

THE STATE OF PENTESTING 2022

The State of Pentesting 2022

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Executive Summary

Security is the result of decisions and actions made by many different people. Every individual has a part to play, but as digital transformation and DevSecOps adoption accelerates, security and development teams both take center stage. The struggles and wins of one team increasingly affect the other. Which is why for this year's State of Pentesting report, we decided to focus on issues and stats that are relevant to **both security and development teams**: to separate these two inextricably linked groups would only yield a partial picture of the security landscape.

Cobalt is a Pentest as a Service vendor, so we get to directly observe how organizations deal with vulnerabilities and the challenges threatening their security. One of their most pressing issues? They don't have enough people on their teams to handle the workload. Headlines around "The Great Resignation" continue to populate news feeds, but those working in tech might argue they have always had to deal with a lack of manpower. We began to suspect things have moved to a critical tipping point when our 2021 pentesting data started showing results like this:

- Teams have been struggling with the same vulnerabilities for 5 years in a row.
- Most of the findings we discover are connected to missing configurations, outdated software, and lack of access management controls—all issues that can start piling when workloads are getting out of control.
- Teams **want** to fix all of their vulnerabilities, but end up neglecting those that aren't "Critical" or "High" risk.
- Most findings that get fixed take approximately 14 days to address, but there are situations where they take 31 days or longer.

Research Methodology

Cobalt's State of Pentesting report data comes from two sets:

- 2,380 pentests conducted over the course of 2021.
- A survey of 602 cybersecurity and software development professionals.

For more information see Appendix B, "Methodology".

We started to think, are teams reaching a breaking point, dealing with too much work? If so, could we capture or quantify the impact? Here are a few takeaways from our research that may make you pause:

- Nearly every team we surveyed has been affected by talent shortages.
- As a result, organizations are losing strength in their security posture and code quality, creating considerable risk of successful breaches.
- Try as they might to retain their talent, organizations are seeing a lot of resignations. More than half of survey respondents are considering quitting their jobs.

These stressful circumstances can wreak considerable damage, both to organizations and their people. Leadership should take a hard look at what is causing burnout and disillusionment, take stock of their go-to-market priorities versus their teams' capacity, and consider the daily interactions they have with their colleagues. Our research highlights underlying concerns, but also proposes solutions.

The first step? Acknowledge that business as usual is not usual. Not anymore, and perhaps may never go back to pre-pandemic expectations.

NEXT CHAPTER: THE STATE OF PENTESTING 2022 AT A GLANCE →

The State of Pentesting 2022 at a Glance

Top Vulnerability Categories

1. Server Security Misconfigurations
2. Cross-Site Scripting (XSS)
3. Broken Access Control
4. Sensitive Data Exposure
5. Authentication and Sessions

These vulnerability categories have stayed at the top of our list for 5 years straight.

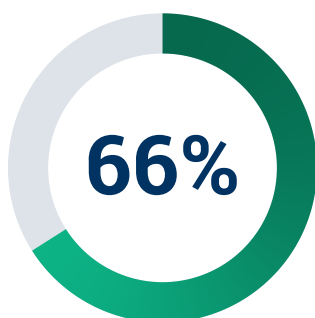
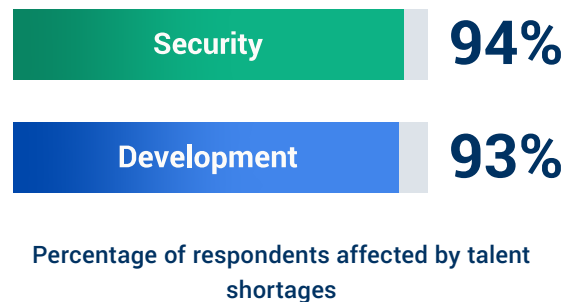
To proactively fix and prevent vulnerabilities, both security and development teams need access to more resources, particularly manpower.

Neither group has that luxury. Out of 602 respondents, almost everyone said they struggle with talent shortages.

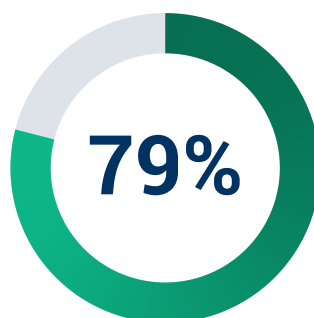
Talent shortages have a tangible impact on security programs. As colleagues leave and roles stay open, teams are struggling to maintain security standards, particularly around compliance and supporting secure development. Vulnerabilities are more likely to slip past undetected, and teams are concerned they're not ready to respond to an attack. Their biggest concerns are social engineering and third-party software exposure.

Top Findings

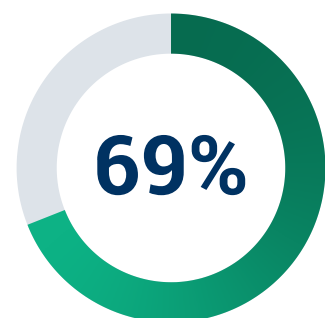
1. Cross-Site Scripting (XSS): Stored
2. Broken Access Control: Insecure Direct Object References (IDOR)
3. Components with Known Vulnerabilities: Outdated Software Versions
4. Server Security Misconfiguration: Insecure SSL or TLS protocols
5. Server Security Misconfiguration: Lack of Security Headers



struggle to maintain high quality security standards

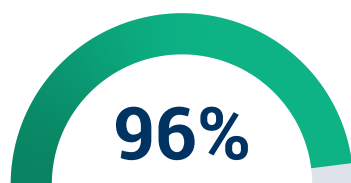


struggle to consistently monitor for vulnerabilities

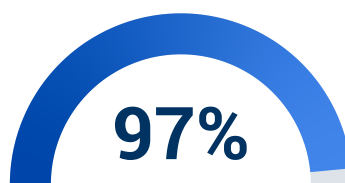


struggle to monitor for and respond to security incidents

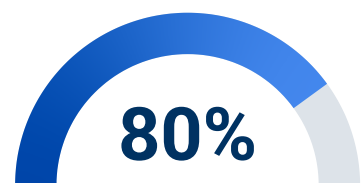
Talent shortages are also straining collaboration efforts between security and development departments. This slows teams down, both in fixing critical vulnerabilities and meeting launch deadlines. In addition, the quality of developers' work drops, raising the chance that new code will bring in even more vulnerabilities.



of security teams see a slower response to patching critical vulnerabilities

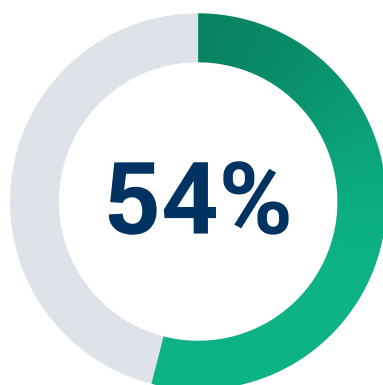


of developers struggle to meet critical launch deadlines

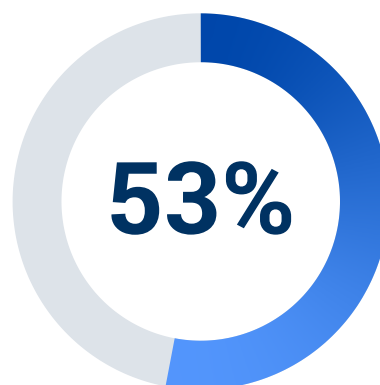


of developers said collaboration challenges with the security team compromise the quality of their code

Teams are stressed and burnt out. A large portion of respondents are considering quitting their jobs. But it's not all doom-and-gloom. For an overview of what employers can do to reverse this trend, check the section 'Hiring, Onboarding, and Retention'.



of security practitioners are considering quitting their jobs



of developers are considering quitting their jobs

Now that we've addressed the more abstract takeaways from the survey, let's turn our sight towards the security vulnerabilities that slipped past teams' defenses.

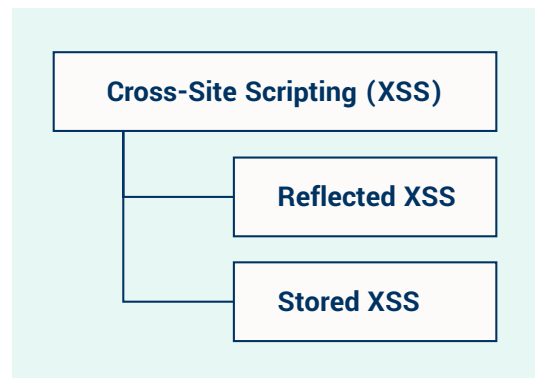
What Are the Most Common Vulnerabilities?

The answer to this question comes in two parts. The first step is to look at **Vulnerability Categories**, such as Broken Access Control or Cross-Site Scripting (XSS). Nested within these categories are **Findings**, which are more granular descriptions of the specific flaw an attacker could exploit. Here's an example:

Vulnerability Category: An application is vulnerable to Cross-Site Scripting (XSS) attacks. This happens when the application doesn't validate and encode user-supplied input properly, so it gets treated as code, rather than as text. There are two possible findings under this category:

Finding #1: An instance of Reflected XSS.

An attacker creates a URL that contains a vulnerable parameter. When they send that URL to another user, the user's browser accepts the code string and performs whatever actions it describes—for example, generating an alert box that prompts users to share sensitive information.

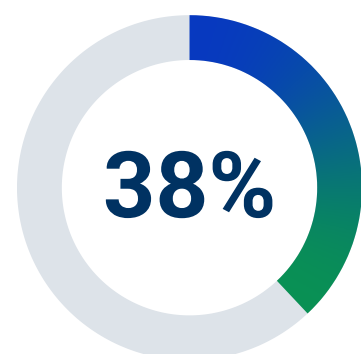


Finding #2: An instance of Stored XSS. When an attacker passes script code to the server in a user-editable location, the application stores it on the server. When another user accesses the affected page, their browser interprets and renders the stored code as part of the page.

Top 5 Vulnerability Categories

Following the same hierarchy, we started our analysis with the 5 most frequently discovered vulnerability categories in 2021:

1. Server Security Misconfigurations: 38%
2. Cross-Site Scripting (XSS): 13%
3. Broken Access Control: 11%
4. Sensitive Data Exposure: 10%
5. Authentication and Sessions: 8%



of our 2021 findings are
connected to Server Security
Misconfigurations

These stats should be familiar to readers who follow the [OWASP Top 10 list for Web Application Security Risks](#). Each of our top vulnerability categories had a spot in their 2021 list.

OWASP Top 10

[OWASP's](#) most widely-known project is reporting the frequently observed vulnerabilities for web applications in their [Top Ten list](#). Cobalt's reporting has largely referred to their taxonomy, with a few exceptions: in 2021, OWASP filed Cross-Site Scripting under the larger "Injection" category and renamed "Sensitive Data Exposure" to "Cryptographic Failures." "Authentication and Sessions" in our list maps to "Identification and Authentication Failures" in theirs.

What's interesting is how our top vulnerability categories have—or rather, haven't—changed in the last 5 years.

	2017	2018	2019	2020	2021
#01	Server Security Misconfigurations	Server Security Misconfigurations	Server Security Misconfigurations	Server Security Misconfigurations	Server Security Misconfigurations
#02	Cross-Site Scripting (XSS)	Authentication and Sessions	Cross-Site Scripting (XSS)	Cross-Site Scripting (XSS)	Cross-Site Scripting (XSS)
#03	Authentication and Sessions	Cross-Site Scripting (XSS)	Authentication and Sessions	Broken Access Control	Broken Access Control
#04	Sensitive Data Exposure	Sensitive Data Exposure	Sensitive Data Exposure	Sensitive Data Exposure	Sensitive Data Exposure
#05	Broken Access Control	Broken Access Control	Broken Access Control	Authentication and Sessions	Authentication and Sessions

Figure 1: The top 5 most common vulnerability categories in our database since 2017

What's the same: Since 2017, Server Security Misconfigurations have stuck around at the top position and Cross-Site Scripting (XSS) has stayed in second place for every year other than 2018. The two vulnerability categories are often related. If your application is missing a Content Security Policy (CSP) header—a type of security configuration—you are more vulnerable to an injection attack like XSS. The prevalence of these vulnerabilities boils down to the following problem: "There's something you can turn on—but you didn't." We typically see this after teams forget to adjust default settings when deploying their applications to a cloud environment.

What's different: Where we saw a notable difference is the rise of the Broken Access Control category, and we're not alone in our observations. OWASP noticed the same uptick. In the 2017 version of their list, Broken Access Control was at 5th place, but it shot up to the top position in their 2021 update with this stat attached: "94% of applications were tested for some form of Broken Access Control."

One possible reason for this is growth in operations. We like to think of it like this: If you had a house with one door, all you have to worry about is keeping that one door locked. But if you expand that house and add a garage door and 5 windows—or in our case, adopt more technology, expand systems, widen networks, and manage more users—you're more likely to forget to lock everything. Creating or updating your user/access matrix can help.

Top 5 Findings

For a detailed breakdown of **how to fix and prevent each of the findings** listed here, check the Appendix in [The State of Pentesting 2021](#).

Diving deeper into our data, we uncovered a similar pattern when it came to the top 5 findings: most flaws from 2020 stayed at the top, but a couple of new issues made their way onto the list.

	2020	2021
#01	Broken Access Control: Insecure Direct Object References (IDOR)	Cross-Site Scripting (XSS): Stored
#02	Cross-Site Scripting (XSS): Stored	Broken Access Control: Insecure Direct Object References (IDOR)
#03	Components with Known Vulnerabilities: Outdated Software Versions	Components with Known Vulnerabilities: Outdated Software Versions
#04	Broken Access Control: Username/Email Enumeration	Server Security Misconfiguration: Insecure SSL or TLS protocols
#05	Cross-Site Scripting (XSS): Reflected	Server Security Misconfiguration: Lack of Security Headers

Figure 2: The top 5 most common findings in our database for 2020 and 2021

For a detailed breakdown of the **top vulnerabilities according to asset type**, check APPENDIX A.

01. Stored Cross-Site Scripting (XSS)

Stored Cross-Site Scripting (XSS) took the top spot for most common findings in 2021. This is a very common vulnerability across the web, observed even in [web apps as prominent as Apple's iCloud](#). In theory, any feature that allows user input can be vulnerable, because it gives attackers an opportunity to inject and store malicious scripts into web applications.

Breaking Down Stored XSS

Here's an example of how it works: A web form has a field that accepts user text input, then stores that input somewhere on the server's database. An attacker accesses that web form and enters a line of code, which the server accepts and stores in the database.

The next time a user pulls up data that includes the attacker's input, their browser attempts to run the malicious code.

How do you fix and prevent Stored XSS?

Overall, you should treat all user-supplied input as untrusted (or potentially malicious) data. This means taking the following steps while designing the application:

1. Only accept untrusted data input in select locations.
2. Create a whitelist of allowed characters.
3. Always sanitize input, encode output, or both, for any data that comes into or out of the application.
4. Use a well-known and secure encoding API for input and output encoding, such as the [OWASP ESAPI](#), or research and use an existing output encoder.

Note: We do not recommend trying to write input and output encoders, unless absolutely necessary.

02. Insecure Direct Object References (IDOR)

Insecure Direct Object References (IDOR) were a prevalent finding both in 2020 and 2021. This type of flaw has the potential to give attackers access to personally identifiable information, which later enables identity theft, fraud, or blackmailing. In 2017, pentesters found an IDOR vulnerability that could [leak users' Airbnb messages](#).

What to Do About IDOR

Insecure Direct Object References (IDOR) can give access to resources via user-supplied input. Attackers could bypass authorization by modifying a value of a parameter that points directly to an object in your database.

Here's an example: Due to the way a website or application handles resources, one customer's file has the ID "file123" in the URL, which corresponds to that file's location in the database.

An attacker who can access "file124" changes the resource ID number in the URL to a different number, such as "file123" and can view the other customer's file.

How do you fix and prevent IDOR?

Use per-user or per-session indirect object references. For example, instead of using the resource's database key, you could use a drop-down list of six resources authorized for the current user with the numbers "1" to "6" to indicate which value the user selected. The application then maps these per-user indirect references back to the actual database key on the server, and returns the requested information.

Check the user's access when they try to view content. Each time the application uses a direct object reference from an untrusted source, the application should also make an access control check to ensure that the user is authorized to access the requested object.

03. Outdated Software Versions

The Outdated Software Versions finding was at third place for both 2020 and 2021. At first glance, outdated software doesn't sound risky or important, but [recent security news suggest otherwise](#).

Why Outdated Software Matters

Let's look at a recent example of a vulnerability that sidetracked development and security operations everywhere: the Log4j flaw. In late 2021, any team using the Apache Log4j library for logging and configurations was vulnerable to a remote code execution attack. Hackers could run code on vulnerable devices and take full control of them.

Apache issued a patch to fix this vulnerability on December 6th. It later became clear this patch didn't fully address the problem, so they released another patch on December 13th.

Then another one on December 17th. And another one on December 28th. Teams who didn't stay on top of patch releases and ran outdated versions of the software were still vulnerable to a flaw that has been described as a "a severe risk" by the Cybersecurity and Infrastructure Security Agency.

How do you fix and prevent Outdated Software Versions?

The core of the problem is version management, which can add a lot to teams' workloads when it takes dozens of apps and programs to keep a website, product, or business running. Staying on top of updates for all of them can quickly spiral out of control, which is why our pentesters recommend using an automated Vulnerability Management System to scan for software updates and notify the IT team when there are fixes to deploy.

04. Insecure SSL or TLS protocols

Where we started to see year-over-year differences in our data was in the increased frequency of misconfigurations around encryption, particularly around the use of SSL protocols.

SSL in itself is outdated and insecure, and should be replaced with TLS 1.2 or 1.3. This vulnerability is common with applications deployed to the cloud, because teams don't always go into the provider's settings and adjust security configurations.

While this is another example of a low-severity flaw, the use of outdated transport protocols doesn't come without its risks. Attackers with a Man-in-the-Middle (MITM) position can break into older secure communication channels and attempt to decrypt the information. Some configurations also allow an attacker to downgrade communication from a stronger cipher suite to one that they can crack.

SSL vs TLS

SSL stands for Secure Socket Layer, which is a type of protocol responsible for encryption, protecting the transfer of sensitive information like credit card details, Social Security Numbers, or other types of Personally Identifiable Information (PII).

Because SSL has serious cryptographic weaknesses, the next version of the protocol—TLS or Transport Layer Security—became available in 1999. There have been multiple security updates since then, but many servers still take connections using outdated versions of the protocol. What we recommend is that your servers accept TLS v 1.2 or higher.

How to fix and prevent Insecure SSL?

1. Use only the most up-to-date TLS protocols. Configure your servers to accept only TLS version 1.2 or 1.3.
2. Do not accept any Secure Sockets Layer (SSL) versions.
3. Configure the server to use only strong cipher suites, which include AES ciphers at 128 bits or higher, TDES/TDEA triple-length keys, and RSA at 2048 bits or higher.

Note: For legacy clients that require insecure browsers (sorry, Internet Explorer), it may be necessary to enable TLS 1.0. However, if you need to be PCI DSS compliant (e.g. your company processes credit card information), this is strictly forbidden.

While you're at it, now is also a good time to check your SSL certificates and make sure they have not expired.

05. Lack of Security Headers

Setting up security headers can be an effective and inexpensive way to strengthen the security of a web application. At the same time, implementing them can seem tedious, especially to a stretched development team.

The impact of lacking security headers can vary depending on the context of the application. A missing HTTP Strict Transport Security header on an online banking application is concerning, because an attacker could successfully intercept users' HTTP requests and redirect them to a clone page to steal their information.

Teams should carefully consider which headers are most important to both their operations and users, and work towards adding them across their servers.

Why Bother with Security Headers?

Security Headers are a type of HTTP response header—code which instructs browsers how to display content and interact with a web page without any of that instruction rendering on the user's screen.

Security headers regulate security features around that communication and can help mitigate different attacks, such as Clickjacking, XSS, and encryption-related downgrade attacks.

They can also strengthen privacy by enabling users to use their browsers' security features such as disabling access to their webcam or microphone.

How to implement security headers:

Consider implementing the following recommended security headers, at minimum:

- HTTP Strict Transport Security
- X-Frame-Options
- X-Content-Type-Options
- Content-Security-Policy
- X-Permitted-Cross-Domain-Policies
- Cross-Origin-Resource-Policy

For more information on these and other headers that your servers may need, see the [OWASP Secure Headers Project](#).

NEXT CHAPTER: HOW MUCH RISK ARE TEAMS MANAGING? →

How Much Risk Are Teams Managing?

In 2021, the majority of vulnerabilities we found were lower risk, with 54% classed as “Low” severity and 11% classed as “Informational.” 24% were “Medium,” 10% were “High,” and less than 1%—0.88% to be exact—were “Critical.”

What These Risk Levels Mean

Every pentesting company describes their findings’ risk level differently. Until 2021, Cobalt used a 3-level system based on Impact (how the flaw could affect technical and business operations) and Likelihood (how likely it is attackers will exploit the flaw).

In 2021, we switched to 5 more granular and descriptive levels. These are still based on Impact and Likelihood, but capture more nuance to the highest and lowest ends of the risk scale. Here’s what they mean:

- **Informational:** Notes vulnerabilities of minimal risk to your business.
- **Low:** Specifies common vulnerabilities with minimal impact on their own, but possibly dangerous if chained.
- **Medium:** Vulnerabilities that are “Medium risk <> Medium impact,” “Low risk <> High impact,” or “High risk <> Low impact.”
- **High:** Impacts the security of your application platform/hardware, including supporting systems. Includes high probability vulnerabilities with a high business impact.
- **Critical:** Includes vulnerabilities such as administrative access, remote code execution, financial theft, and more.

Compared to 2020, we reported fewer findings with a severity level of “Medium,” “High,” and “Critical”—what organizations might label “important”—while “Low” and “Informational” became more common in 2021. Do these drops signal that assets are becoming more secure? Not necessarily.

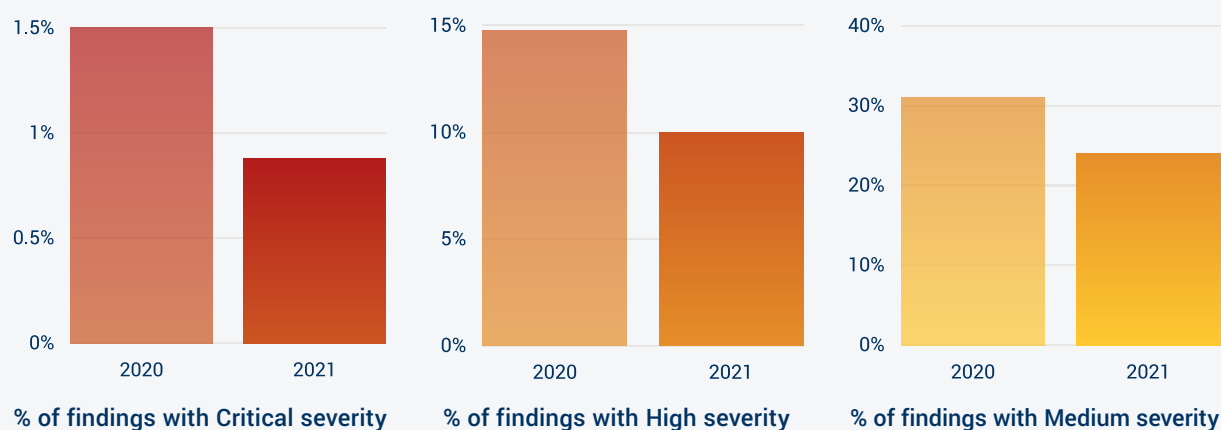


Figure 3: Percentage of total findings with “Critical,” “High,” or “Medium” severity levels in 2020 and 2021

“Low” and “Informational” vulnerabilities often get ignored or postponed because they don’t trigger alarm bells. These flaws pile up and attackers can chain them into more impactful attacks. Here’s an example:

Finding #1: Username enumeration with a lack of rate limiting. Attackers can send hundreds or thousands of login requests without being stopped.

Finding #2: Weak password policy. Customers can set passwords like ‘12345.’

On their own, these findings might not look critical, but together they give attackers the opportunity to brute-force their way into the application. It takes only one user with a weak password. Once attackers have access, they can look for other ways to increase their privileges and do more damage.

As we help customers patch vulnerabilities, we can observe how teams react to these findings. The scenarios we see are:

- Teams fix the finding and request a retest to confirm if the fix is working correctly. Note that we offer retests on discovered findings for free, so there is no financial barrier to retesting.
- Teams mark the finding as “Accepted Risk” because its severity level doesn’t meet their remediation threshold.
- Teams don’t report their decision back to us. The finding could have been fixed, but a retest hasn’t checked if their patch is working. Alternatively, it’s staying in their backlogs for an indefinite period of time.

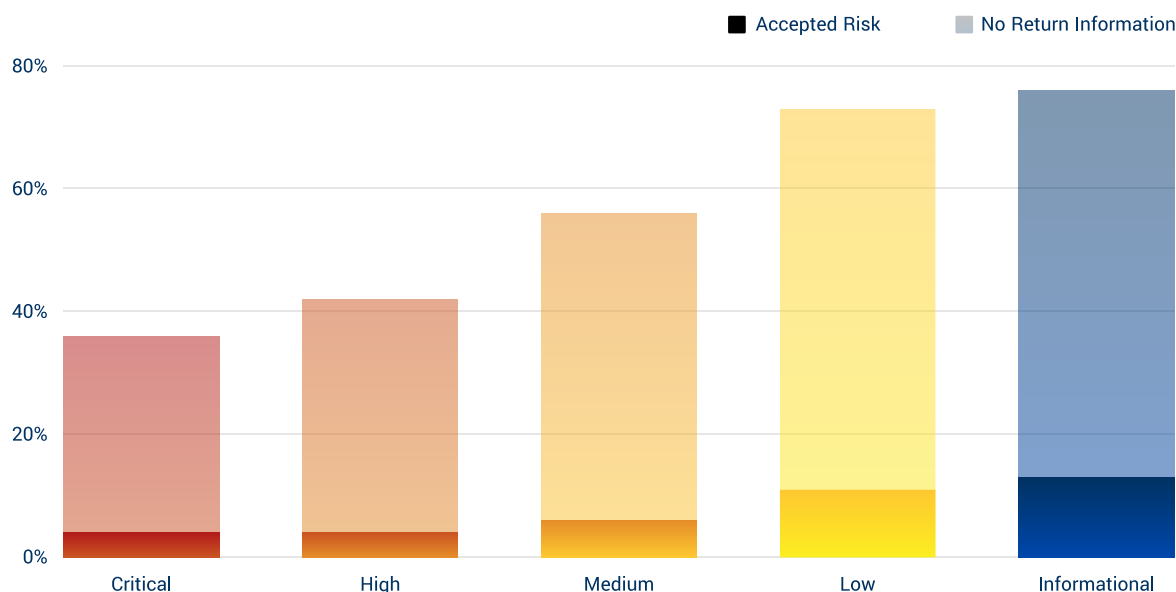


Figure 4: Percentage of findings marked "Accepted Risk" or lacking return information in 2021

Even if we don't know the reason, the intent behind "Accepted Risk" findings is clear: there will not be immediate action to remove this vulnerability. Findings with no return information are more ambivalent. We don't know the outcome on the customer's side, but we do know that the patch hasn't been retested—chances are, there could still be an issue that gives attackers access. When we look at our data, we see a clear trend. **The less "critical" a finding is, the less likely it is that teams will fix and verify it.** That might seem obvious, but the reasoning isn't what you think.

It's wrong to assume the core of the problem is that teams don't care. We looked into this in [last year's report](#) and we found a much more nuanced situation: security teams **are** determined to prioritize low-risk flaws—nearly 80% said they wished their organization focused on them just as much as "High" or "Critical" flaws. The challenge is a lack of resources, where 25% of our respondents said it took at least 60 days to patch low-risk findings.

NEXT CHAPTER: HOW MUCH TIME DOES IT TAKE TO FIX VULNERABILITIES? →

How Much Time Does It Take to Fix Vulnerabilities?

The median number of days teams needed to fix vulnerabilities was 14. But things started to change as we dug into that number. Do findings with a certain risk level get fixed faster, or slower? Does company size—and by extension security and development team size—influence that number in any way? Based on industry benchmarks around company and team sizes (these don't hold true for everyone, but they're a good place to start), we broke down our remediation data one step further.

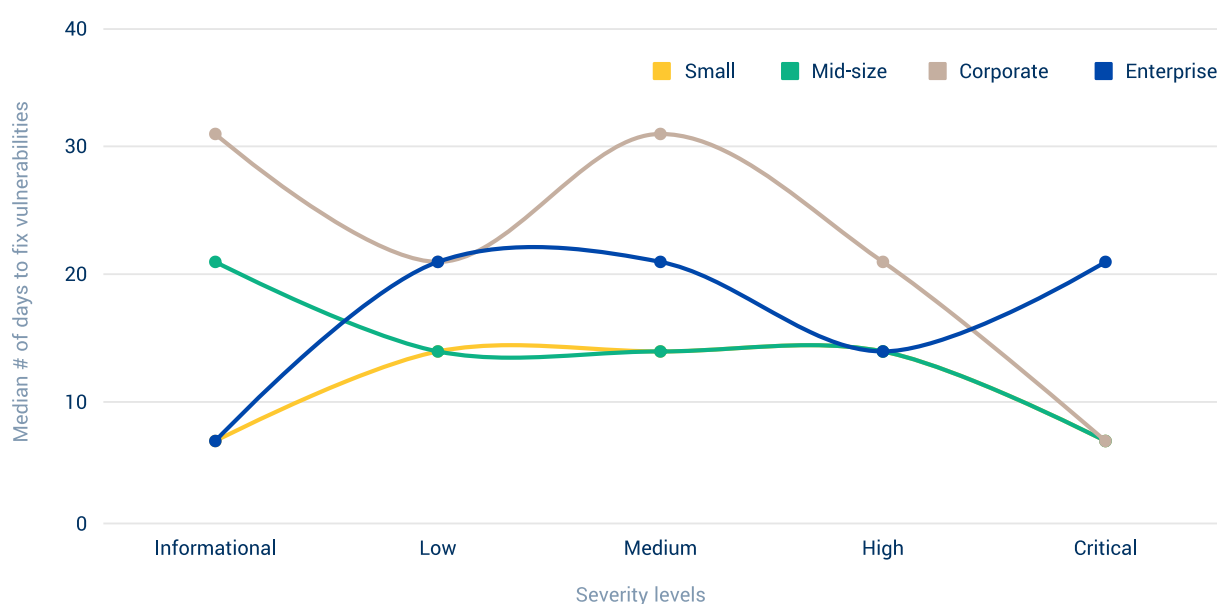


Figure 5: Median number of days to fix findings per severity level and company size

Small	Mid-Size	Corporate	Enterprise
- Companies with 1-50 employees - No dedicated security team	- Companies with 51-500 employees - Up to 5 security team members	- Companies with 501-1500 employees 5-10 security team members	- Companies with 1500+ employees 10+ security team members

Our expectations were that the closer a finding's risk level is to "Critical," the faster it gets fixed. This is true in most cases, with the exception of "Enterprise" companies who need 21 days (median) for the task. A couple of factors could be causing this: they are the largest company type in our list and are therefore more likely to have more complicated environments and slower change-management processes.

What surprised us was that “Enterprise” companies on average took 7 days to fix “Informational” findings—we expected these to be left as the lowest priority, requiring 31 days or longer. It could be that they are more straightforward to fix and get remediated first as “low-hanging fruit,” while others are stuck somewhere in the pipeline.

This graph does confirm that smaller companies are faster in fixing their findings. The “Small” category seems to be the fastest with every risk level, but “Mid-Size” aren’t too far behind.

Why is this? We admit that a research best practice is to translate data into actionable insight, but we came up short when we tried to posit a conclusive answer. Our assumptions are that smaller companies might be more nimble, with smaller attack surfaces and fewer processes to follow. They can maintain velocity because they are often born in the cloud, practice agile processes, and smaller teams face greater scrutiny and individual accountability than their enterprise counterparts. Enterprises may follow a waterfall methodology, or be undergoing digital transformation to migrate legacy systems and processes.

Regardless, we recognize that this is guesswork and aim to make it a point of further exploration in **The State of Pentesting 2023**.

NEXT CHAPTER: TALENT SHORTAGES HOLDING BACK SECURITY & DEVELOPMENT →

Talent Shortages Holding Back Security & Development

Our pentesting data helped us conclude that:

- Teams are struggling to fix and prevent the same vulnerabilities for at least the past 5 years in a row.
- The majority of findings stem from not staying on top of configurations, software updates, or access management controls.
- Teams want to fix every vulnerability, but end up neglecting those classed as “low-risk.”
- The findings that **do** get fixed typically take 14 days, but this number can fluctuate considerably based on the risk level, with some findings needing 31 days or longer.

Teams **want** to have robust security, but struggle to meet that objective. Cobalt’s State of Pentesting reports explore why; last year we looked into tools, processes, and where workflows could be more efficient. But that’s only part of the story.

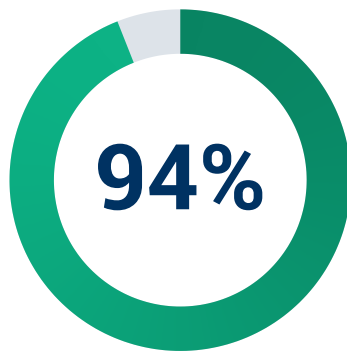
Before anything else, successful security programs need the right people, and enough of them. Everyone within an organization can be a part of this process, but as companies move towards a DevSecOps approach, the two main pillars are the security and development teams.

Both have to balance a multitude of competing priorities: business objectives, go-to-market strategies and launch roadmaps, compliance and risk governance, maintaining infrastructure, monitoring for vulnerabilities, remediating as many flaws as possible, staying prepared for a growing list of attack vectors, training employees...we can keep going, but you get the point. As organizations struggle to remain competitive amidst an unpredictable global economy, heavy expectations fall on the shoulders of these two teams.

Do they have what they need to succeed? Our research has come back with a resounding “No.”

Both security and development teams are struggling with alarming talent shortages. It’s up to debate whether The Great Resignation is causing this problem, or is exacerbating an issue going much further back in time. It’s more important to focus on what teams are sharing right now: **they’re stressed, struggling to keep operations running at required standards, and thinking of leaving.** The rest of our report explores these issues and shares what employers and team leads could do to reverse them.

The Impact on Security Teams



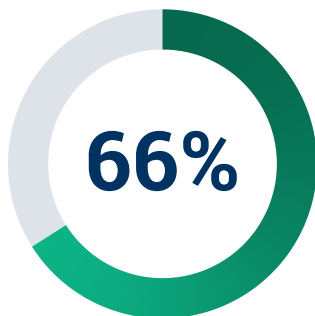
of security respondents
affected by labor shortages

Nearly every security team has been, is, or will be struggling with finding and retaining talent. 45% of security respondents said their department is **currently** experiencing a shortage of employees, 11% **expect to have this challenge** in the near future, and 38% said **they had to deal with it in the last 6 months**, but have been able to resolve it for now.

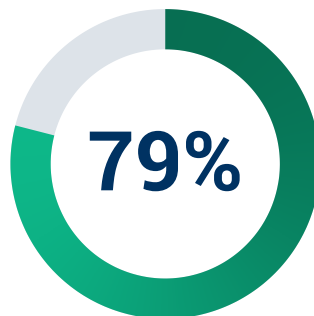
This talent shortage isn't happening solely because there are too many jobs and too few candidates. There's a more distressing trend: people are quitting their jobs. 84% of respondents said that someone from their team has left within the past six months.

The Hard Hit to Security Programs

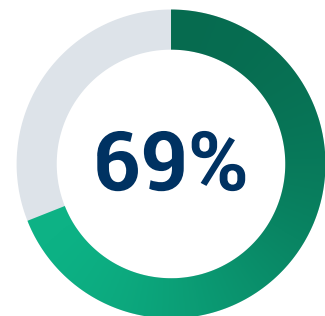
90% of respondents who have suffered shortages or lost team members are struggling with workload management. Here's the impact we see:



struggle to maintain high
quality security standards



struggle to consistently
monitor for vulnerabilities



struggle to monitor for and
respond to security incidents

The majority are feeling the hit in multiple areas. Security teams have historically been struggling to keep up with business needs, and talent challenges are not making things easier. The security standards hardest hit are:

- Compliance to cybersecurity frameworks: 62% of respondents selected
- Supporting secure development: 50%
- Risk governance: 49%
- Maintaining critical security infrastructure: 46%
- Employee training: 34%

As far as vulnerabilities are concerned, the categories teams worry about most are:

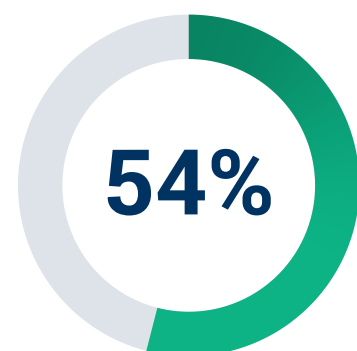
- Server security misconfigurations: 51% of respondents selected
- Insecure data storage: 45%
- Server-side injections: 43%
- Sensitive data exposure: 42%
- Using components with known vulnerabilities: 36%
- Broken authentication and session management: 33%
- Cross-site scripting: 25%
- Cross-site request forgery: 23%
- Lack of binary hardening: 21%
- Broken access control: 17%
- Network security misconfigurations: 16%

As for monitoring and responding to incidents, the threats that keep teams up at night are:

- Social engineering: 55% of respondents selected
- Third-party software exposure: 45%
- Network/application compromise: 45%
- Phishing: 41%
- Information leakage: 41%
- Ransomware: 37%
- IoT attacks: 27%
- Damage to reputation: 19%
- DoS and DDoS: 16%

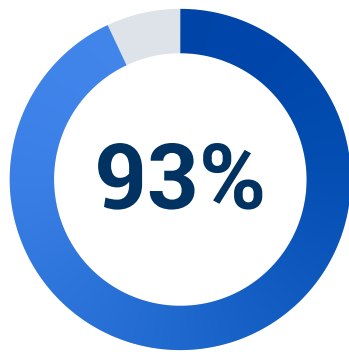
Impact on Team Members

Plagued by limited resources and mounting pressure, people see their colleagues leave and their work increase. Burnout starts to enter the picture. 58% of respondents said they are currently experiencing it, 63% said their mental health has been impacted, and 64% even said the job stress has affected their physical health. It's only a matter of time before they start thinking of leaving too. In fact, **a startling 54% of our security respondents said they currently want to quit their jobs.**



of security respondents are considering quitting their jobs

The Impact on Development Teams



of development respondents
affected by labor shortages

While security teams are looking to developers for help in fixing and preventing vulnerabilities, development teams are dealing with talent problems of their own. 45% of the developers we surveyed are **currently dealing with a shortage of employees**, 12% said they **expect to have this issue in the next 6 months**, and 36% said **they had talent shortages in the past 6 months**, but have resolved them for now.

Only 7% said they have been adequately staffed and expect to continue that way. This aligns with mass job resignation, as 81% of respondents confirmed someone from their development team has left the company within the last 6 months.

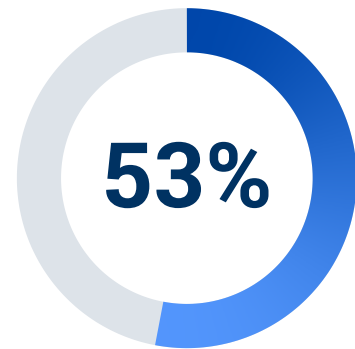
Development Gets Sidetracked

Just as with security teams, talent shortages have caused noticeable disruptions for dev teams. The main impact to their work includes:

- **Decreased standards:** 70% of developers said their team's ability to adhere to code quality standards has suffered.
- **Lowered response time:** 74% said labor shortages cause noticeable disruption to their usual response time for fixing security vulnerabilities.
- **Decreased security participation:** 70% agreed that labor shortages interfere with their ability to participate in security objectives such as tabletop exercises and threat profiling.
- **Monitoring and logging disruption:** 75% agreed that the labor shortages weaken their ability to keep an eye on monitoring and logging tools.
- **Administrative disruption:** 71% agreed that labor shortages disrupt administration of DevOps tools and workload systems (Jira, GitHub, CircleCI, etc.).
- **Educational gaps:** Not only did 74% agree that departing employees take critical knowledge with them, but additionally 73% agreed that labor shortages disrupt their personal learning and education goals.

Impact on Team Members

Each talent loss has detrimental consequences for dev teams. In fact, 63% of respondents said that their mental and/or physical health has been negatively impacted by labor shortages. And like security employees, the majority (66%) are feeling burnt out. The talent crisis also has negative implications for personal (86%) and team (78%) morale, **so it's no surprise that development teams might also be facing continued losses, with 53% of our respondents saying they currently want to quit their jobs.**



of development respondents are considering quitting their jobs

Impact on the Security <> Development Relationship

As talent shortages hit teams individually, by extension they also make it harder to collaborate. More security respondents (89%) felt that DevSecOps workflows are strained compared to their dev counterparts (70%). The good news is both teams report that their colleagues show empathy and try to fill in the gaps where possible.

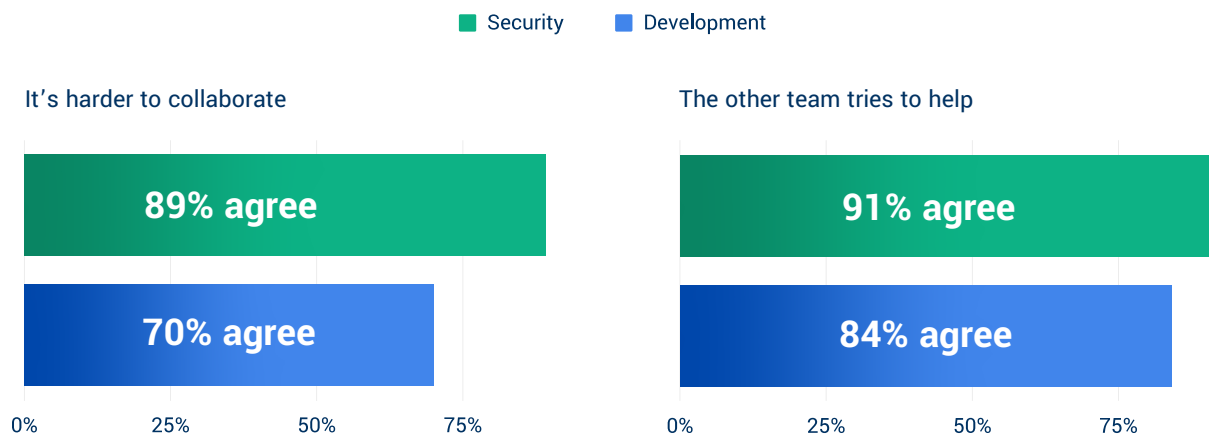


Figure 6: Talent shortages' impact on collaboration between security and development

What specific challenges do talent shortages cause? We asked both sides, and their responses point to the same thing: security concerns aren't as top-of-mind as they should be.

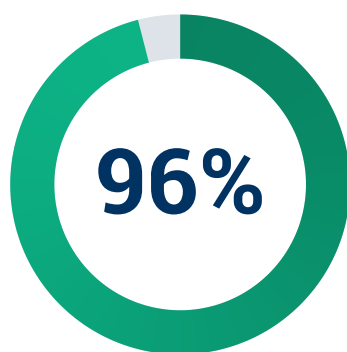
In fact, 69% of security respondents reported a lack of urgency in patching vulnerabilities and 63% reported issues repeating themselves in later code releases.

This can easily turn into a frustrating situation for the security team, but developers seem pushed against all odds in managing multiple priorities, based on the list of challenges they shared:

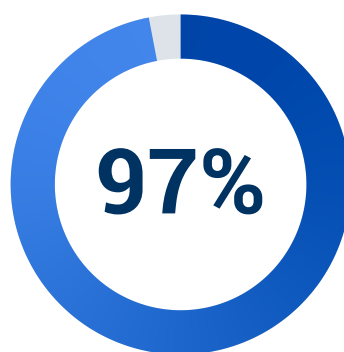
- Deprioritization of security posture/collaboration **due to other developmental commitments:** 62% of respondents selected
- Policies and procedures changing when personnel changes: 55%
- Lack of trust and/or discomfort with level of accountability when working on security issues: 47%
- Loss of knowledge holders: 44%
- Difficulty keeping up with noisy monitoring and scanning tools: 34%
- Increase in the overall number of issues to review/resolve: 30%
- Disagreements about required strength of security posture: 14%

Notice that disagreements about the overall security posture is not a prevalent issue. This suggests developers **want** to be focused on remediation and prevention, but are unable to under the current circumstances. Their workload either has to decrease—which is unlikely in today's highly competitive technology world—or they need more manpower, which is a thorny problem.

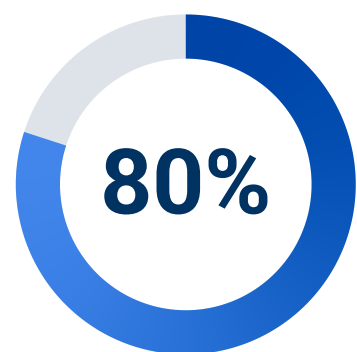
Talent shortages and collaboration issues manifest into larger problems that should put organizations on high alert: security and operations are at risk.



of security respondents struggling to collaborate see a slower response to patching critical vulnerabilities



of developers said collaboration challenges make it harder to meet critical launch deadlines



of developers agreed collaboration challenges compromise the quality and security of their code

One might assume that teams can manage as long as they realign their priorities: low-risk issues would have to be ignored for some time, opening up enough resources to fix the most critical findings and launch the most important features.

The truth is teams have been doing this juggling act for years, and there isn't much more left to put in the backlog that won't significantly hurt operations. Here are the hard stats:

96% of security respondents who reported collaboration issues said they are now slowed down in patching critical vulnerabilities. This creates considerable risk of a successful breach.

The majority (97%) of developers feeling the strain reported it's harder to meet critical deadlines for feature launches, and 80% said collaboration challenges compromise the quality and security of their code.

A vicious circle forms: remediation is delayed, new code comes out with more flaws that add to the problem, and overstretched teams have more to deal with. The end result for the individual can be frustration and disillusionment, while for the organization it can be a breach that sets them back even further.

Hiring, Onboarding, and Retention

Keeping the Talent You Have

With these rates of burnout, team disconnect, and work overload, how can organizations best respond? Fighting to retain talent is the first step that comes to mind. But we see a dissonance between efforts and results.

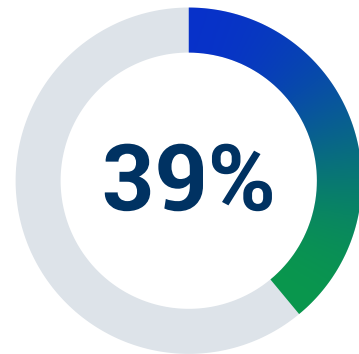
95% of our respondents said that their organization prioritizes retaining and nurturing them. But if employers are trying this hard, why are so many planning their exit? Are organizations missing the mark when it comes to what their teams truly value?

One of our theories is that employers are being reactive, instead of proactive. A common scenario is to have a knee-jerk response when a team member puts in their resignation, offering a pay raise or additional benefits. But this could be too little, too late: the employee has made up their mind, not because of this one conversation, but because of what has happened throughout their time with the team.

So what can organizations start doing today? We asked our respondents, and here's what they shared was important to them:

- 59% said they need a strong focus on their personal and professional development.
- 55% said they want a stronger community feeling while their company is primarily working from home.

- 44% said they wanted additional compensation options, such as bonuses or stock options.
- 41% said they wanted attention paid to their physical and mental wellbeing.
- 39% said they wanted more competitive pay that doesn't fall behind the market.
- 39% said they want clearly structured and manageable workloads.
- 31% said they want strong and supportive leadership.
- 16% said they want varied career opportunities such as a flexible career ladder or options to switch teams.



said they wanted more competitive pay

These results gave us some food for thought. Competitive pay wasn't at the top of the list, like many (including us) might have expected.

Instead, the focal point seems to be around needing fulfillment and community. Respondents want to continue growing in their careers, rather than treat their roles as "just a job." They want to feel connected to their colleagues, especially when people aren't together as often or at all while working from home. Making these improvements isn't quite as straightforward as throwing money at the problem: they take time and careful consideration, but can pay off considerably in the long term.

Filling Open Roles

While managing their retention, companies still have a major task ahead of them—filling their vacant roles. Of the respondents who have visibility into hiring efforts, 47% on the security side said it's slow and challenging to fill open positions. Interestingly, that number was lower for development respondents: only 32% of them said they're having difficulties finding the right people.

Looking at Figure 7, for both sides the main problem seems to be finding the people with the right skills: both hard—having adequate technical knowledge, or experience with relevant tools—and soft, such as project management skills, handling feedback, and the ability to collaborate. At first glance this might not be surprising. But when we combine it with the finding that people want more support with their professional development, we start to wonder if the current recruitment philosophy is flawed.



Figure 7: The recruitment challenges security and development teams are experiencing

Rather than find the candidate who covers 95%+ of the bullet points in the job description, it might be more sustainable to consider candidates who are missing a few core skills, but are eager to learn and can be coached.

Companies could also do well to review their recruitment processes and cut out unnecessary steps. Inefficiencies can hurt both sides: the hiring team is stretched further, while the candidate starts getting frustrated with the bureaucracy. This seems to be a pain point for security roles in particular. Our results show they are more likely to have to wrangle too many open roles at once compared to the dev team.

As far as which roles are the hardest to fill, the same level tripped up both teams: managers and team leads. Security teams are struggling to find the right Directors or CISOs, while developers have the toughest time finding Distinguished/Principal/Staff Engineers, Engineering Managers and Tech Leads.

Both teams need a long time to fill most of their positions. 70% of respondents said that, on average, it takes at least 3 months. And the challenges don't end once an employee is hired—66% of respondents said it typically takes at least 3 months to fully integrate a new team member into their department.

Delegating and Outsourcing

While teams are trying to fill roles, they're looking to alternative solutions like outsourcing to a third party. 82% of security respondents said they follow this strategy, and the dev team wasn't too far behind with 80%.

Here's what they typically outsource:

Security	Development
→ Detection and response: 71%	→ Software development: 83%
→ Pentesting: 69%	→ Security compliance/testing: 43%
→ IoT security: 41%	→ Infrastructure/DevOps: 40%
→ Red teaming: 33%	→ Product management/Design: 37%
→ Threat intelligence: 30%	→ Testing (QA/TA): 29%
	→ Data engineering: 23%
	→ Visual Design (UI/UX): 13%

Pentesting was the second-most outsourced security service in our survey. In part this is because compliance frameworks require a third party to execute it. But there's unquestionable value in having a professional team find vulnerabilities before an attacker does. Those who outsource pentesting are generally satisfied, rating their experience as 4 out of 5 on average.

However, there is still room for improvement. The number one change respondents are after? Speed. 74% said their pentesting provider could optimize their experience by getting tests scoped and running in less time. But speed alone isn't enough—they also need the process to be easier, more collaborative, and more transparent. After all, a vendor shouldn't be adding more complexity to an already stretched team. They should be making things easier.

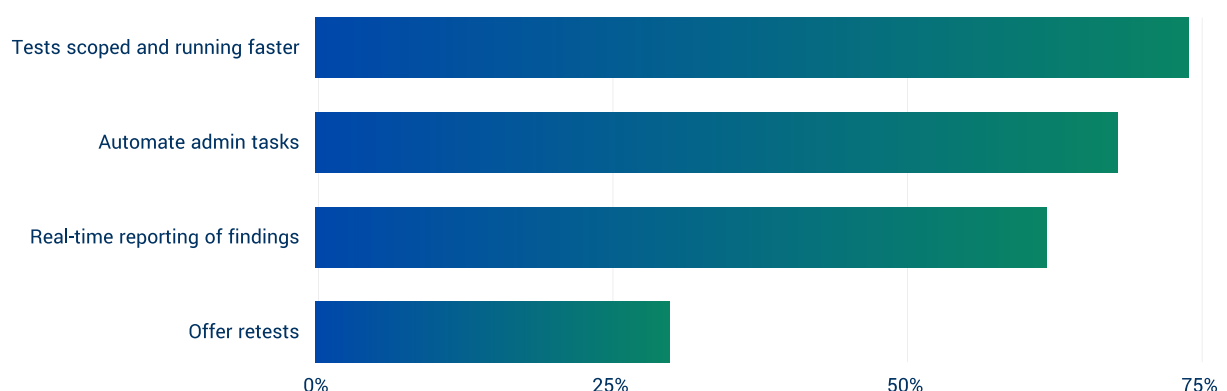


Figure 8: What changes respondents want to see with pentesting services

Traditional vendors like consultancies struggle to match those requirements. Pentest as a Service vendors are more aligned with flexibility and speed. We explore how these two options stack up against each other in [“The Buyer’s Guide to Modern Pentesting.”](#)

Conclusion: Enabling Teams to Succeed

Every team wants to do great work. Yes, our data points to talent shortages, collaboration hiccups, mounting attack scenarios, and growing numbers of vulnerabilities that get pushed to backlogs. But we also observe that despite these odds, teams keep running. They keep **trying**.

A truly humbling moment in our research was when we asked our respondents “Do your security/development counterparts help you fill in the gaps?” We got a resounding “Yes” from both sides. Despite everything about their work radically shifting in the past 2 years, people show empathy for one another and try to keep each other up. They might not be getting it all done, but they have their eyes on the prize: enable and defend the organization. It goes without saying that the organization should do the same for them.

The challenges we outline in this report are difficult, but they’re not impossible to solve. We’ve broken down our proposed solutions into two groups:

Group 1: Vulnerability Management & Remediation

#1. Focus on learning.

Share regular training with teams based on security reports like the [OWASP Top 10 list](#) and Cobalt’s State of Pentesting reports.

#2. Do some “spring cleaning.”

Review your security configurations, access/user matrixes, SSL certificates, software versions, and security headers. Having these set up and consistently monitored can address a big portion of the top vulnerabilities we see each year.

#3. Clearly communicate risk.

Show leadership how inadequate resources and mounting low-risk findings can link up and turn into much bigger security problems. [Our 2021 report can help you with some stats.](#)

#4: Outsource to agile vendors.

Find vendors who help you, rather than burden you. Be ruthless with questions around how much time they need to deliver results, how they integrate with your systems, and what efficiencies they can bring to your workflows. Check out [this buyer’s guide](#) for some sourcing tips.

Group 2: Employee Wellbeing and Sustainable Recruitment

#1: Put employee development first.

The majority of our respondents want more support in growing personally and professionally. In addition, a large portion of teams are struggling to find new candidates with the right hard skills. It could be a better strategy to hire less experienced talent and invest more in their training and certifications.

#2: Keep recruitment simple.

Inefficient recruitment processes were the biggest hiring complaint after candidates lacking hard and soft skills. Review your hiring steps and consider where you can streamline without sabotaging your vetting process: it could be fewer interviews, or candidates talking to multiple members of the hiring committee in one call, or cutting back on the number of assignments.

#3: Streamline your onboarding.

On average it takes 3 months to fully onboard a new hire. This can put a lot of strain on your established team, especially if they have to put training time aside for every new hire. Consider pre-recording training sessions that are universal to roles and including them in your onboarding decks.

We said it at the start: Security is the result of decisions and actions made by many different people. With this report, we hope readers feel empowered to take the actions that will have the strongest impact, empowering and supporting their teams throughout the rest of 2022.

Cobalt's Take on Pentesting



Start Testing Faster

Launch pentests in **days, not weeks** with our intuitive platform and team of **on-demand security experts**

50%

Faster to execute a pentest than traditional consultancies



Remediate Risk Smarter

Accelerate find-to-fix cycles through technology integrations and **real-time collaboration** with pentesters

300+

Highly vetted pentesters around the world



Make Security Stronger

Mature your security program through a **scalable, data-driven** approach to pentesting

24 hours

To get a pentest up and running

"The main benefits that we get from Cobalt are speed, scalability, and repeatability. We're able to quickly launch and execute pentests; and beyond that, we're able to see individual findings in real time and relay them to the engineering team so they can start triaging immediately."

Eric Galis - VP of Compliance and Security at Cengage

Cobalt Integrations

Connect Cobalt to the tools & platforms you're already using to gain more insights, increase findings visibility, and streamline the SDLC.



Jira



Slack



Tugboat
Logic



Kenna
Security



ThreadFix



GitHub



JupiterOne



DefectDojo



Asana

APPENDIX A: What Are the Top Findings for Different Types of Assets?

For a detailed breakdown of how to fix and prevent each of the findings listed here, check the Appendix in [The State of Pentesting 2021](#).

Web assets: An online application. Includes APIs that supply data to the app.

What we saw in 2021 wasn't very different from the previous year, with Stored Cross-Site Scripting (XSS) and Insecure Direct Object References (IDOR) holding the top 2 positions. Outdated Software Versions vulnerabilities became more common in 2021.

2020	2021
Cross-Site Scripting (XSS): Stored	Cross-Site Scripting (XSS): Stored
Broken Access Control: Insecure Direct Object References (IDOR)	Broken Access Control: Insecure Direct Object References (IDOR)
Cross-Site Scripting: Reflected	Components with Known Vulnerabilities: Outdated Software Versions

APIs: Application Programming Interfaces independent of a web app.

In 2020 the APIs we tested had many instances of Stored Cross-Site Scripting (XSS). In 2021, that flaw wasn't as prevalent, pushed back by Lack of Security Headers and Insecure SSL or TLS protocols findings.

2020	2021
Cross-Site Scripting (XSS): Stored	Server Security Misconfiguration: Lack of Security Headers
Server Security Misconfiguration: Lack of Security Headers	Server Security Misconfiguration: Insecure SSL or TLS protocols
Server Security Misconfiguration: Insecure Cipher Suites	Server Security Misconfiguration: Insecure Cipher Suites

Mobile: Any application intended for smartphones or tablets.

We saw a bigger year-on-year shift with mobile applications, where Insecure SSL or TLS protocols, Email Triggering and Username/Email Enumeration completely replaced the most common vulnerabilities in 2020.

2020	2021
Lack of Binary Hardening: Lack of Jailbreak Detection	Server Security Misconfiguration: Insecure SSL or TLS protocols
Broken Access Control: Insecure Direct Object References (IDOR)	Server Security Misconfiguration: Email Triggering
Mobile Security Misconfiguration: Absent SSL Certificate Pinning	Broken Access Control: Username/Email Enumeration

Internal Network: Networked devices typically protected by a corporate firewall, including network shares and domain servers.

The Outdated Software Versions vulnerability has been our most frequent finding for internal networks for the last 2 years. Server Security Misconfigurations were also a prevalent issue, but in 2021 we saw more examples of Insecure Cipher Suites and Insecure SSL or TLS protocols.

2020	2021
Components with Known Vulnerabilities: Outdated Software Versions	Components with Known Vulnerabilities: Outdated Software Versions
Server-Side Injection: Remote Code Execution	Server Security Misconfiguration: Insecure Cipher Suite
Server Security Misconfiguration: Using Default Credentials	Server Security Misconfiguration: Insecure SSL or TLS protocols

External Network: Internet-facing components of a company's network, including external portals and website servers.

We didn't see any changes in the top 3 findings for external networks, with the list still showing Outdated Software Versions, Insecure SSL or TLS protocols, and Insecure Cipher Suites.

2020	2021
Components with Known Vulnerabilities: Outdated Software Versions	Components with Known Vulnerabilities: Outdated Software Versions
Server Security Misconfiguration: Insecure SSL or TLS protocols	Server Security Misconfiguration: Insecure SSL or TLS protocols
Server Security Misconfiguration: Insecure Cipher Suite	Server Security Misconfiguration: Insecure Cipher Suite

APPENDIX B: Methodology

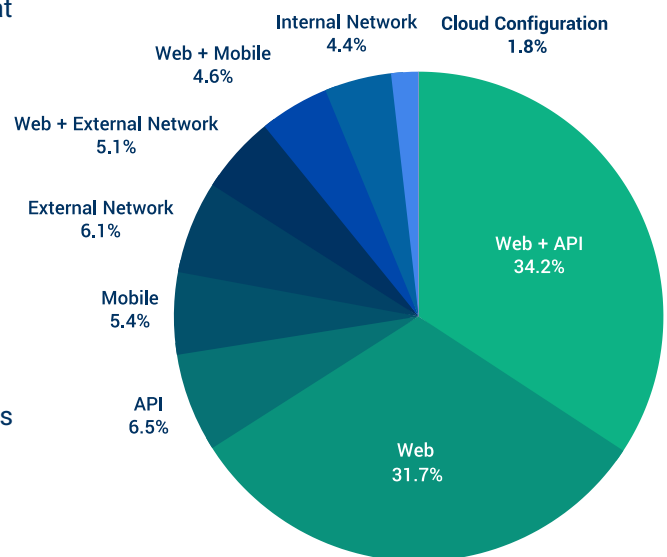
Cobalt's State of Pentesting report includes two types of data sets:

- Anonymized pentest data collected via Cobalt's proprietary Pentest as a Service platform (referred to later as "Cobalt's Pentest Data");
- Survey responses on questions related to talent shortages and their impact on security and development teams (referred to later as "Survey Data")

Cobalt's Pentesting Data

Between January 1st 2021 and December 31st 2021, our Penetst as a Service (PtaaS) platform collected data from 2,380 pentests that covered multiple asset types:

- **Web:** An online application. Includes APIs that supply data to the app.
- **API:** Application Programming Interfaces independent of a web app.
- **Mobile:** Any application intended for smartphones or tablets.
- **External Network:** Internet-facing components of a company's network, including external portals and website servers.
- **Internal Network:** Networked devices typically protected by a corporate firewall, including network shares and domain servers.
- **Cloud Configurations:** Systems on "the Cloud," using services such as Amazon AWS, Microsoft Azure, or Google GCP.



A portion of our pentests covered a combination of assets, such as Web and External Network. For 2021, the majority of tests we did were on web applications and APIs, covering nearly three-quarters of this report's data.

The data represents companies of varied sizes, from a variety of industries ranging from SaaS to Insurance and Fintech, and 4 geographic regions: EMEA, APAC, North America and South America.

Survey Data

We distributed an online survey to 602 cybersecurity and software development professionals across the United States, all of whom work for companies with 500 or more employees. 60% of respondents were in security roles, while 40% were in development roles. Their job title breakdown was as follows:

Security:

- IT Security Governance: 19%
- Data Security Manager: 14%
- AppSec Manager: 11%
- Manager Offensive Security: 11%
- Cloud Security Manager: 8%
- Infrastructure Security Manager: 7%
- CISO: 5%
- CIO: 5%
- Product Security Manager: 5%
- Head of Security Director Data & Cloud Security: 4%
- Head of Information Security: 4%
- Security/Risk/Compliance Manager: 4%
- Vulnerability Management: 2%
- CSO: 1%

Development:

- Software Developer: 43%
- Engineering Project Manager/
Engineering Manager: 12%
- Software Engineer: 12%
- Software Architect: 7%
- Senior Software Engineer/Senior
Software Developer: 5%
- Technical Lead/Engineering Lead/Team
Lead: 5%
- Principal Software Engineer: 4%
- CIO/Chief Digital Officer/Chief Innovation
Officer: 4%
- Junior Software Developer: 2%
- Other: 2%
- CTO: 2%
- Chief Architect: 2%