azul

STATE OF JAVA

SURVEY & REPORT

A SURVEY OF OVER 2,000 JAVA PROFESSIONALS
FROM THE ONLY COMPANY 100% FOCUSED ON JAVA

2023

azul

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STATE OF JAVA

INTRODUCTION

Java has been a stalwart of software development for decades. But recently, it has navigated a series of challenges including Oracle's fourth major update to their pricing or licensing in as many years, rising costs as enterprises migrate Java-based applications to the cloud, and critical security vulnerabilities like Log4j.

THE AUTHORITATIVE **JAVA STUDY** CONDUCTED BY THE ONLY COMPANY **100% FOCUSED ON JAVA**

The 2023 Azul State of Java Survey and Report, initiated by the sole company with a 100% focus on Java, serves as an authoritative guide to understanding the current pulse, trajectory, and sentiments surrounding Java.

With over 2,000 Java users from across the globe weighing in, we sought unparalleled insights into how Java holds its ground in today's dynamic technology environment. The first annual Azul State of Java Survey and Report sheds light on the challenges and opportunities for Java today. As businesses strive for innovation, efficiency, and security, we hope our State of Java survey helps you better understand Java's current state, future trajectories, and prevailing sentiments.

KEY FINDINGS

JAVA ADOPTION

66%
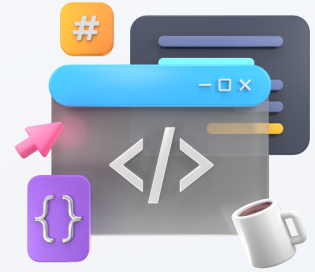PAY FOR JAVA SUPPORT

98%
USE JAVA IN SOFTWARE OR INFRASTRUCTURE

93%
USE JAVA-BASED FRAMEWORKS, LIBRARIES, AND TOOLS

ORACLE JAVA MARKET SHARE

82%
OF RESPONDENTS ARE CONCERNED ABOUT ORACLE PRICING

72%
CONSIDERING NON-ORACLE JAVA SOLUTIONS

42%
ONLY USE AT LEAST ONE INSTANCE OF ORACLE JAVA

79%
WERE AFFECTED BY THE HACK TO LOG4J

57%
SAY OPEN-SOURCE LIBRARIES AND APPLICATIONS ARE CONCERNING SOURCES OF CVES

JAVA SECURITY

90%
USE JAVA IN A PUBLIC, PRIVATE, OR HYBRID CLOUD ENVIRONMENT

JAVA AND THE CLOUD REVOLUTION

UNUSED
41% USE LESS THAN 60% OF THE PUBLIC CLOUD COMPUTE THEY PAY FOR

69%
PAY FOR UNUSED CLOUD CAPACITY

KEY AREAS **OF FOCUS**

➡ JAVA ADOPTION

Despite ranking as the second favorite programming language among developers (Jetbrains 2022), questions persist about whether Java is growing or fading in relevance. In our research, an overwhelming 98% of businesses continue to use Java in their software applications or infrastructure, and 57% of those organizations indicate that Java is the backbone of a majority (60%+) of their applications. Compound this number by Java-based frameworks, libraries, and JVM-based languages and it's clear Java continues to play an instrumental role in the modern enterprise.

➡ ORACLE JAVA MARKET SHARE

Oracle held about 75% of the market for Java Development Kit (JDK) distributions in 2020, but in our survey only 42% of respondents use at least one instance of Oracle Java, and 74% of those organizations are using at least one other JDK distribution (predominantly OpenJDK, the open-source implementation of Java SE specification). The introduction of Oracle's fourth major pricing or licensing update in four years, announced in January this year, has sparked widespread apprehension with a staggering 82% of businesses expressing concerns, and nearly three-fourths (72%) actively exploring alternatives to Oracle Java.

➡ JAVA AND THE CLOUD REVOLUTION

The cloud landscape is rapidly transforming, with organizations continuing their advance to the cloud but also acutely aware of soaring costs. An astounding 95% of companies have taken steps to lower cloud costs in the past year, and higher-performance Java implementations are playing a critical role in cloud cost optimization.

➡ JAVA SECURITY

A vulnerability in the popular Log4j library thrust Java security into the spotlight in 2021, sending engineering teams into frenzied activities to patch the vulnerability. In the aftermath, 79% of businesses report having been directly or indirectly impacted by this vulnerability.

JAVA ADOPTION

JAVA REMAINS AS RELEVANT AND POPULAR AS EVER

Based on the survey results, it's clear that Java is alive and well. The research finds that 98% of the companies surveyed for this report use Java today; only 2% were disqualified from completing the survey as they did not use Java. In fact, 57% of respondents say at least 60% of their applications are Java-based. When adding in Java-based frameworks, libraries, and languages, the number is even higher.

83%

OF COMPANIES REVEALED THAT 40% OR MORE OF ALL THEIR APPLICATIONS ARE JAVA-BASED
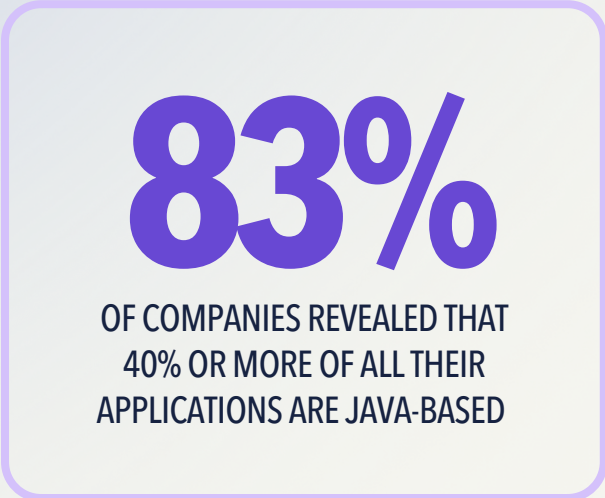
TO THE BEST OF YOUR KNOWLEDGE, WHAT PERCENT OF YOUR ORGANIZATION'S APPLICATIONS ARE BUILT WITH JAVA OR RUN ON A JAVA VIRTUAL MACHINE (JVM)? PLEASE CONSIDER IN-HOUSE DEVELOPED SOFTWARE AS WELL AS 3RD PARTY SOFTWARE.

3%
1%-19%

14%
20%-39%

26%
40%-59%

38%
60%-79%

19%
80%-100%

57% OF RESPONDENTS SAY AT LEAST 60% OF THEIR APPLICATIONS ARE JAVA-BASED
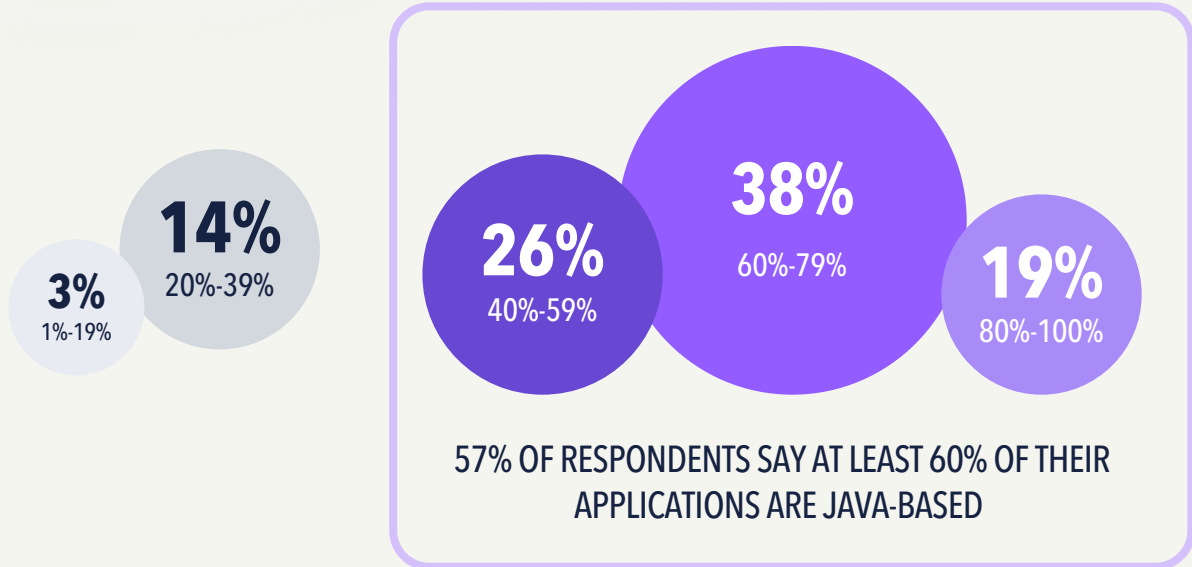
COMPANIES ARE ADOPTING NEWER SUPPORTED VERSIONS OF JAVA

85% of respondents indicate they use a Long-Term Support (LTS) release of Java. Versions 11 (48%) and 17 (45%), are the most popular. Java 8, released in 2014, is third with 40%. It's common practice for companies to skip the feature releases and only upgrade to Long-Term Support releases of Java.

We were encouraged to see critical mass beyond Java 8 to more recent LTS versions Java 11 and 17, likely an indication that application teams have been able to move beyond the incompatibility issues introduced in JDK 9.

The end of free updates for Oracle JDK 8 in 2019 is most likely also a contributing factor to the adoption of newer LTS versions. Oracle JDK 17 uses the "Oracle No-Fee Terms and Conditions (NFTC)" license, but only until September 2024. This permits wider use without a Java SE subscription, specifically for "internal business applications." The NFTC is only applicable until one year after the release of the next LTS, which is every two years.

WHICH VERSION(S) OF JAVA DOES YOUR ORGANIZATION CURRENTLY USE FOR ITS APPLICATIONS?
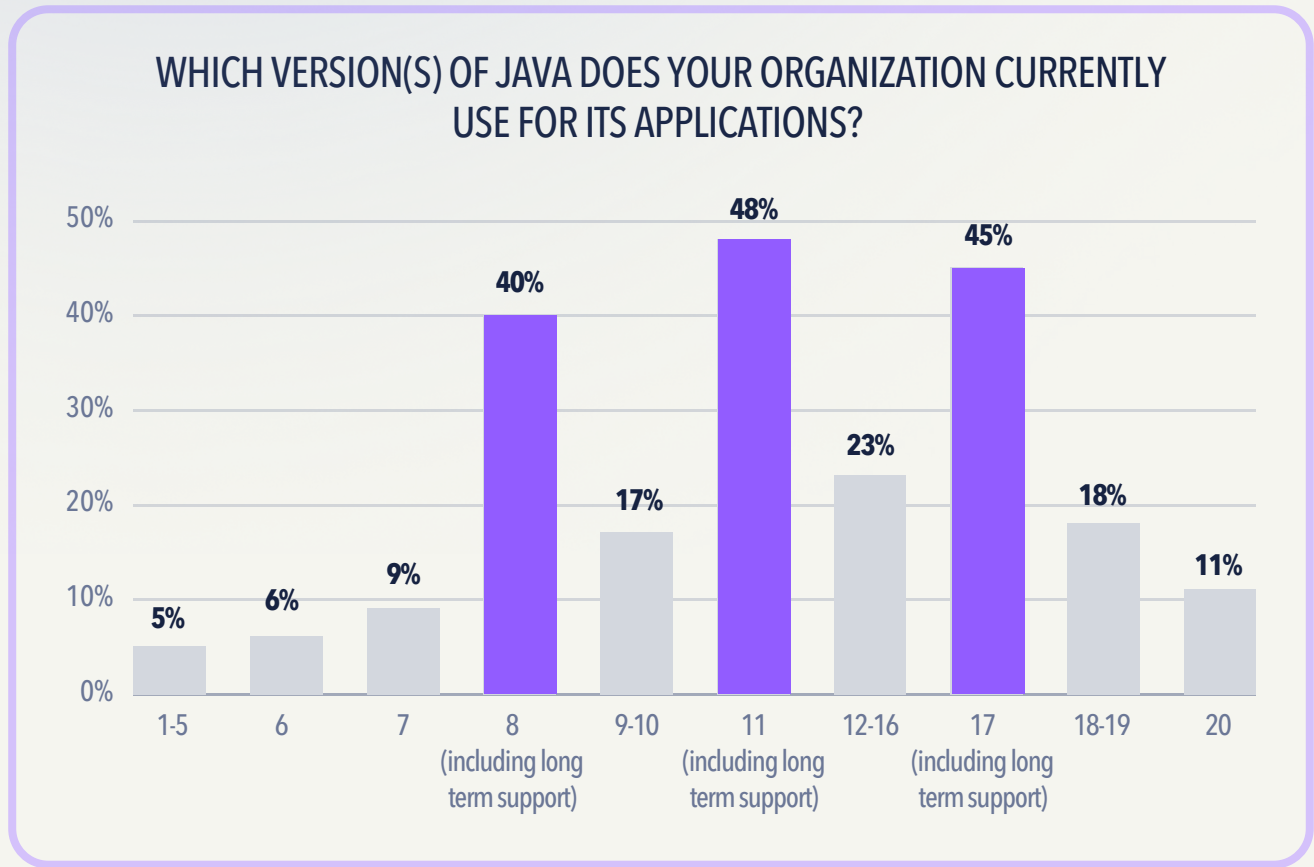
Companies looking to continue avoiding Oracle commercial license fees will need to adopt a continuous upgrade cycle to stay on the latest LTS release during the free three-year period. With a Java LTS release cadence of two years, companies only have one year to make a full migration to the new LTS release. We do not anticipate this will be easy for companies without offsetting implementation costs, as slow version adoption has demonstrated in our survey.

As expected, most (64%) participants in our survey use more than one Java version, and 85% of participants indicate they use an LTS release of Java. However, 43% use at least one version that is no longer commercially supported by Oracle.

While 5% use versions 1-5 that aren't supported anywhere anymore, 15% use Java 6 and 7, which only Azul still supports through at least 2027.

WHICH <u>LTS AND NON-LTS</u> VERSION(S) OF JAVA DOES YOUR ORGANIZATION CURRENTLY USE FOR ITS APPLICATIONS?
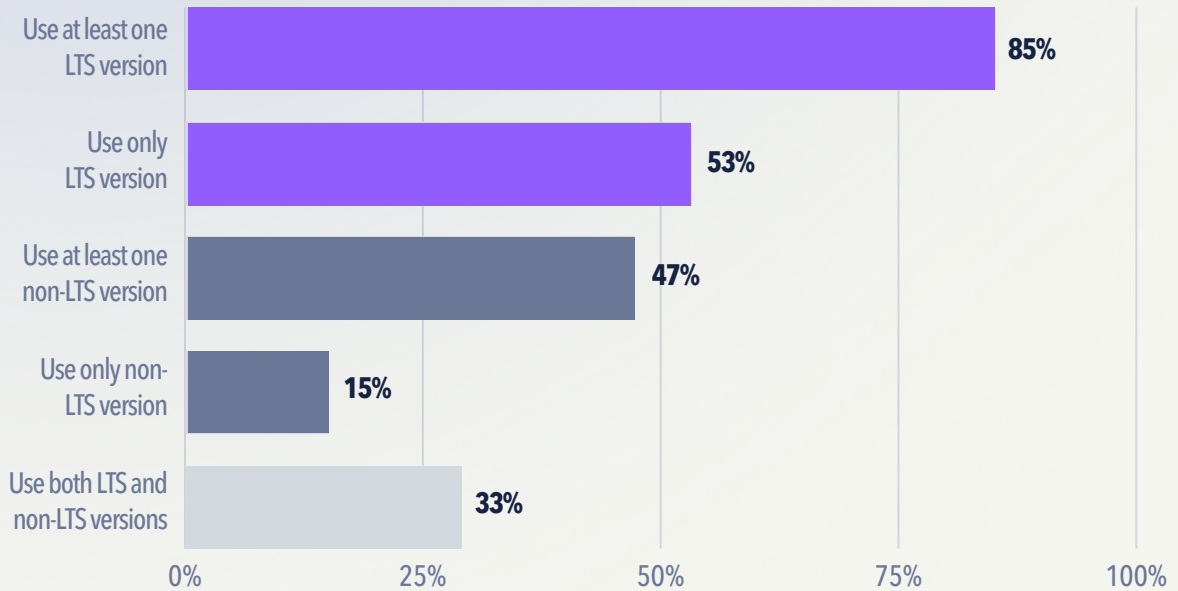
- Use at least one LTS version — 85%
- Use only LTS version — 53%
- Use at least one non-LTS version — 47%
- Use only non-LTS version — 15%
- Use both LTS and non-LTS versions — 33%

WHICH <u>SUPPORTED AND UNSUPPORTED</u> VERSION(S) OF JAVA DOES YOUR ORGANIZATION CURRENTLY USE FOR ITS APPLICATIONS?

- Use at least one supported version — 85%
- Use only supported versions — 56%
- Use at least one unsupported version — 43%
- Use only unsupported versions — 15%
- Use both supported and unsupported versions — 29%
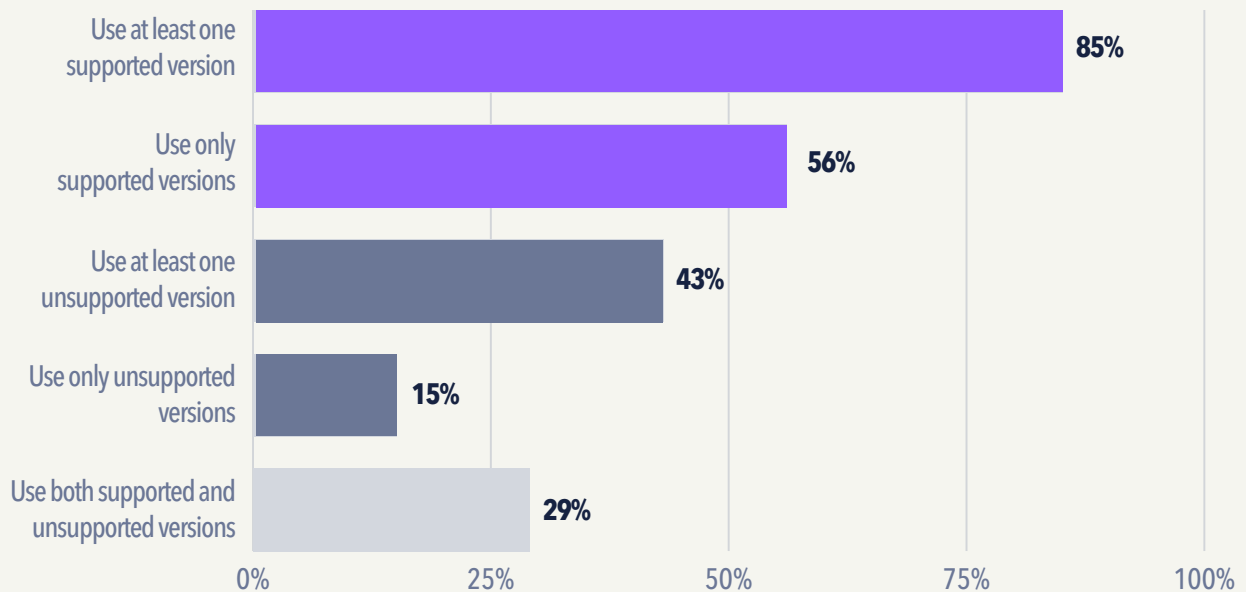
MOST COMPANIES USING JAVA PAY FOR JAVA SUPPORT

Nearly two-thirds (66%) of companies pay for Java support, as we believe they should. Depending on where you purchase support, it comes with several distinct advantages:

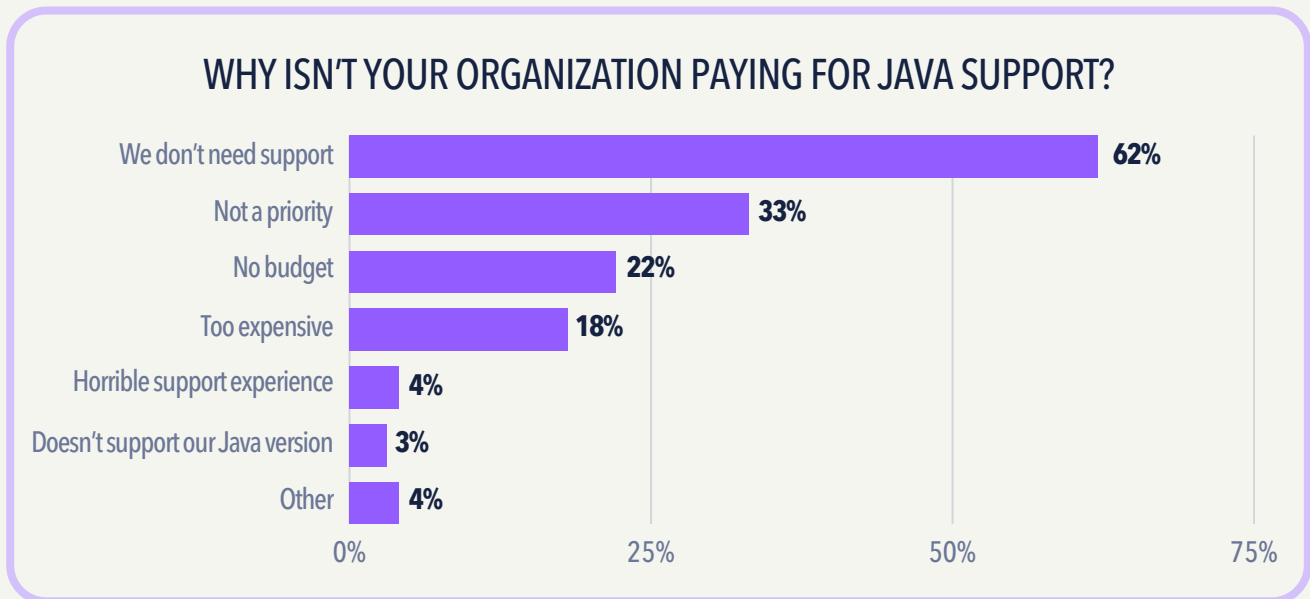- Confidence that all your security patches, bug fixes, and enhancements are current and available
- Security-only patches which are only provided by Oracle and Azul
- Proactive notifications of out-of-cycle bug fixes with root cause analysis for symptomatic issues
- Support for older Java versions like 6 and 7
- Protection from additional licensing requirements and General Public License contamination

IS YOUR ORGANIZATION PAYING FOR JAVA SUPPORT?

34% No

66% Yes
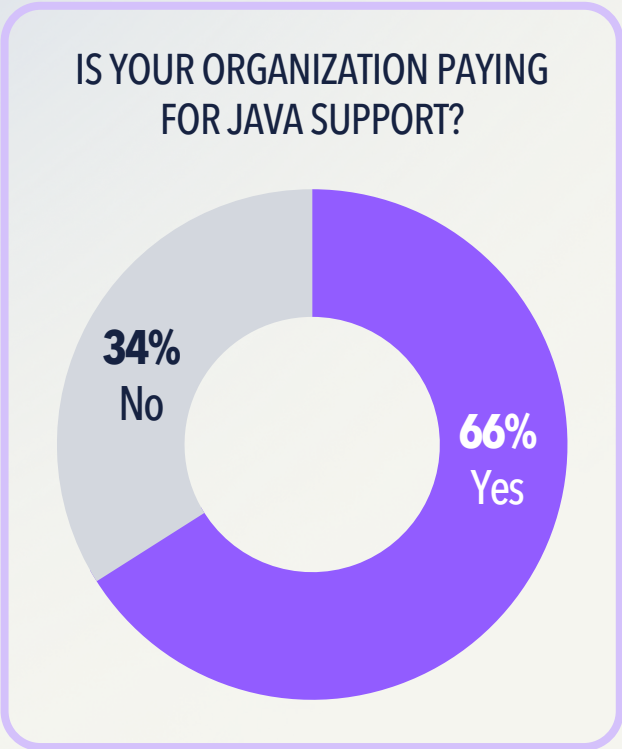
Using commercially unsupported Java is an inherently risky exercise since the same vulnerabilities that can get introduced into new releases of Java are often present in older versions. So why don't more companies pay for commercial support?

WHY ISN'T YOUR ORGANIZATION PAYING FOR JAVA SUPPORT?

We don't need support	62%
Not a priority	33%
No budget	22%
Too expensive	18%
Horrible support experience	4%
Doesn't support our Java version	3%
Other	4%

0%   25%   50%   75%

The reason most often cited by companies in our survey as to why they don't buy support is that they don't need it. Whether that's true or misguided, other leading reasons are that it's not a priority, they haven't allocated budget for it, and it's too expensive.

Interestingly, there is a sharp difference in companies paying for Java based on company size, as less than a quarter of companies with 1,000 or fewer people pay for support, while an overwhelming number of larger organizations do pay for support.

HOW COMPANY SIZE AFFECTS WHETHER TO PAY FOR SUPPORT

	<100	100-1,000	1,000-5,000	5,000-10,000	OVER 10,000
NO	96%	75%	16%	13%	32%
YES	4%	25%	84%	87%	68%
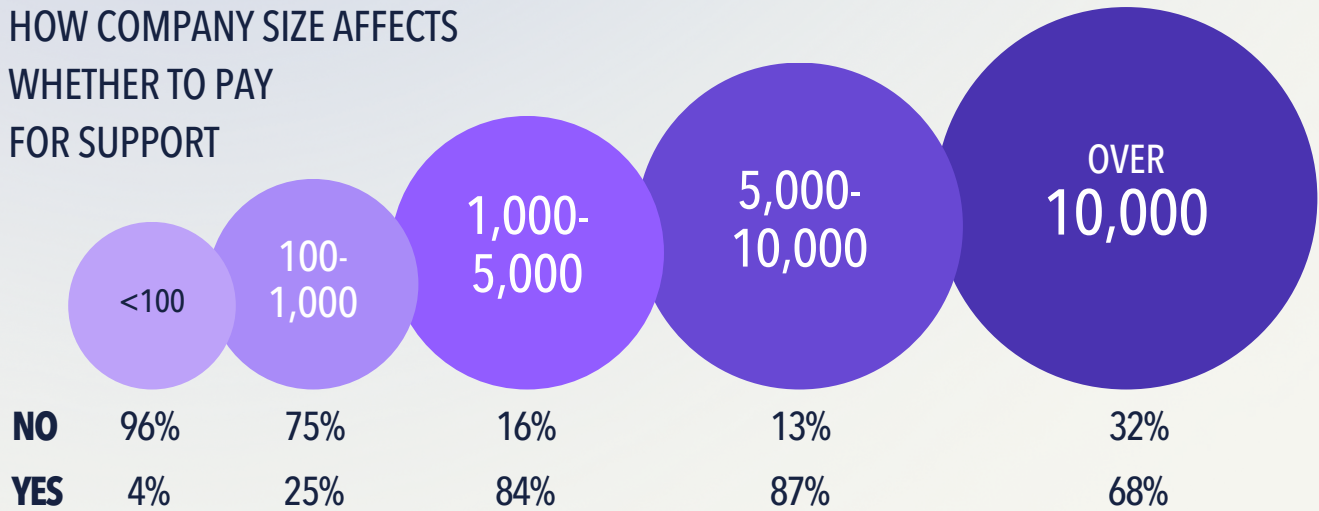
DEVOPS TEAMS LEAN ON JAVA-BASED APPLICATION ARCHITECTURES

There's more to Java than the core language, and those in our survey are nearly unanimous in their use of Java-based frameworks, libraries, and tools. This result solidifies Java's position as the programming language and runtime platform of choice for large-scale applications and infrastructure.
We asked about the tools and services used the most, and we discovered:

WHAT JAVA-BASED INFRASTRUCTURE IS YOUR ORGANIZATION USING?

Infrastructure	Percentage
Kafka	42%
Elastic	39%
Hadoop	33%
Cassandra	27%
Hazelcast	25%
Spark	24%
Hbase	19%
Flink	17%
Solr	13%
Other	5%
Not using Java-based infrastrucutre	7%
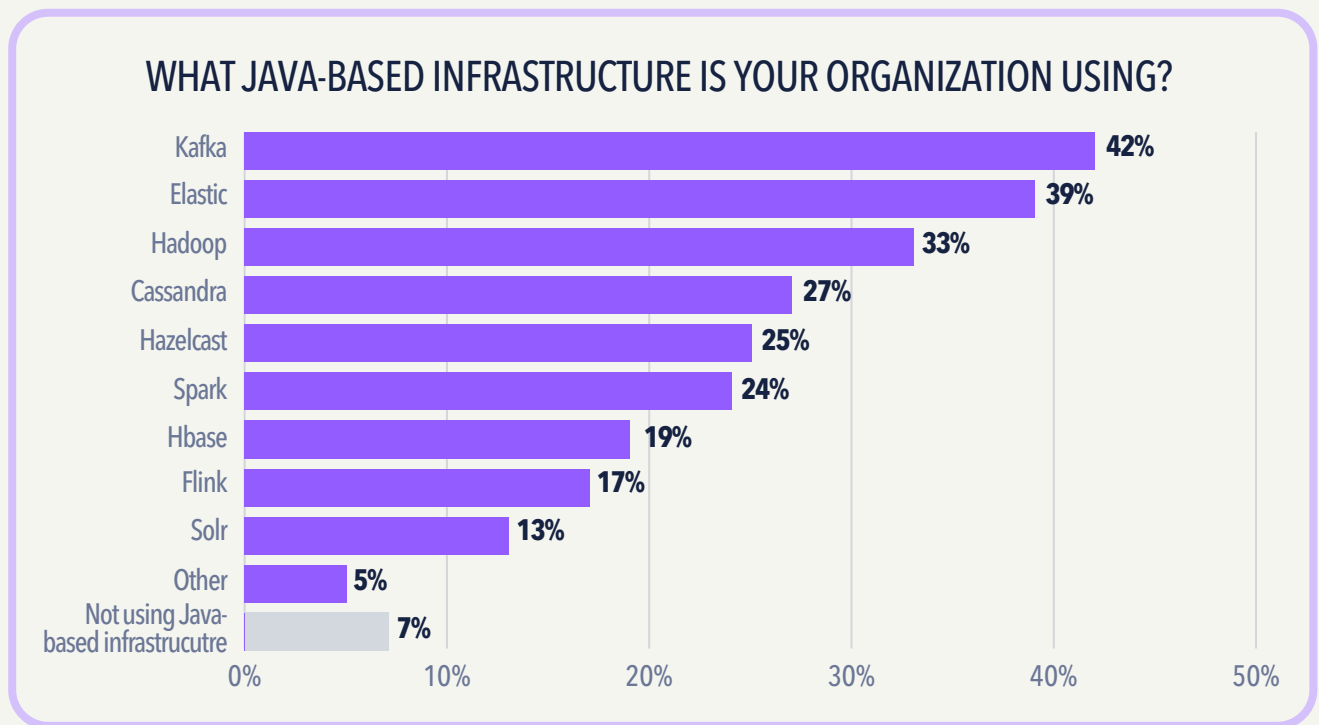
31%

OF ORGANIZATIONS USE
JAVA-BASED MICROSERVICES
FRAMEWORKS, LED BY
SPRING BOOT (61%)

67%

OF COMPANIES ARE USING
OF JAVA INFRASTRUCTURES,
LED BY KAFKA (42%) AND
ELASTIC (39%)

WHICH MICROSERVICE FRAMEWORKS DOES YOUR ORGANIZATION USE FOR JAVA-BASED MICROSERVICES?

Framework	Percentage
Spring Boot	61%
Quarkus	34%
Micronaut	33%
DropWizard	25%
Vert.x	13%
Other	2%
Not using Java-based infrastrucutre	7%

0%   25%   50%   75%
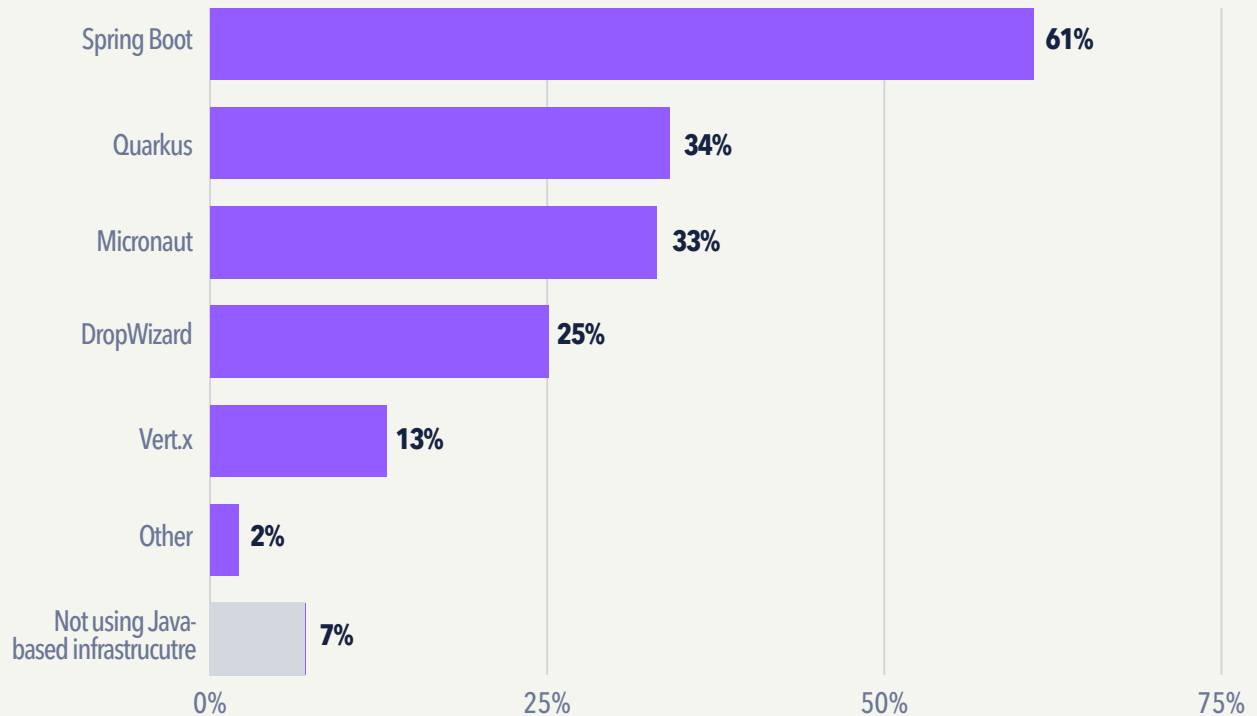
WHAT JAVA-BASED LANGUAGES IS YOUR ORGANIZATION USING?

Language	Percentage
Kotlin	47%
Groovy	43%
Scala	30%
We are only using "traditional" Java	23%
Clojure	22%
Other	1%

0% 10% 20% 30% 40% 50%
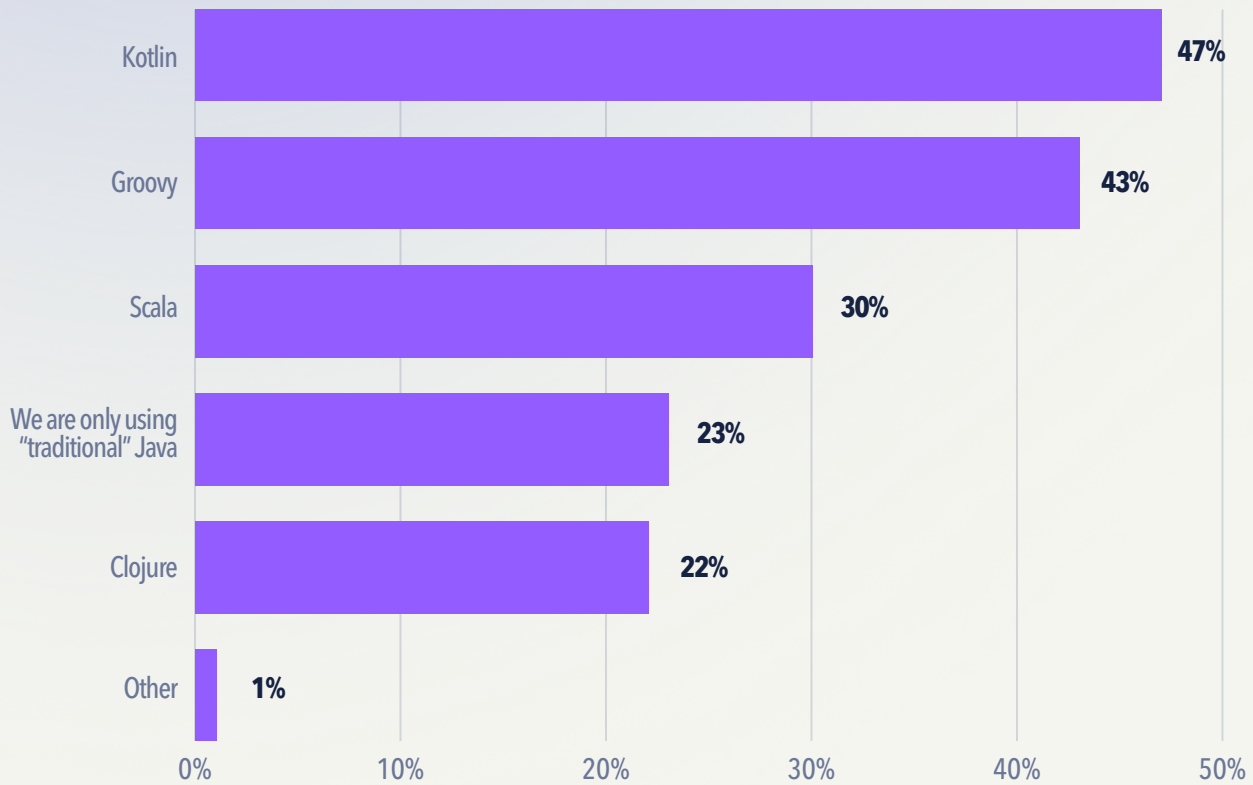
73%

OF COMPANIES HAVE ADOPTED ADDITIONAL JAVA-BASED LANGUAGES, INCLUDING KOTLIN (47%) AND GROOVY (43%) IN ADDITION TO STANDARD JAVA

50%

DESPITE RECENT SECURITY HACKS, LOG4J REMAINS THE MOST COMMONLY USED JAVA LIBRARY (51%), FOLLOWED BY MAVEN (50%).

71%

OF ORGANIZATIONS
USE JAVA-BASED
WEB OR APPLICATION
SERVERS, LED BY
TOMCAT (49%)

WHAT JAVA-BASED WEB AND APPLICATION SERVERS IS YOUR ORGANIZATION USING?

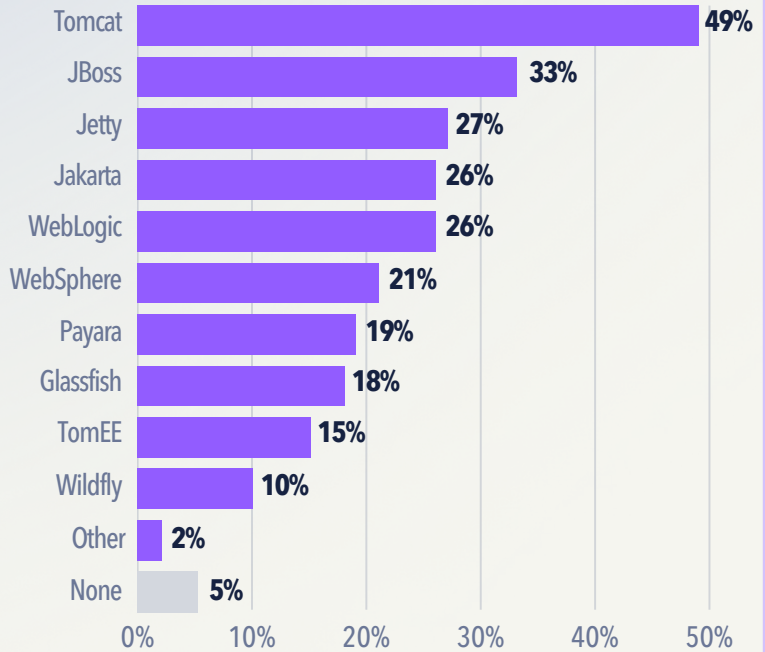| Server	%
Tomcat	49%
JBoss	33%
Jetty	27%
Jakarta	26%
WebLogic	26%
WebSphere	21%
Payara	19%
Glassfish	18%
TomEE	15%
Wildfly	10%
Other	2%
None	5%

WHAT JAVA-BASED FRAMEWORKS, LIBRARIES, OR TOOLS IS YOUR ORGANIZATION USING?

Tool	%
Log4j	51%
Maven	50%
Hibernate	48%
Spring	47%
Gradle	34%
Guava	27%
Netty	24%
JSF	22%
Grails	16%
Struts	13%
Play	11%
Vaadin	8%
Other	3%
None	1%
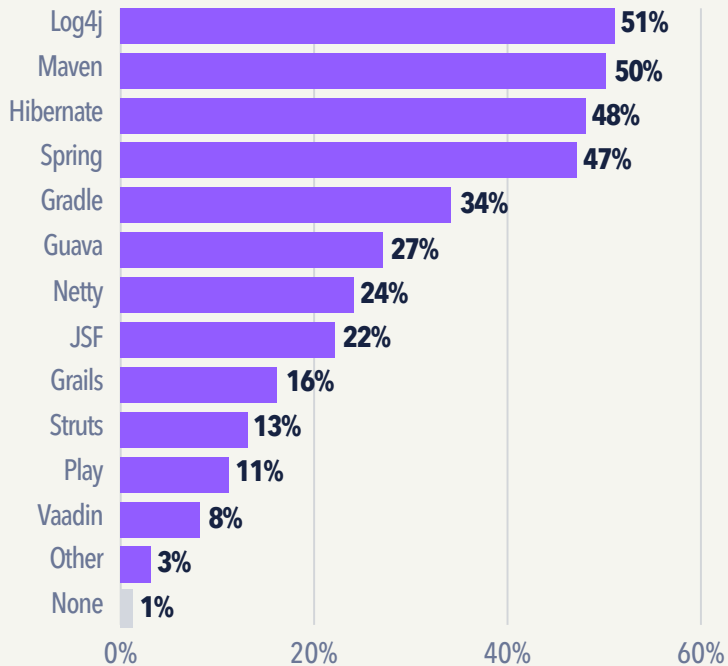
76%

OF TODAY'S
ENTERPRISES ARE
USING JAVA-BASED
FRAMEWORKS,
LIBRARIES, AND TOOLS.

ORACLE JAVA MARKET SHARE

ORACLE'S MARKET SHARE IS WANING

While Oracle remains a strong player in the Java market with 42% of respondents still using at least one instance of Oracle Java, 74% of those individuals also use a JDK from at least one other OpenJDK provider. About 60% of companies use a non-Oracle OpenJDK distribution over Oracle Java SE.
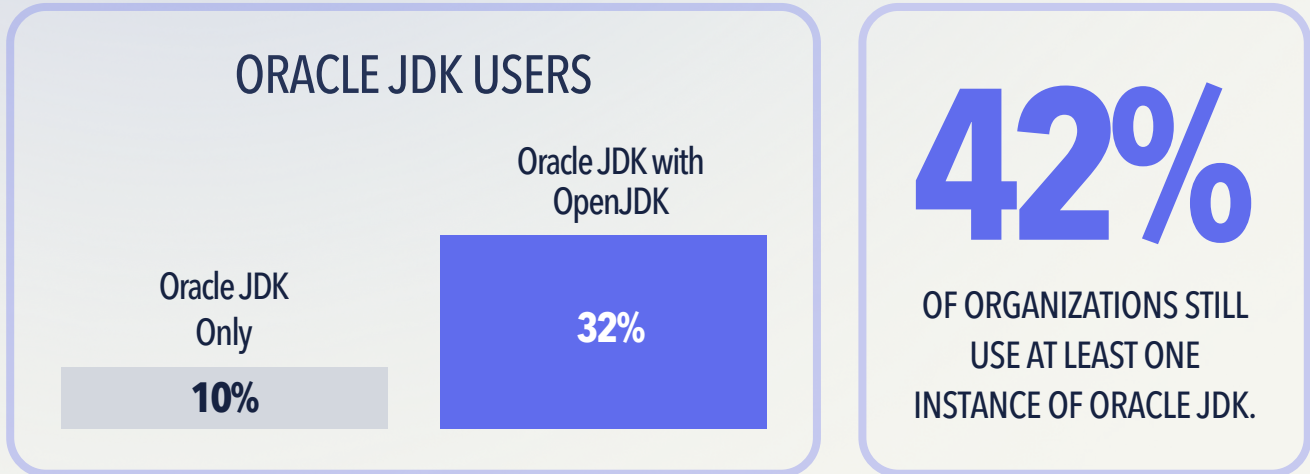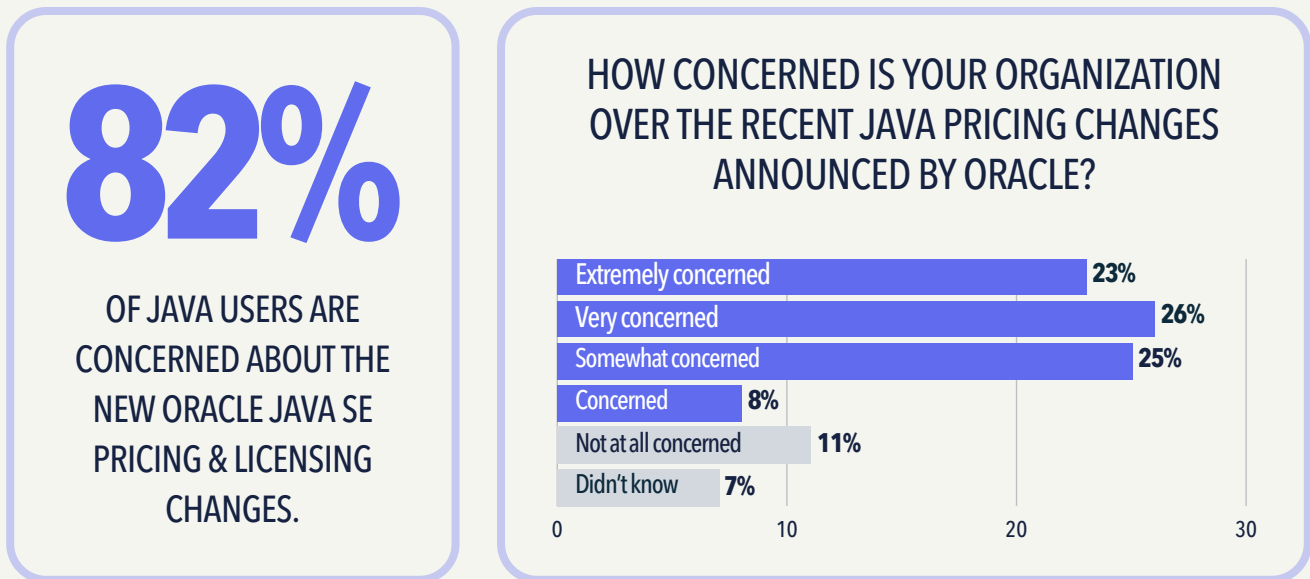
ORACLE JDK USERS

Oracle JDK with OpenJDK
32%

Oracle JDK Only
10%

42%
OF ORGANIZATIONS STILL USE AT LEAST ONE INSTANCE OF ORACLE JDK.

ORACLE JAVA'S LICENSING CHANGES HAVE BUSINESSES LOOKING ELSEWHERE

When Oracle changed its Java pricing model to a per-employee model in January 2023, there was immediate backlash. By the time of this survey in May-June 2023, it hadn't abated. 82% of Java users are concerned about the new Oracle Java SE pricing and licensing changes. The new pricing model charges based on the total number of "Employees" (a defined term that also includes contractors, consultants, agents and others) rather than the number of servers, desktops, or users of the software. For most companies, especially larger ones, licensing Oracle JDK is significantly more expensive under the new pricing model.

82%
OF JAVA USERS ARE CONCERNED ABOUT THE NEW ORACLE JAVA SE PRICING & LICENSING CHANGES.

HOW CONCERNED IS YOUR ORGANIZATION OVER THE RECENT JAVA PRICING CHANGES ANNOUNCED BY ORACLE?

Category	Percentage
Extremely concerned	23%
Very concerned	26%
Somewhat concerned	25%
Concerned	8%
Not at all concerned	11%
Didn't know	7%

More than 70% of respondents using Oracle Java say they are considering a non-Oracle JDK too. Interestingly, that percentage was the same for users of Oracle JDK, Oracle OpenJDK, or both. Of those who are not considering non-Oracle JDKs, a minority (14%) said they didn't know they could move to another JDK like OpenJDK distributions.

IS YOUR ORGANIZATION CONSIDERING MIGRATING FROM ORACLE JAVA TO A NON-ORACLE DISTRIBUTION?

28%
No

72%
Yes
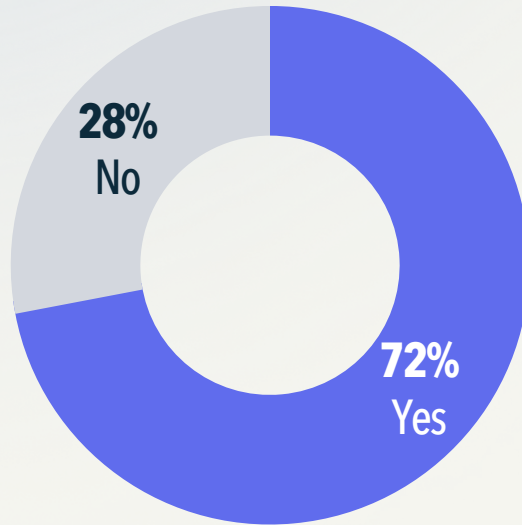
In most cases migrating to another JDK like OpenJDK is straightforward and there are companies that specialize in helping organizations do it successfully.
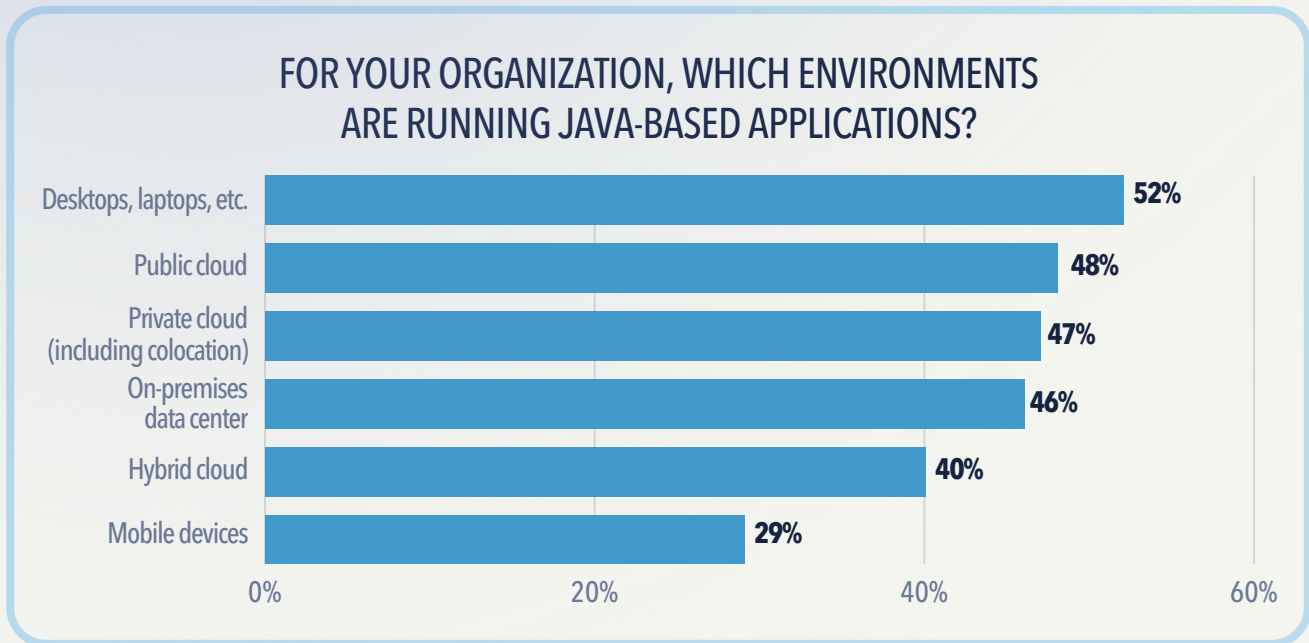
Oracle's new pricing model is proving more expensive for many customers, especially larger ones. Parnassia Groep saved 80% on Java licensing and support fees by switching from Oracle to Azul Platform Core.

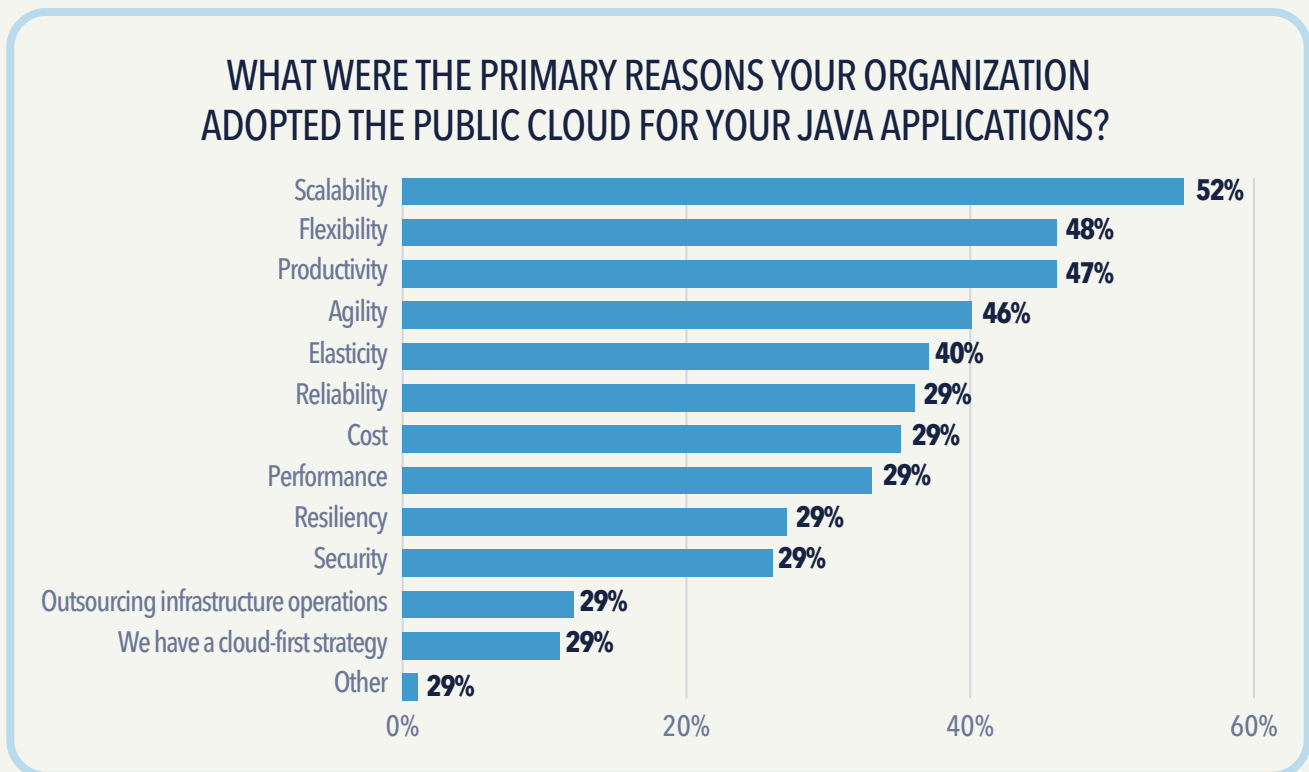Find out more for yourself with the Azul Core Savings Calculator.

JAVA AND THE CLOUD REVOLUTION

COMPANIES ARE RUNNING JAVA IN THE CLOUD

Java is decidedly cloudy, as 90% of respondents are using Java in a public (48%), private (47%), or hybrid (40%) cloud environment.

FOR YOUR ORGANIZATION, WHICH ENVIRONMENTS ARE RUNNING JAVA-BASED APPLICATIONS?

Environment	Percentage
Desktops, laptops, etc.	52%
Public cloud	48%
Private cloud (including colocation)	47%
On-premises data center	46%
Hybrid cloud	40%
Mobile devices	29%

Businesses continue to move their applications to the cloud for scalability, flexibility, productivity, and agility. By and large, they are not utilizing cloud deployments to optimize cost. However, cost and security remain two of the leading challenges for companies in the cloud.

WHAT WERE THE PRIMARY REASONS YOUR ORGANIZATION ADOPTED THE PUBLIC CLOUD FOR YOUR JAVA APPLICATIONS?

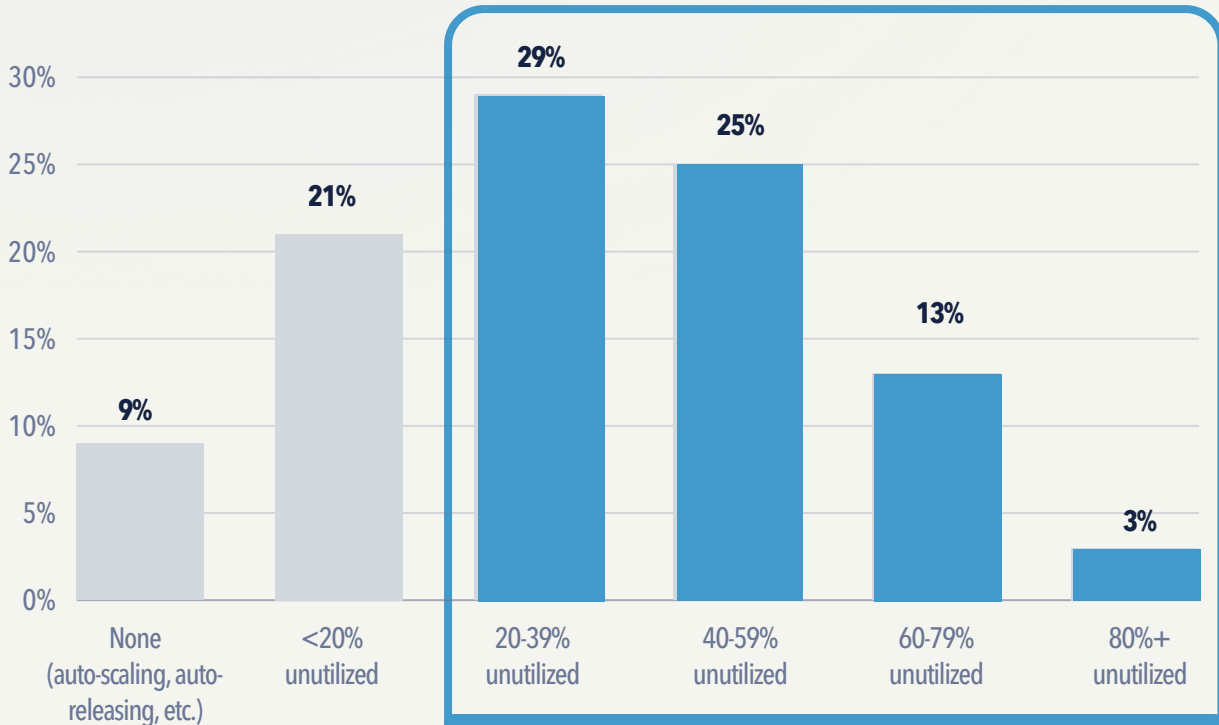| Reason	Percentage
Scalability	52%
Flexibility	48%
Productivity	47%
Agility	46%
Elasticity	40%
Reliability	29%
Cost	29%
Performance	29%
Resiliency	29%
Security	29%
Outsourcing infrastructure operations	29%
We have a cloud-first strategy	29%
Other	29%

COMPANIES ARE OVERPROVISIONING CLOUD RESOURCES

One of the key factors contributing to high cloud costs is overprovisioning resources. One reason is that if an organization reduces the cloud resources it uses during off-peak times, it might not be able to turn them on quickly enough if sudden demand strikes. As a consequence, it leaves those resources on – and pays for them – all the time.

In a telltale sign of overprovisioning cloud resources, nearly 70% of companies say they are paying for at least 20% of cloud capacity that they are not using. More than 40% of respondents say they use less than 60% of the public cloud compute they're paying for. That's a lot of wasted spend!
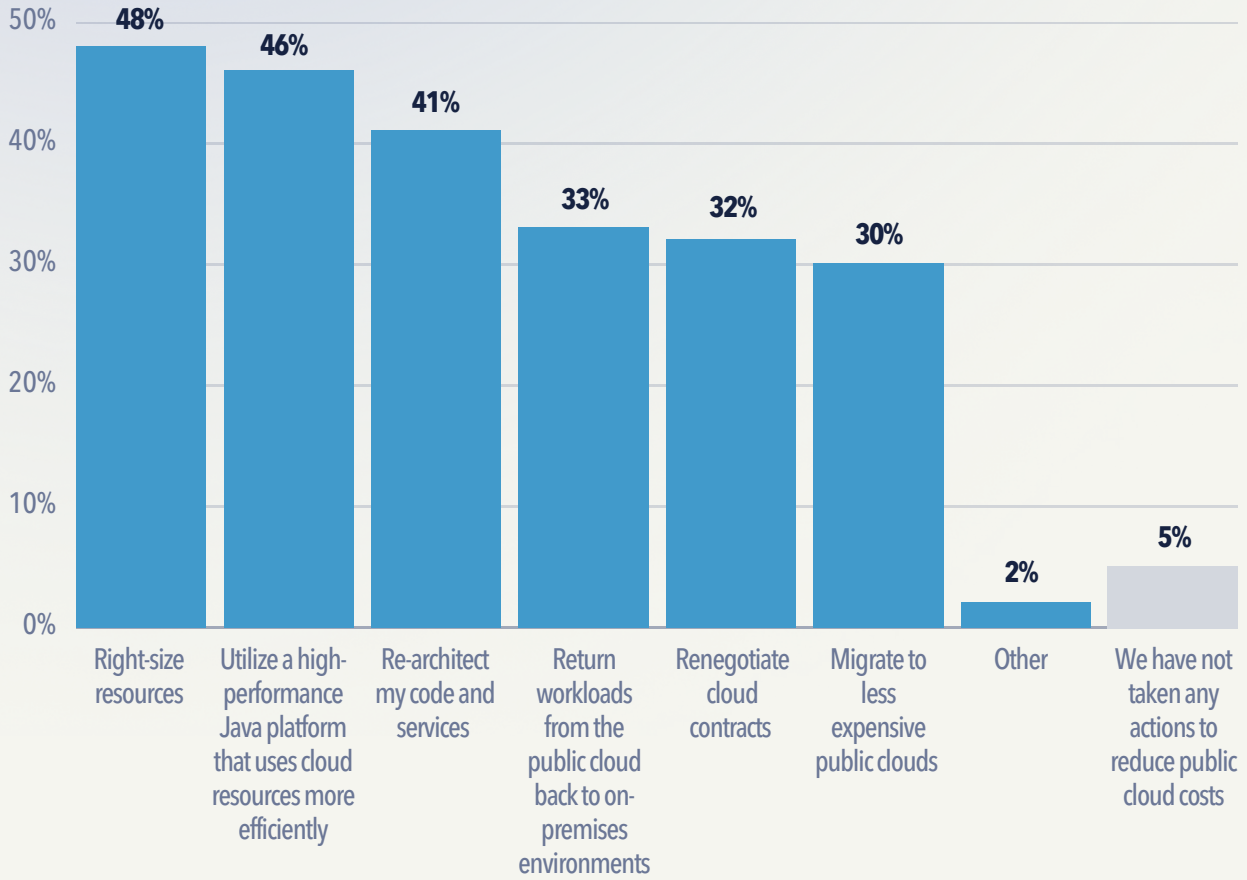
HOW MUCH UNUSED OPERATIONAL COMPUTE CAPACITY (HEADROOM) DOES YOUR ORGANIZATION HAVE IN THE PUBLIC CLOUD?

Bar chart:
- None (auto-scaling, auto-releasing, etc.): 9%
- <20% unutilized: 21%
- 20-39% unutilized: 29%
- 40-59% unutilized: 25%
- 60-79% unutilized: 13%
- 80%+ unutilized: 3%

70% OF COMPANIES ARE OVER PROVISIONING CLOUD RESOURCES

Business leaders are not just accepting high cloud costs. Nearly all of them (95%) have taken steps to reduce cloud costs in the last year. A third of companies in our survey have gone as far as repatriating some compute from the public cloud back to on-premises. The second most popular tactic to reduce public cloud cost is to leverage a high-performance Java platform to use fewer cloud resources.

OVER THE LAST YEAR, WHAT ACTIONS HAS YOUR ORGANIZATION TAKEN TO REDUCE PUBLIC CLOUD COSTS FOR YOUR JAVA-BASED APPLICATIONS AND INFRASTRUCTURE?

- Right-size resources: 48%
- Utilize a high-performance Java platform that uses cloud resources more efficiently: 46%
- Re-architect my code and services: 41%
- Return workloads from the public cloud back to on-premises environments: 33%
- Renegotiate cloud contracts: 32%
- Migrate to less expensive public clouds: 30%
- Other: 2%
- We have not taken any actions to reduce public cloud costs: 5%
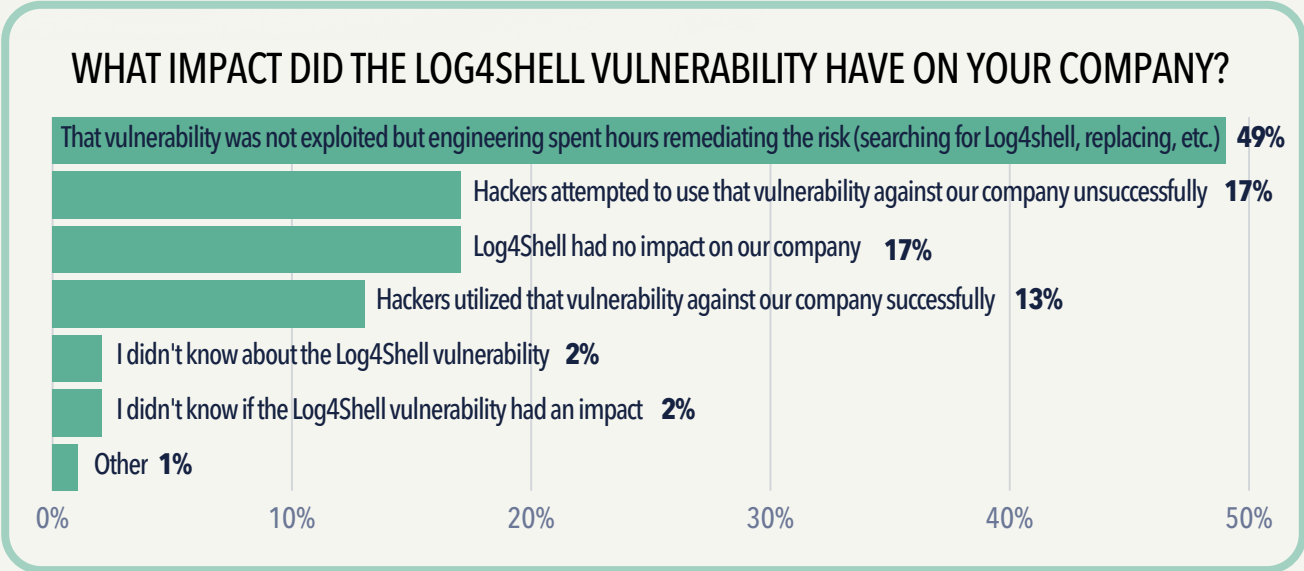
JAVA
SECURITY

SECURITY CONCERNS CONTINUE SINCE LOG4J

The vast ecosystem of Java-based libraries, architectures, tools, and languages is one of the strengths of the Java platform. While all software is at risk from common vulnerabilities and exposures (CVEs), Java frameworks and libraries have a wider "blast radius" because they are so widely used and are most often open source. The Log4j logging library reminded us of this fact in 2021 when it became infected with the Log4Shell vulnerability.

80%
OF COMPANIES IN OUR SURVEY WERE IMPACTED BY LOG4SHELL

Nearly 80% of companies in our survey were impacted by Log4Shell. About half were impacted indirectly by the extra time required of their engineering teams. Surprisingly, nearly a third were impacted by the vulnerability itself, as 17% report that hackers tried unsuccessfully to exploit the vulnerability and 13% say bad actors exploited the vulnerability successfully. The insidious nature of Log4Shell is Log4j's ubiquity and how easily vulnerable versions can be re-introduced after being patched. In 2022, The U.S. Cyber Safety Review Board noted that one federal agency spent 33,000 hours patching Log4j exposures on the network. It's no wonder the U.S. Department of Homeland Security called it "one of the most serious software vulnerabilities in history."

WHAT IMPACT DID THE LOG4SHELL VULNERABILITY HAVE ON YOUR COMPANY?

- That vulnerability was not exploited but engineering spent hours remediating the risk (searching for Log4shell, replacing, etc.) **49%**
- Hackers attempted to use that vulnerability against our company unsuccessfully **17%**
- Log4Shell had no impact on our company **17%**
- Hackers utilized that vulnerability against our company successfully **13%**
- I didn't know about the Log4Shell vulnerability **2%**
- I didn't know if the Log4Shell vulnerability had an impact **2%**
- Other **1%**

The impact of the Log4j hack emphasizes the ongoing threat of security vulnerabilities in Java applications. It also supports another survey finding, that third-party and open-source applications and libraries are the most concerning sources of CVEs. Nearly two out of three survey respondents say exactly that, with 57% listing open-source libraries and applications as the most concerning sources of CVEs, and 51% specifying that third-party libraries and applications are the most concerning sources of CVEs.

Still, Log4j remains one of the most popular Java libraries in use.

CONCLUSION

CONCLUSION

Software application development and deployment continue to evolve at a rapid pace, as does Java. In our first annual State of Java Survey and Report 2023, we uncovered some expected results and uncovered some surprises.

EXPECTED RESULTS AND SURPRISES

82%

OF COMPANIES ARE CONCERNED ABOUT THE NEW PRICING AND 72% CONSIDERING SWITCHING TO A DIFFERENT JDK.

We knew Java is still a popular, progressive programming platform. If you combine the percentage of respondents who knowingly use Java to run their applications with the number who use Java-based infrastructures, libraries, and tools, nearly every enterprise is using Java and Java-based technologies.

We also suspected Oracle's pricing change in January 2023 had sparked significant angst. If you live in the Java world at all, you know the emotional reaction that resulted. However, the results were more pronounced than we expected, with 82% concerned about the new pricing and 72% considering switching to a different JDK.

SURPRISES

The cost of running applications in the cloud has received plenty of attention, but we didn't realize how prevalent attempts were to mitigate those high costs. We also were surprised by how many organizations had attempted to reduce cloud costs by using a high-performance Java platform.

We expected that the impact from the Log4j compromise in 2021 was almost entirely on engineering teams devoting time to protecting against the Log4Shell vulnerability, however, we thought there would be relatively little impact from attempts to exploit it.

Seeing that nearly a third of Java users experienced at least one attempt to exploit Log4Shell was surprising.
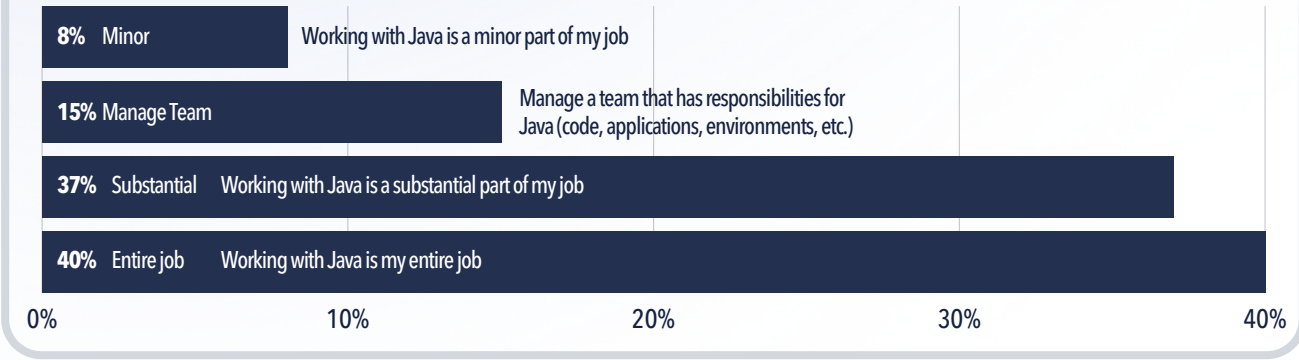
"NEARLY A THIRD OF JAVA USERS EXPERIENCED AT LEAST ONE ATTEMPT TO EXPLOIT LOG4SHELL WAS SURPRISING."
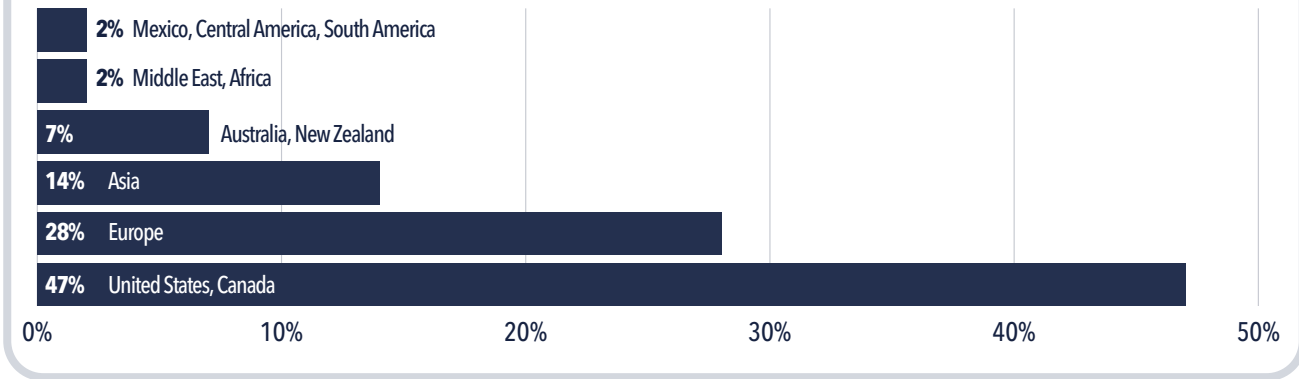
ABOUT THIS SURVEY

ABOUT THIS SURVEY

The report data was compiled from Java professionals and those that use or deploy Java-based applications and infrastructure at all seniority levels. Participants from companies of all sizes were invited to take part in a survey on their company's use of specific computer languages. 98% of the companies surveyed indicated they had responsibility for Java. A total of 2,062 qualified participants from six continents completed the survey. Dimensional Research, a leading market research firm, administered the electronic survey. Some participants were offered token compensation for their participation.
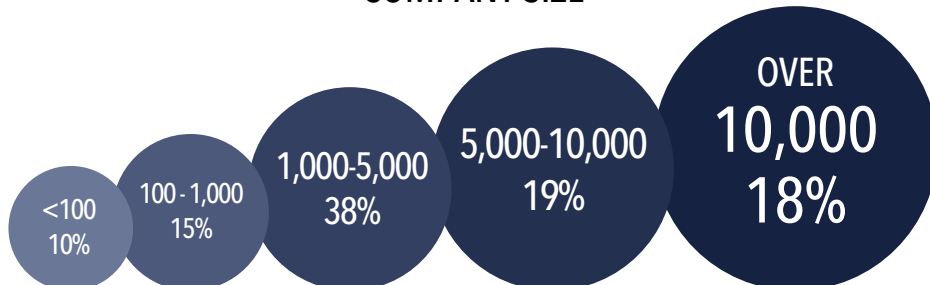
JAVA RESPONSIBILITIES

8%	Minor	Working with Java is a minor part of my job
15%	Manage Team	Manage a team that has responsibilities for Java (code, applications, environments, etc.)
37%	Substantial	Working with Java is a substantial part of my job
40%	Entire job	Working with Java is my entire job

0%   10%   20%   30%   40%

LOCATION

2%	Mexico, Central America, South America
2%	Middle East, Africa
7%	Australia, New Zealand
14%	Asia
28%	Europe
47%	United States, Canada

0%   10%   20%   30%   40%   50%

COMPANY SIZE

<100
10%

100 - 1,000
15%

1,000-5,000
38%

5,000-10,000
19%

OVER
10,000
18%

ABOUT AZUL

Headquartered in Sunnyvale, California, Azul provides the Java platform for the modern cloud enterprise. Azul is the only company 100% focused on Java.

Millions of Java developers, hundreds of millions of devices, and the world's most highly regarded businesses trust Azul to power their applications with exceptional capabilities, performance, security, value, and success. Azul customers include 35% of the Fortune 100, 50% of the Forbes Top-Ten World's Most Valuable Brands, all 10 of the world's top 10 financial trading companies, and leading brands like Avaya, Bazaarvoice, BMW, Credit Suisse, Deutsche Telekom, LG, Mastercard, Mizuho, Priceline, Salesforce, Software AG, and Workday. Learn more at azul.com and follow us @azulsystems.

ABOUT DIMENSIONAL RESEARCH

Dimensional Research provides practical marketing research to help technology companies make their customers more successful. Our researchers are experts in the people, processes, and technology of corporate IT and understand how IT organizations operate. We partner with our clients to deliver actionable information that reduces risks, increases customer satisfaction, and grows the business. For more information, visit www.dimensionalresearch.com.

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