Significant use ■ Some use ■ Plan to use

N=708   *2023 Vaadin State of Java in the Enterprise Report*

Note: Because this survey was sent to Vaadin's marketing database, the tech stack usage is more weighted to Vaadin Flow users than it might otherwise be.
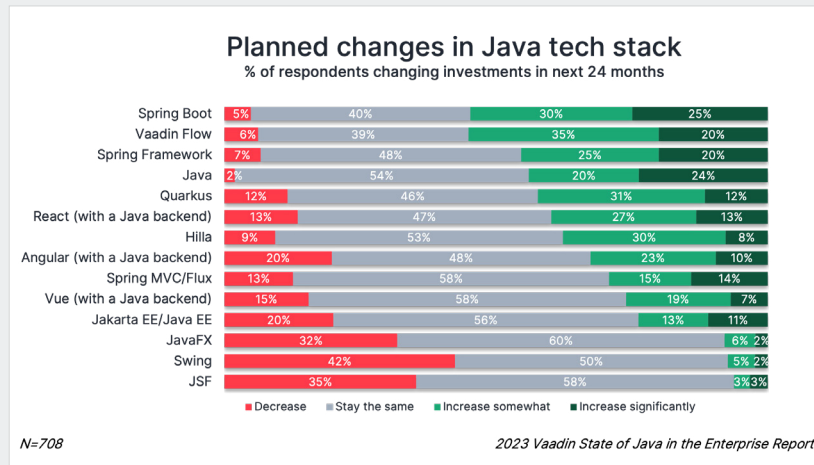
"

Java is the first choice for our production-related applications, but more often in the flavor of Spring Boot and Kotlin.

———

"

[Our strategy is] Java for backend and Angular/React for frontend

Tech stack investments continue to evolve

Not only is Spring Boot currently the most used Java framework, it also ranks at the top of the pack for increased investments, with 55 percent planning to increase their use of Spring Boot. Respondents also plan to increase investments in Vaadin Flow, Spring Framework Quarkus, and others.

The frameworks that are likely to decline the most are Swing with 42% of respondents planning to decrease usage, JSF (35 percent), and JavaFX (32 percent)
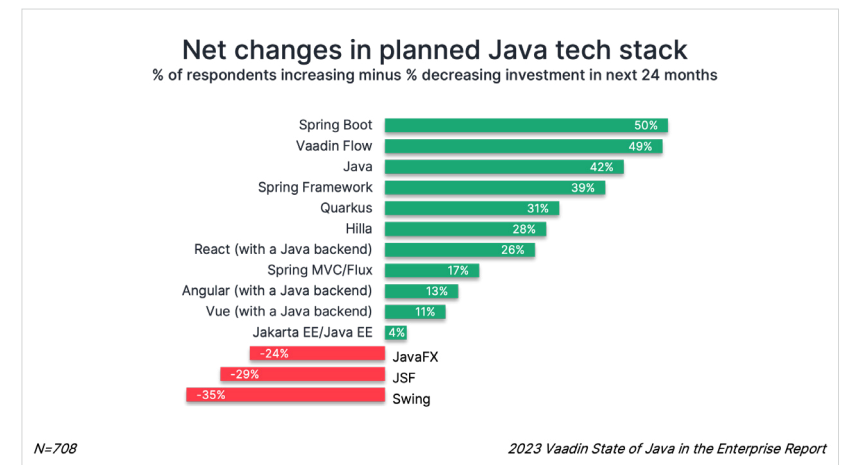

Planned changes in Java tech stack
% of respondents changing investments in next 24 months

	Decrease	Stay the same	Increase somewhat	Increase significantly
Spring Boot	5%	40%	30%	25%
Vaadin Flow	6%	39%	35%	20%
Spring Framework	7%	48%	25%	20%
Java	2%	54%	20%	24%
Quarkus	12%	46%	31%	12%
React (with a Java backend)	13%	47%	27%	13%
Hilla	9%	53%	30%	8%
Angular (with a Java backend)	20%	48%	23%	10%
Spring MVC/Flux	13%	58%	15%	14%
Vue (with a Java backend)	15%	58%	19%	7%
Jakarta EE/Java EE	20%	56%	13%	11%
JavaFX	32%	60%	6%	2%
Swing	42%	50%	5%	2%
JSF	35%	58%	3%	3%

N=708   *2023 Vaadin State of Java in the Enterprise Report*

> [Our strategy is to] continue to use Java as a backend but to include more Kotlin in new projects.

Gainers and losers emerge: Spring grows, Swing slows

By examining the net changes in the planned use of technologies (the percentage of respondents planning to increase use minus the percentage planning to decrease use) we can see the clear shift away from older Java technologies from the desktop and early web eras, including Swing, JSF, and JavaFX. Spring Boot is the clear winner with a net 50 percent of respondents planning to increase usage. Despite the already ubiquitous use of Java in the survey respondents, a net 40 percent of respondents plan to further increase Java usage. Frameworks such as Vaadin Flow, Spring Framework, Quarkus, Hilla, and React are also expected to see significant net increases in adoption.
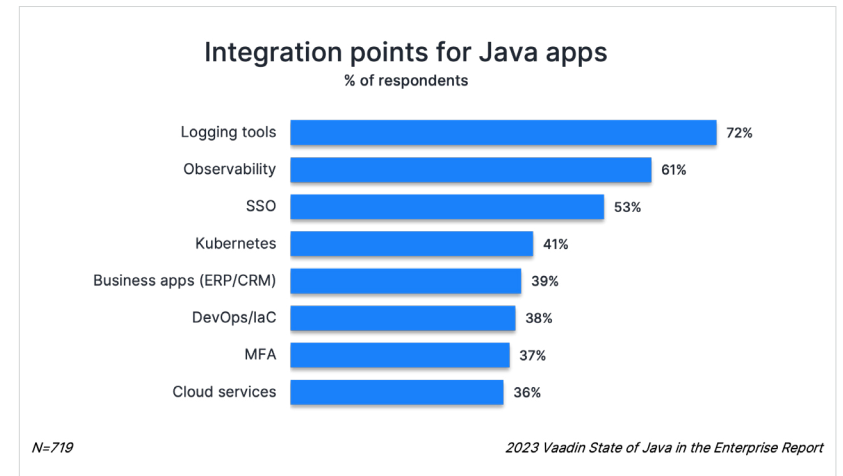

Net changes in planned Java tech stack
% of respondents increasing minus % decreasing investment in next 24 months

Spring Boot	50%
Vaadin Flow	49%
Java	42%
Spring Framework	39%
Quarkus	31%
Hilla	28%
React (with a Java backend)	26%
Spring MVC/Flux	17%
Angular (with a Java backend)	13%
Vue (with a Java backend)	11%
Jakarta EE/Java EE	4%
JavaFX	-24%
JSF	-29%
Swing	-35%

N=708   *2023 Vaadin State of Java in the Enterprise Report*

> [Our strategy is to] use Vaadin whenever possible to stay away from a complicated front-end

Java applications integrate into the cloud-native ecosystem

As Java applications move toward cloud-native architectures, they are also integrating with tools in the cloud-native ecosystem. The top integration points for respondents are logging tools (72 percent), observability tools (61 percent), and SSO tools (53 percent).

Integration points for Java apps
% of respondents

Integration point	%
Logging tools	72%
Observability	61%
SSO	53%
Kubernetes	41%
Business apps (ERP/CRM)	39%
DevOps/IaC	38%
MFA	37%
Cloud services	36%

N=719   *2023 Vaadin State of Java in the Enterprise Report*

Summary: Recommendations for 2023

The 2023 State of Java in the Enterprise report gives us unique insights into business applications that are built with Java. The report highlights that Java is undergoing a transformational resurgence as Java apps are modernized for an increasingly cloud-native world. As a result, Java will continue to maintain its central role in enterprise applications.

With Java's role as an enterprise workhorse for both internal customer-facing applications, modernizing Java applications remains a focus. Although the vast majority of Java applications are accessed via a browser, building an intuitive and simple user experience remains the largest challenge. Almost half of Java apps need further modernization.
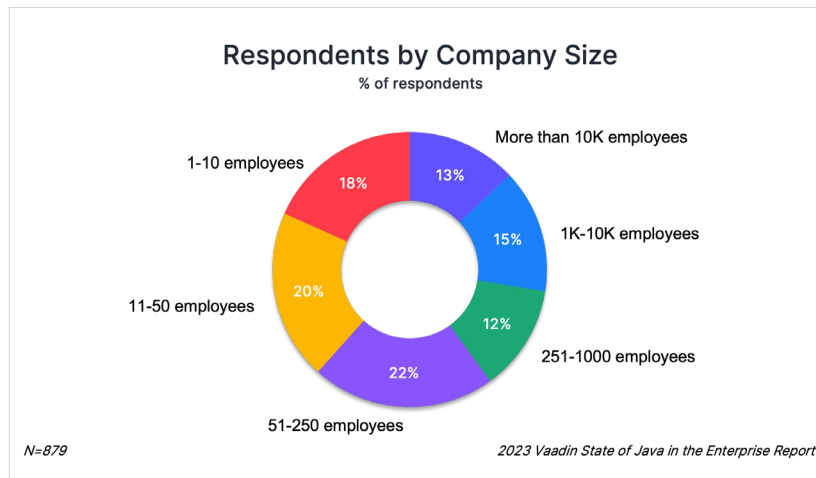
Organizations are planning to accelerate their modernization efforts in order to improve maintainability, avoid security risks, and reduce maintenance costs. More and more, modernized Java apps are being deployed in the public cloud. This move to cloud-native architectures will accelerate in the coming two years and will cause a corresponding shift in Java technology stacks. A number of frameworks will see higher use for Java-based applications, with Spring Boot, Vaadin Flow, Quarkus, Hilla, and React among the biggest winners. Meanwhile, usage of Swing and other legacy frameworks will continue to decline.

Appendix: Demographics

This report is based on a global survey of 879 technology leaders and practitioners in organizations of all sizes across a wide set of industries.
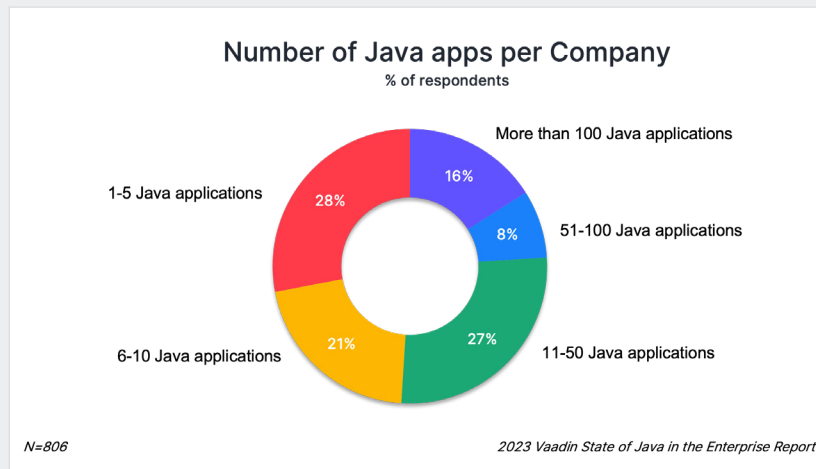
Respondents by company size

Respondents came from organizations of all sizes. Over one-quarter (28 percent) worked at organizations with more than 1000 employees, while about one-third (34 percent) worked at organizations that were between 51 and 1000 employees. The remainder worked at companies with fewer than 50 employees.

Respondents by Company Size
% of respondents

- More than 10K employees: 13%
- 1K-10K employees: 15%
- 251-1000 employees: 12%
- 51-250 employees: 22%
- 11-50 employees: 20%
- 1-10 employees: 18%

N=879

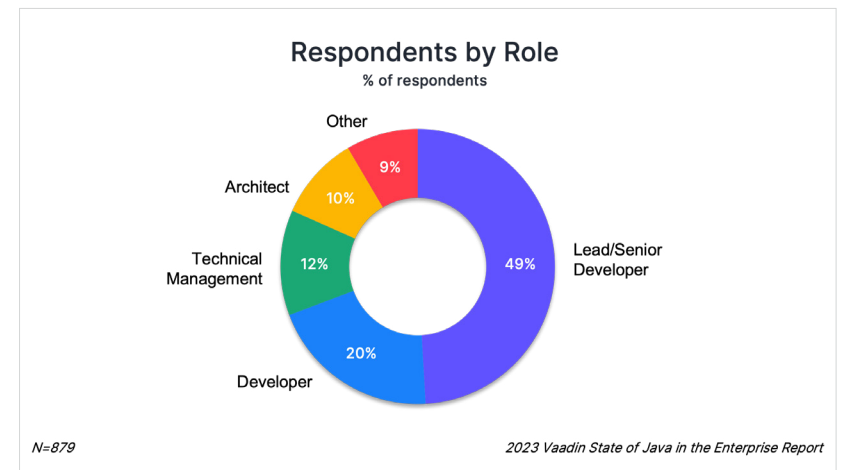*2023 Vaadin State of Java in the Enterprise Report*

Respondents by the number of Java applications

Respondents had differing numbers of Java applications. Almost a quarter (24 percent) had more than 50 Java applications while a similar amount (28 percent) had five or fewer applications. The number of Java applications can be impacted by the industry and company size. For example, a small software organization may only have a few products built with Java, but those may be critical revenue drivers. Conversely, a large financial services firm may have dozens or hundreds of applications, both internal and external facing.

Number of Java apps per Company
% of respondents

More than 100 Java applications — 16%
51-100 Java applications — 8%
11-50 Java applications — 27%
6-10 Java applications — 21%
1-5 Java applications — 28%

N=806

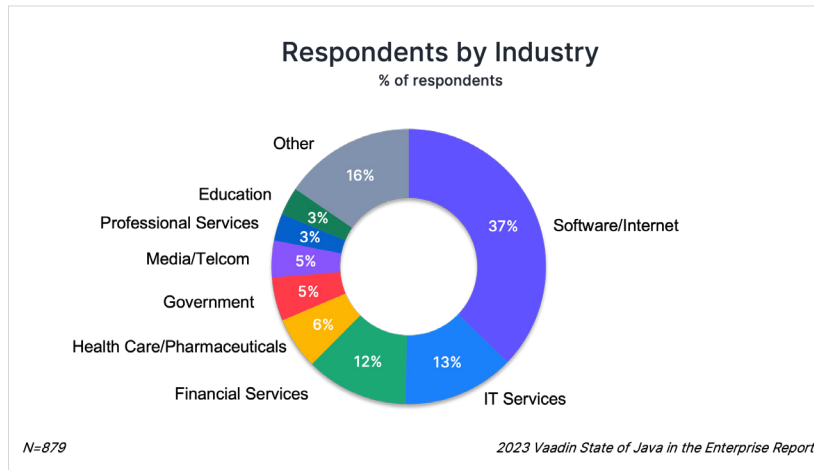*2023 Vaadin State of Java in the Enterprise Report*

Respondents by role

Respondents were required to be involved with the use of Java in their organization, excluding those who were only end users of Java applications. Almost half (49 percent) were Lead/Senior developers, and another 20 percent were Developers. Respondents in Technical management (12 percent) encompassed all levels of management including executives, directors, and managers.

Respondents by Role
% of respondents

Other — 9%
Architect — 10%
Technical Management — 12%
Developer — 20%
Lead/Senior Developer — 49%

N=879

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Respondents by industry

Half of the respondents were from technology companies, with 37 percent from Software/Internet organizations and another 13 percent from IT services firms. The other half were from a wide range of industries, with 12 percent coming from Financial Services and 6 percent coming from Healthcare/Pharmaceutical companies. Government and Media/Telecom companies each represented 5 percent of respondents. The Other category includes a variety of industries, each with fewer than 3 percent of respondents.

Respondents by Industry
% of respondents

Other 16%
Education 3%
Professional Services 3%
Media/Telcom 5%
Government 5%
Health Care/Pharmaceuticals 6%
Financial Services 12%
IT Services 13%
Software/Internet 37%

N=879

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Respondents by region

The largest number of respondents were from Europe, with 26 percent from the DACH region (Germany, Switzerland, and Austria) and 41 percent from other countries in Europe. Another 12 percent of respondents were from the Americas (primarily the United States) and the remaining 13 percent were from the rest of the world.

Respondents by Region
% of respondents

Rest of World 13%
Americas 20%
DACH (Germany, Austria, Switzerland) 26%
Rest of Europe 41%

N=879

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