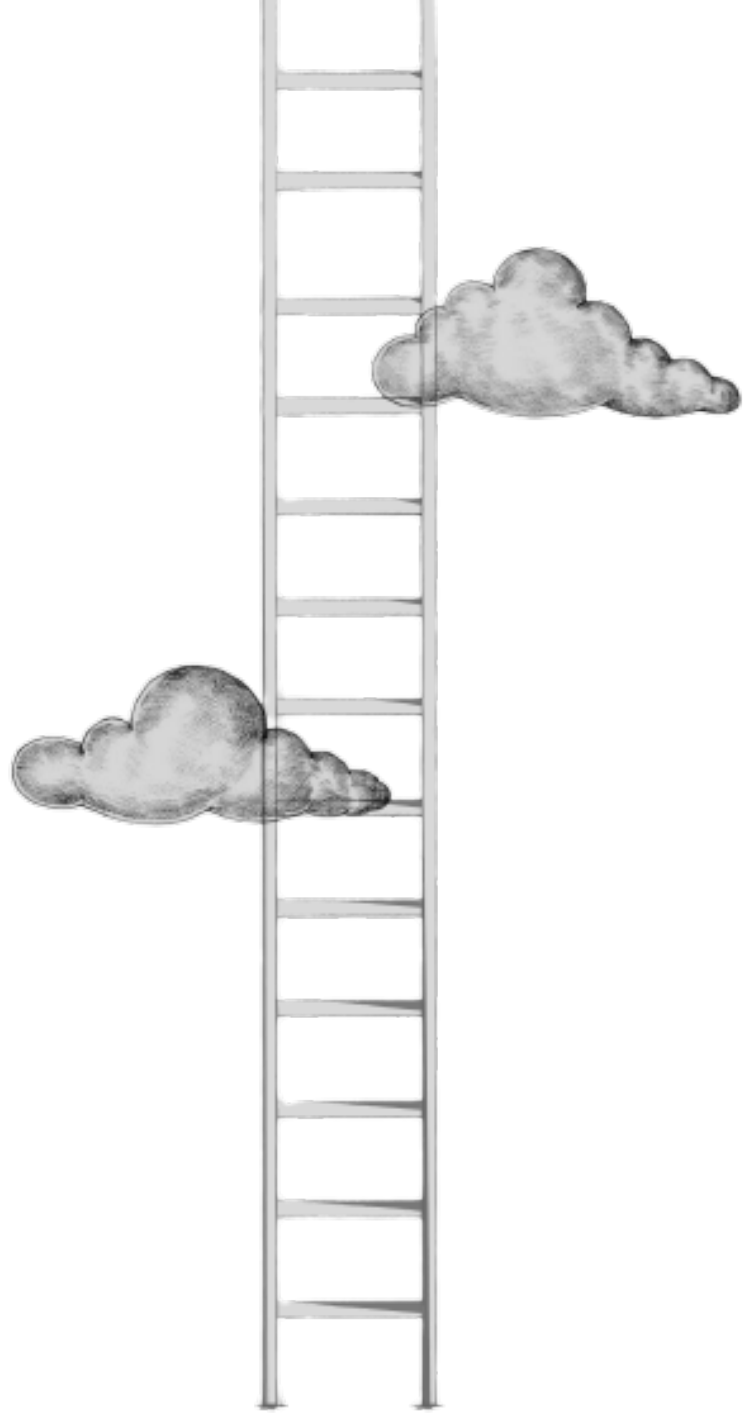
ICONIQ | Growth

Engineering in a Hybrid World

The data behind high-functioning engineering organizations

October 2022



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Engineering in a Hybrid World

About the Research

R&D is increasingly becoming a bigger line item in OpEx and **a key differentiator for companies**, yet it is often the function that organizations have **least visibility into from a reporting lens**. Although engineering and product development are closely tied, this study will be focused primarily on engineering-specific metrics and challenges.

In 2020, the world shifted to remote work with most companies transitioning to hybrid or remote arrangements. At the time of this report, over 50% of respondents had no definitive plan to return to the office. **Like it or not, remote work is here to stay.**

Regardless of whether you are working in an office, it is almost guaranteed **you will be interacting and working with remote workers**. For engineering organizations with distributed teams, this presents a unique challenge of maintaining connection and collaboration across geographic barriers.

Distributed workforces have fundamentally **changed how engineering teams collaborate with each other and the key processes and tools needed to enable successful software development**. This year's report explores how exactly the shift to remote work has impacted engineering organizations.

The data behind high-functioning engineering organizations

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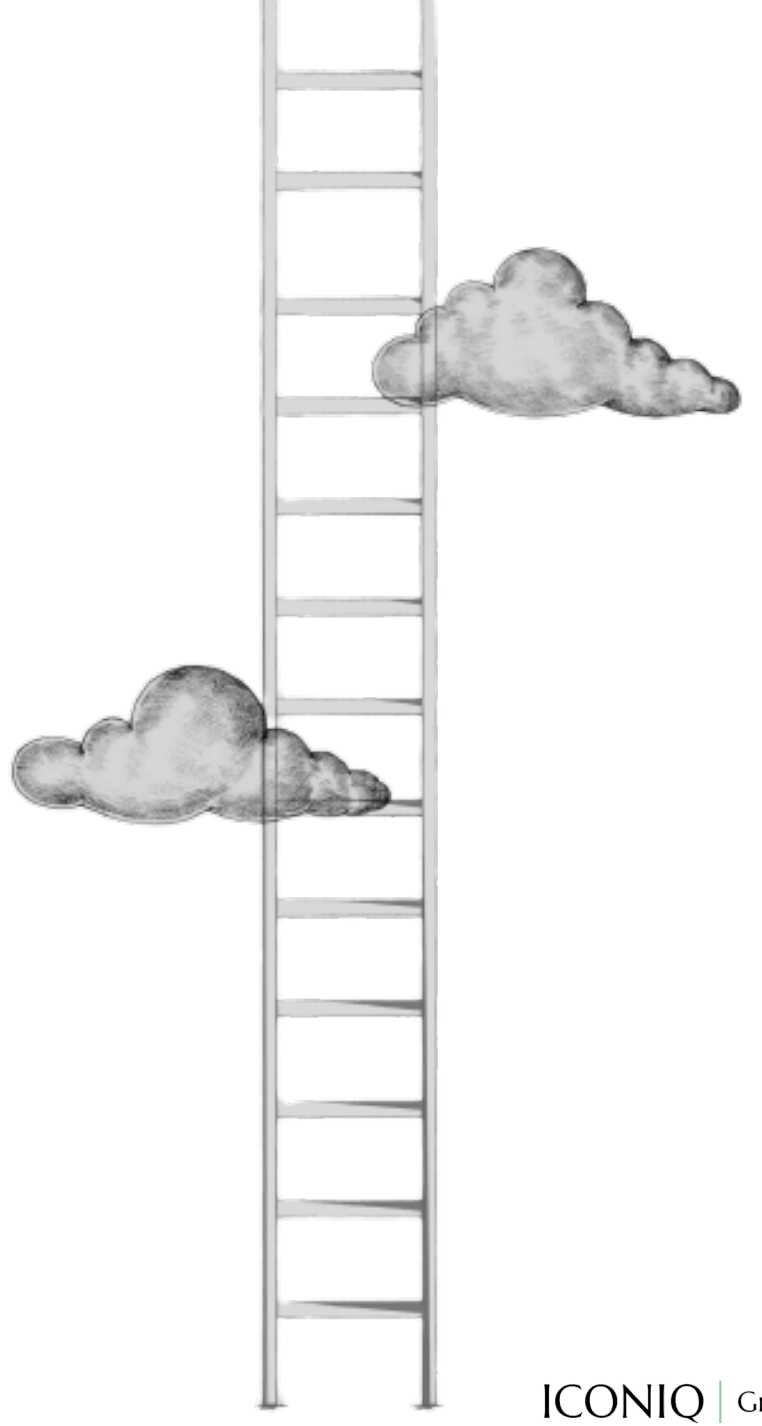
Introduction



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Meta

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Analytics & Insights

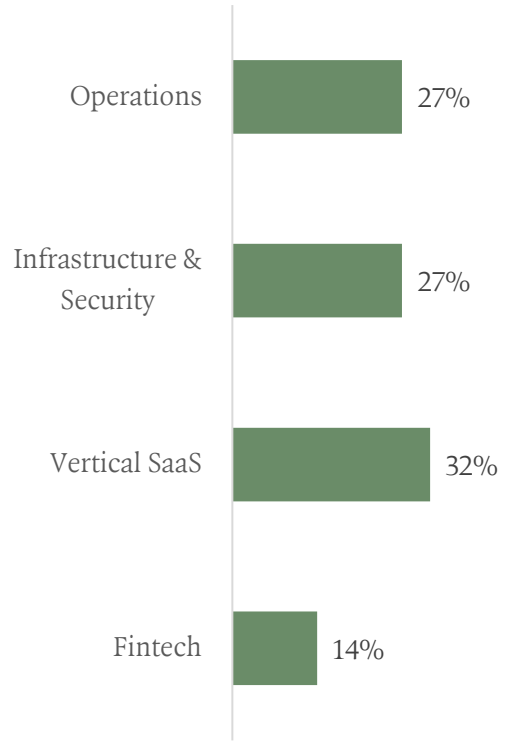
ICONIQ Growth's Analytics team seeks to empower our portfolio with proprietary analytics and insights across business operations and strategy

Full Team on Page 27

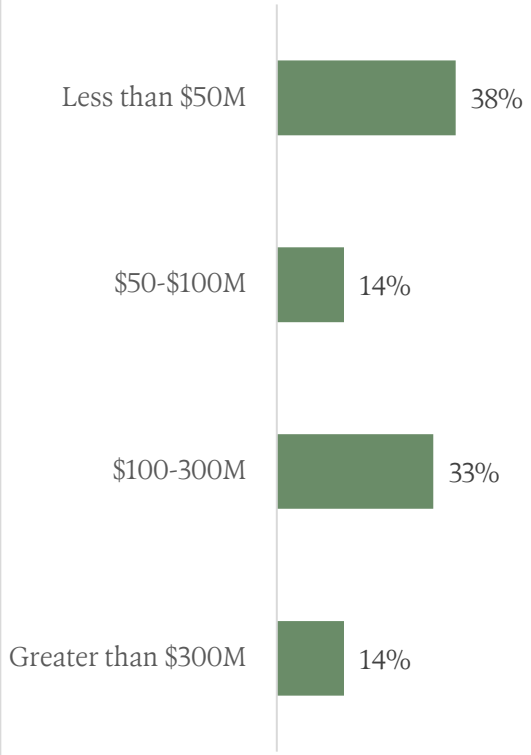
THE Methodology

This study summarizes engineering data collected from a survey completed by **certain ICONIQ Growth portfolio companies and others in the ICONIQ network in September 2022**, in addition to **perspectives from certain ICONIQ Growth Technical Advisory Board members**

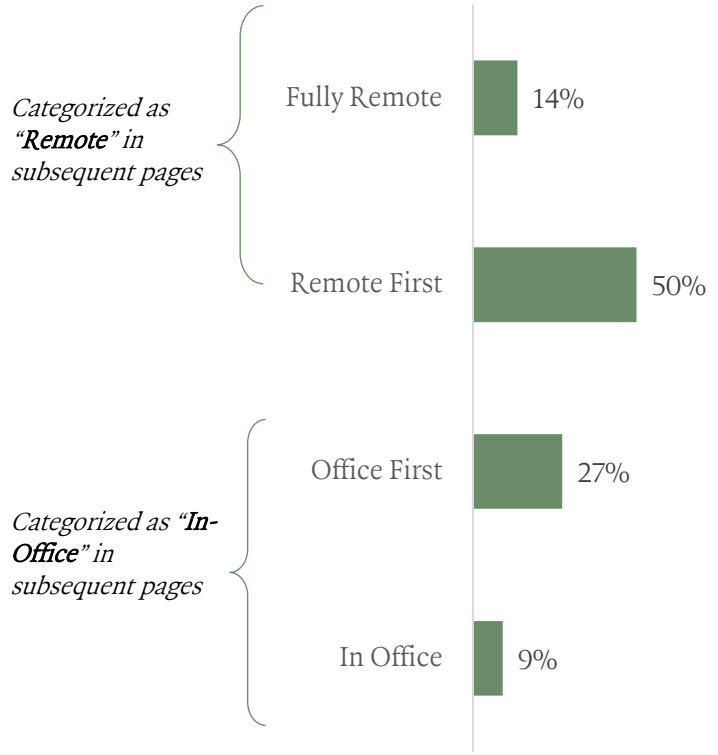
Sector



2022 ARR or Revenue



Workforce Arrangement



Participating Companies

aurora, Benchling, BetterUp, braze, chime, Collibra, DRATA, FREEWILL, Gem, highradius, HIGHSPOT, Moveworks, netskope, optibus, QGenda, recharge, Relativity, Restaurant365, Sastrify, SQUIRE, Unit21, UNITE US, virtru

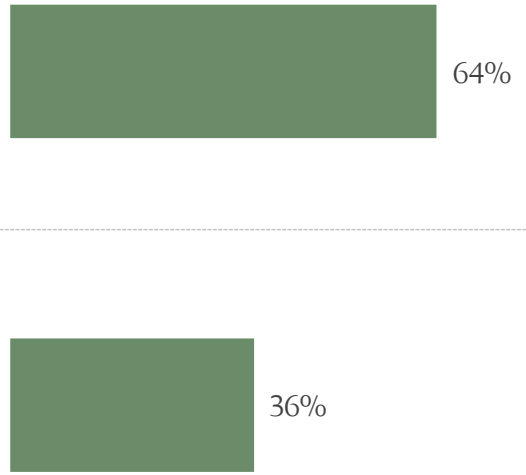
Notes: Includes data where available from 21 ICONIQ Growth portfolio companies and 2 other companies

THE Methodology

This study summarizes engineering data collected from a survey completed by **certain ICONIQ Growth portfolio companies and others in the ICONIQ network in September 2022**, in addition to **perspectives from certain ICONIQ Growth Technical Advisory Board members**

Primary Workforce Arrangement

% of Respondents



Typical Company Profile

Average across Respondents

	2022 ARR or Revenue	Annual R&D Spend	Total Org Headcount	R&D Headcount
Remote	~$133M	~$45M	~650 FTEs	~215 FTEs
In Office	~$230M	~$70M	~1100 FTEs	~400 FTEs

It is important to note that in office companies shown in this report are typically almost double the size of remote companies. While many of the cuts shown on subsequent pages compare in office vs remote companies, scale and size of company may also be confounding factors.

Notes: Includes data where available from 21 ICONIQ Growth portfolio companies and 2 other companies

Executive Summary

Engineering Productivity

- **As companies scale, more time is spent on improving existing products** whereas earlier stage companies can afford to spend more time on building; in the last year, time spent on **building new capabilities declined from 61% to 56% of total elective investments**
- More engineering organizations are starting to track developer productivity, with the top metrics reported on being **number of bugs, % of committed software, working software, and PR to release time**

Organization Structure

- Over the last year, most organizations have shifted to **organize their engineering teams by product**
- Companies surveyed seem to be building teams with **more full-stack engineers** (vs. front-end or back-stack) than in past years
- **Remote companies generally leverage offshore resources more**, with most offshore resources being owned and operated and around **50% of companies are using 3rd party developers**
- Diversity on engineering teams remains a challenge with **women making up a median 21% and BIPOC employees 9% of R&D teams**

R&D Spend

- R&D continues to be a key differentiator for companies, equaling **~40% of total revenue in 2022** (vs. 35% in 2021)
- Companies expect to **increase R&D spend by 21% for 2023**, with remote-first companies expecting to increase their spend more than in-office peers
- Rises in compensation and a competitive hiring market has led to **people costs now accounting for 82% of total R&D spend** (vs 79% in 2021)
- Enabling **synchronous and asynchronous communication across geographic barriers remains a priority** for companies in 2022, with **project management and collaboration tools topping the list** of most used tools this year, followed by data / security

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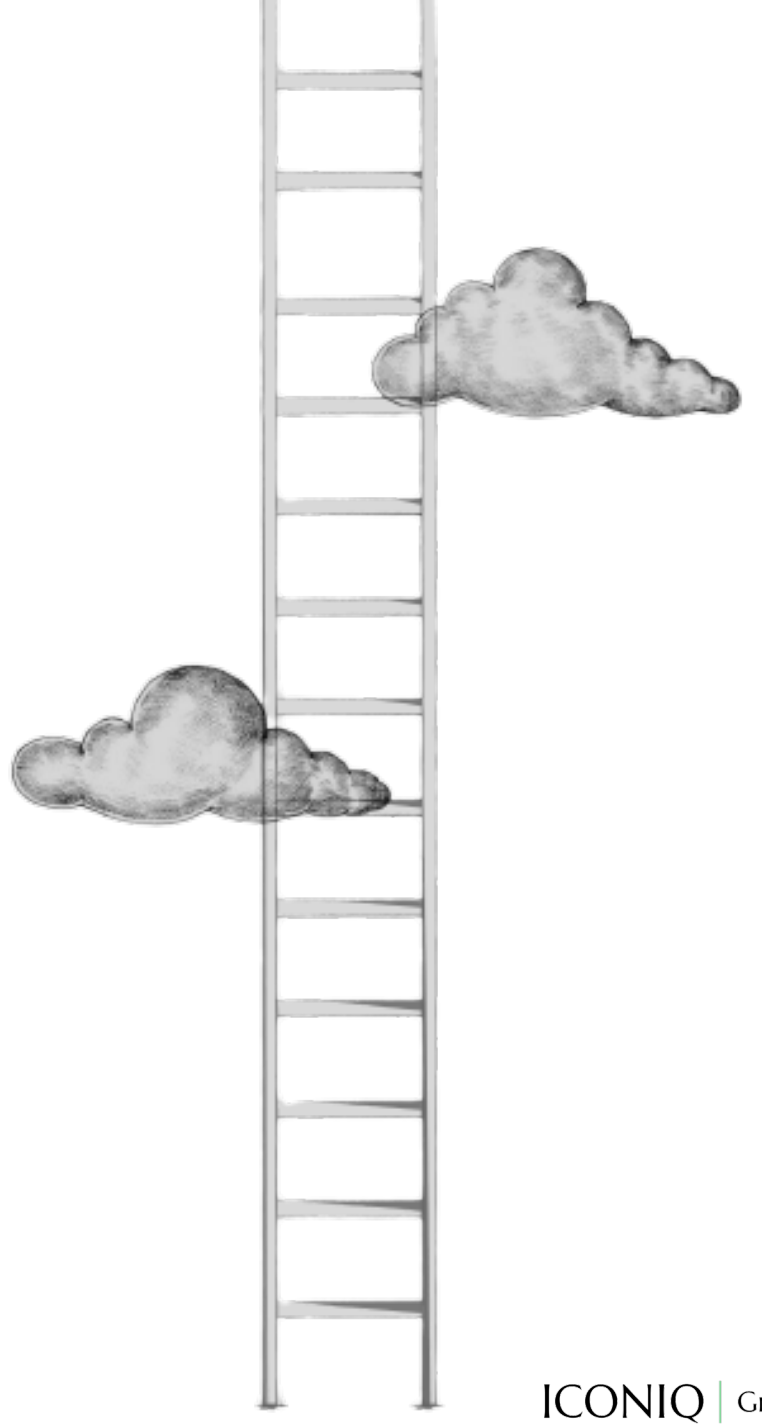
Engineering Productivity

A detailed look at the data:

Capacity Allocation

Developer Productivity Metrics



ENGINEERING PRODUCTIVITY

A Guide to Capacity Allocation

As an engineering organization grows, different types of questions and challenges start to emerge around the investments in time and people the organization is making.

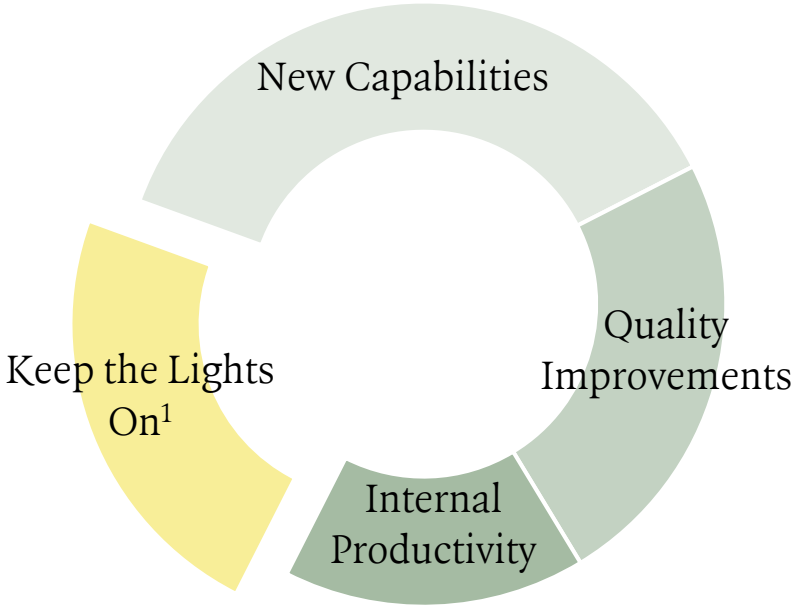
It's critical to have a framework in place that allows the company to think about productivity and prioritize engineering investments in a way that makes sense for engineering internally and is also understandable for the rest of the business. **The below framework categorizes and tracks engineering investment.**

Keep the Lights On (KTLO)

This is defined as the minimum tasks required to maintain the current level of service in the eyes of our customers

For example:

- Maintaining current security posture
- Maintaining current levels of service uptime
- Service and ticket monitoring & troubleshooting
- Addressing functional defects reported by customers
- Regular/routine internal procedures
- Staying up to date with external dependencies
- Browsers, libraries, platforms, web services, partner changes, hardware, etc.



You can read more about the engineering framework here.

Elective Investments

New Capabilities

- Adding a new product
- Adding a new feature or sub-feature
- Supporting a new platform or partner application

Quality Improvements

- Customer requested improvements
- Better performance / utilization
- Iterations to improve adoption, retention, and quality
- Improved product reliability or security

Internal Productivity

- Better developer tooling
- Testing automation
- Code restructuring
- Work to reduce size of *KTLO* bucket in the future

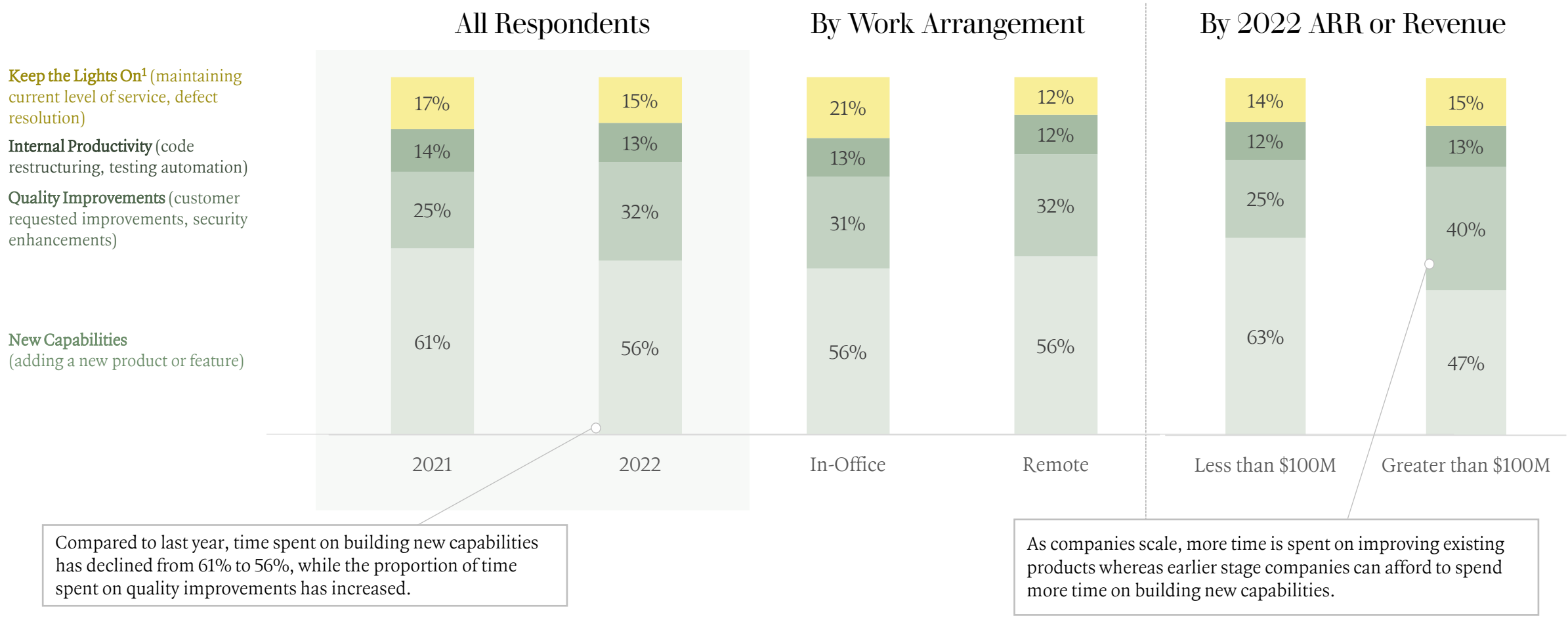
1 Keep the Lights On activities should be viewed as in addition to the rest of development activities – hence why the % capacity is incremental to the 100% sum of internal productivity, quality improvements, and new capabilities

Productivity | Allocation Benchmarks

On average, engineering organizations allocate around 50% of engineering capacity to building new capabilities. Earlier stage companies are typically able to spend a little more time developing new software than companies at scale with a larger base of customers and users to support

Capacity Allocation

Average



Compared to last year, time spent on building new capabilities has declined from 61% to 56%, while the proportion of time spent on quality improvements has increased.

As companies scale, more time is spent on improving existing products whereas earlier stage companies can afford to spend more time on building new capabilities.

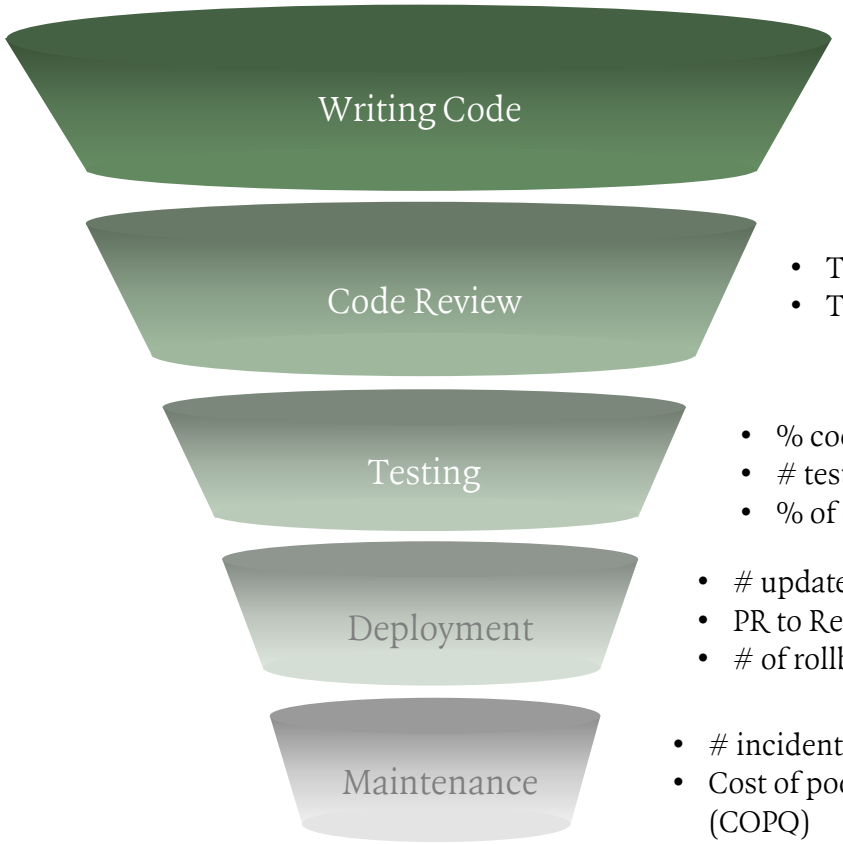
1 Keep the Lights On activities should be viewed as in addition to the rest of development activities – hence why the % capacity is incremental to the 100% sum of internal productivity, quality improvements, and new capabilities

ENGINEERING PRODUCTIVITY

Developer Productivity Metrics

Just as sales teams measure quotas and ramp time, it is important for the engineering organization to measure developer productivity; while specific KPIs will vary across companies, we typically recommend tracking metrics that help you understand per FTE cost, release time, and developer velocity

Common Metrics



- Time spent on planning / requirements gathering
- Time from requirements to code complete
- % of code delivered vs. committed
- # of story points / features written

- Time spent on code review
- Time from review request to merge

- % code coverage
- # test cases
- % of code passed

- Build / testing time
- # critical defects

- # updates / releases
- PR to Release time
- # of rollbacks

- % of roadmap/committed development work shipped on time

- # incidents / outages
- Cost of poor quality (COPQ)

- Service uptime
- # of SLA breaches

Best Practices

- Developer productivity can be compared to a sales funnel, with key **metrics that can be tracked at each stage**
- While specific KPIs will vary across companies, metrics that allow management to understand and **track revenue / FTE cost, release time, and developer velocity on a trended basis** will be critical
- Start by **picking 3 metrics** that are most relevant and critical for your teams
- Rather than tracking every single metric, it's most important to start **building the muscle of reporting and improving on these metrics over time**

Productivity | Top Metrics

Top metrics tracked by engineering organizations include number of bugs, the percentage of committed software, working software, and PR to release time

Top Developer Productivity Metrics

		% of Respondents Tracking
Number of Bugs	1	54%
% of Committed Software	2	46%
Working Software	3	31%
PR to Release Time	4	31%
Cost of Poor Quality	5	8%
% of Code Delivered vs Committed	6	8%
Merge Request Rate	7	8%
Time from review request to merge	8	8%

Other metrics mentioned include:

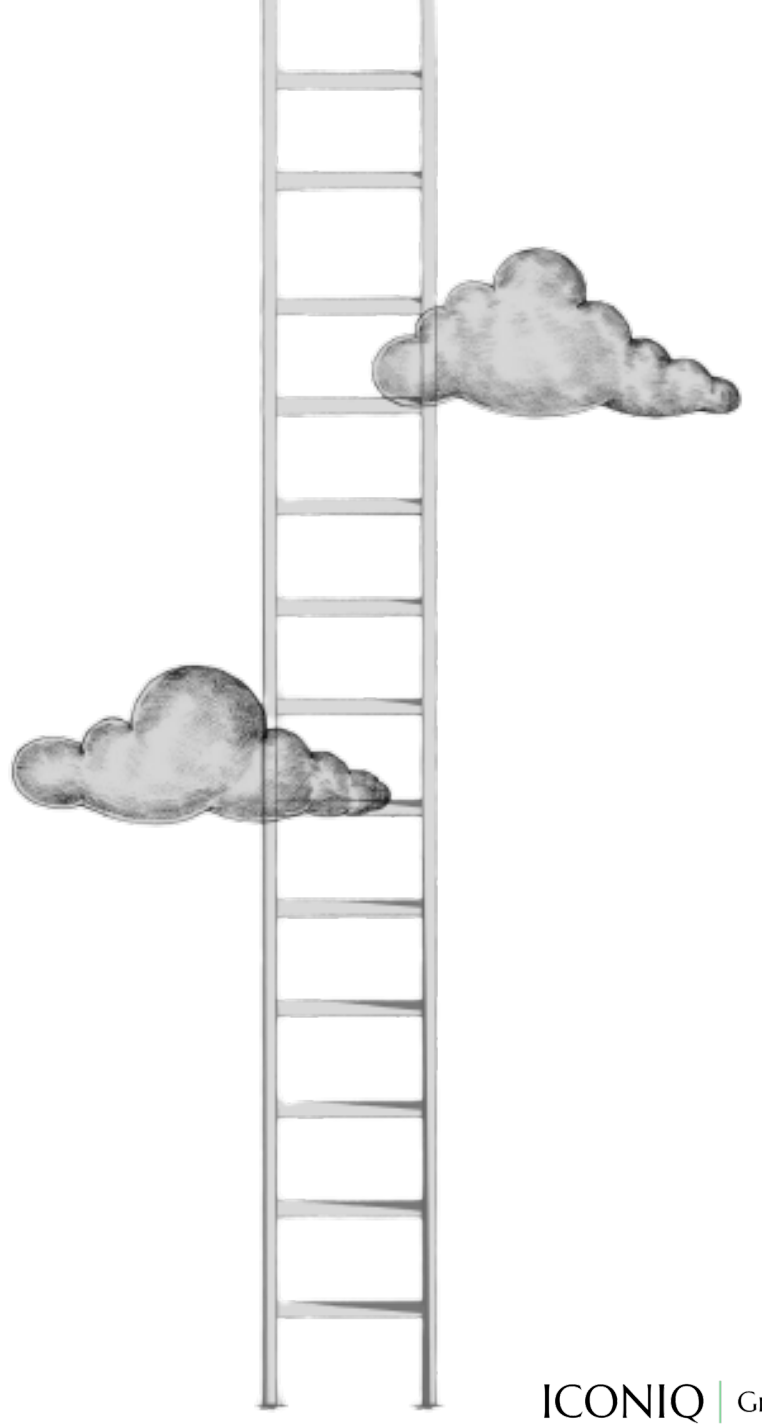
- Developer speed
- Number of hotfixes per release
- Code review time
- Stability of regression test suite
- DORA metrics
- Developer satisfaction

3

Organization Structure

A detailed look at the data:

- Key Ratios
- Team Structure
- Developer Type
- Organization Health



Team Structure | Key Ratios

We generally see a ratio of 8 engineers per manager, 8 engineers per product manager, and 8 engineers per QA for a well-balanced engineering team

Engineer Ratios

Engineer Headcount Ratio

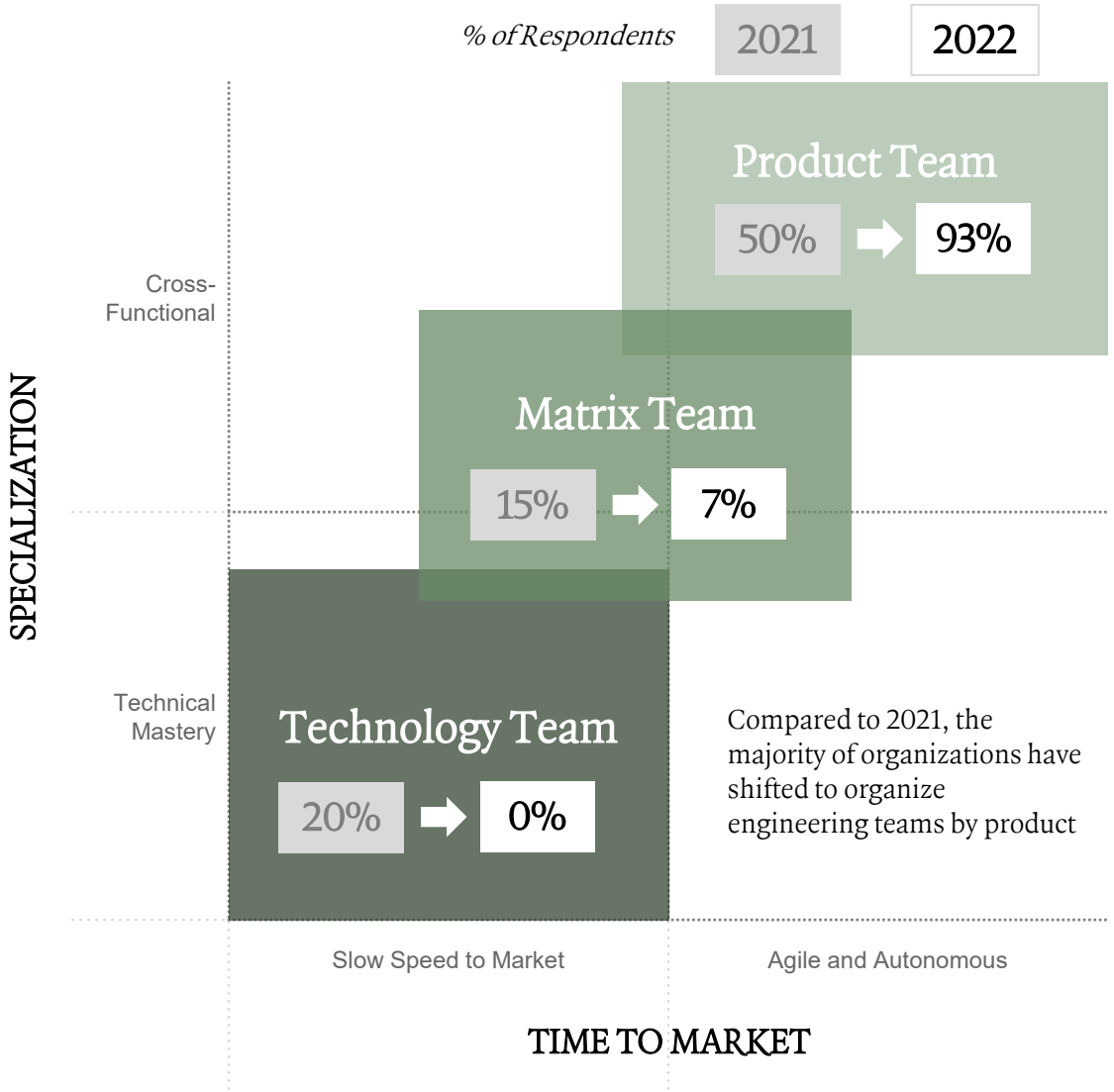
~ 2 FTEs

	Rule of Thumb
Engineer to Manager	~8:1
Engineer to Product Manager	~8:1
Engineer to Quality Assurance	~8:1
Engineer to Design	~10:1
Engineer to Data Science/ML	~10:1
Engineer to Architect	~20:1

These ratios remain relatively consistent regardless of company scale. However, significantly later stage companies with revenue above $300M will tend to see a higher ratio of engineers to roles across product management, design, and QA

Team Structure | Types of Teams

Engineering teams are typically organized by technology, product, some hybrid of both, or in a matrix model; the majority of companies have organized by product in recent years – a strategy that typically enables closer alignment to business outcomes



Compared to 2021, the majority of organizations have shifted to organize engineering teams by product

Product Team

Organized around a product (or persona) area with the team having all roles needed to build the product and one manager. This type of team is **more likely to build a unified product** and be closer aligned to business success. However, product teams may devote **less time and energy on technical excellence.**

Matrix Team

Cross-functional team made up of specialists from different areas. This team is usually a temporary project team organized to develop a specific product or feature. This team orientation fosters **closer collaboration across functions** and improves time to market by having **all the required skills to build and deploy in one team.** Conversely, **decision-making may be more difficult** in this structure given multiple reporting lines and team leadership.

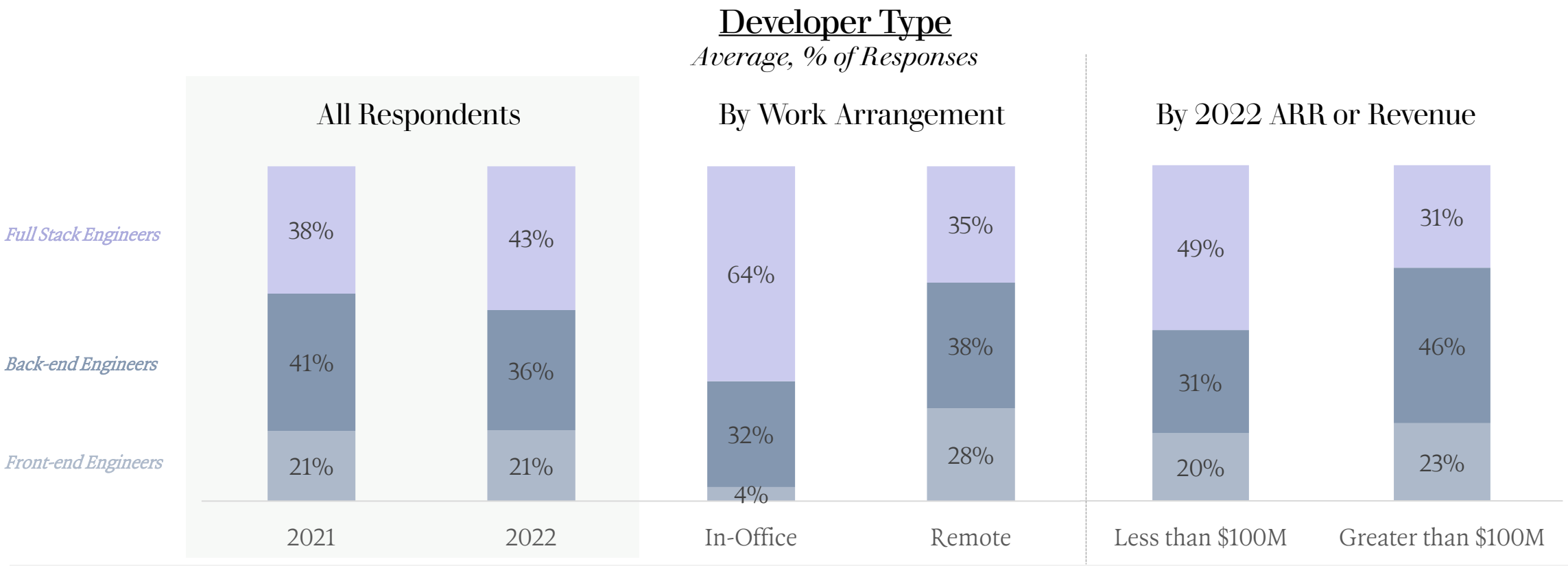
Technology Team

Focused on **a technical area** (e.g., mobile, back-end) with members in the team specialists in the particular area. This team orientation results in **high technical mastery**, which means the team's codebase is likely to be high quality and reduces possibility of technical debt. However, engineering organizations with technology teams may have a **slower time to market** due to the **waterfall development style** required to coordinate across technical teams.

Median Eng. Team Size **7**

Team Structure | Developer Type

Compared to last year, more companies seem to be building teams with full-stack engineers vs. front-end or back-end specialties. In particular, office-first companies have engineering teams comprising 64% full-stack compared to remote-first companies which tend to see a more even distribution



Companies in 2022 had a **greater percentage of full-stack engineers** (median of 43%) compared to 2021 (median of 38%); conversely, the number of **back-end engineers declined** from 41% to 36% as a % of engineers.

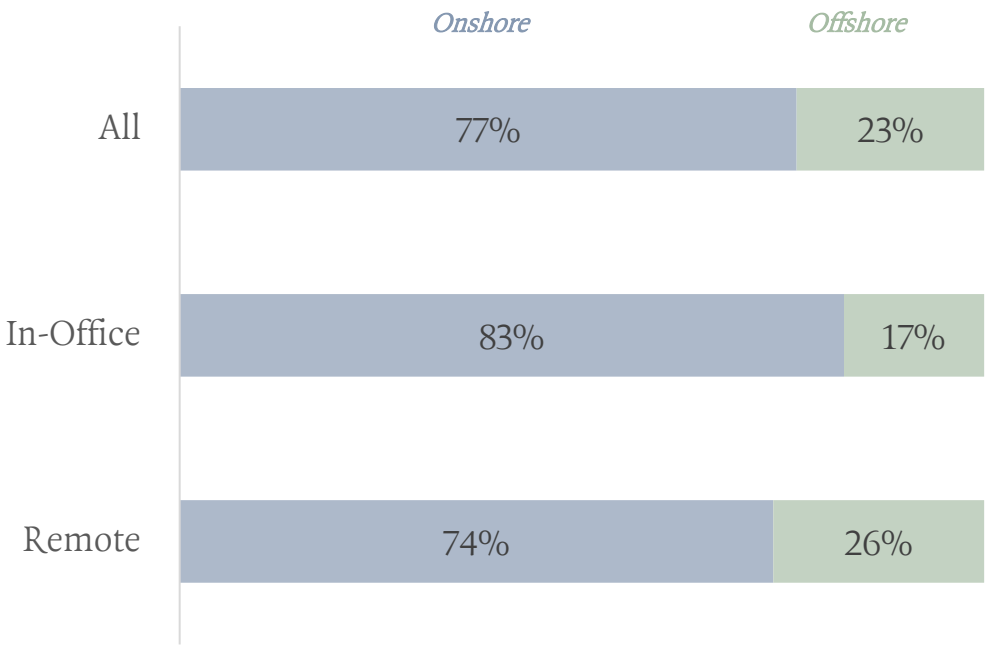
Notably, in-office companies have built teams with **64% of engineers specializing in full-stack**, compared to remote-first companies which tend to see a more **even distribution**. We also see **later stage companies investing more in back-end** engineers (46% of engineering team), perhaps driven by increasing needs for large-scale data processing as companies scale.

Team Structure | Onshore vs Offshore

Remote companies tend to more often leverage offshore resources who typically are tasked with equal responsibilities as the rest of the engineering team

Onshore vs Offshore[1]

Average, % of Responses



Fully remote or remote-first companies tend to have a higher proportion of offshore employees, an opportunity that is likely easier given the already distributed nature of the company

Offshore Strategy: By the Numbers

4

median number of offshore locations

Common Locations

- Brazil
- Canada
- Czech Republic
- Germany
- India
- Serbia
- Spain
- UK
- Ukraine

Notably, all companies surveyed with offshore workers in Eastern Europe still have locations there despite the war.

Primary Type

Level of Responsibility

- Most organizations employ offshore employees with equal responsibilities as the rest of the engineering team
- Other companies have offshore resources focused on test engineering, automation, and/or bug fixes

1 Categorized as outsourced resources typically in a different country

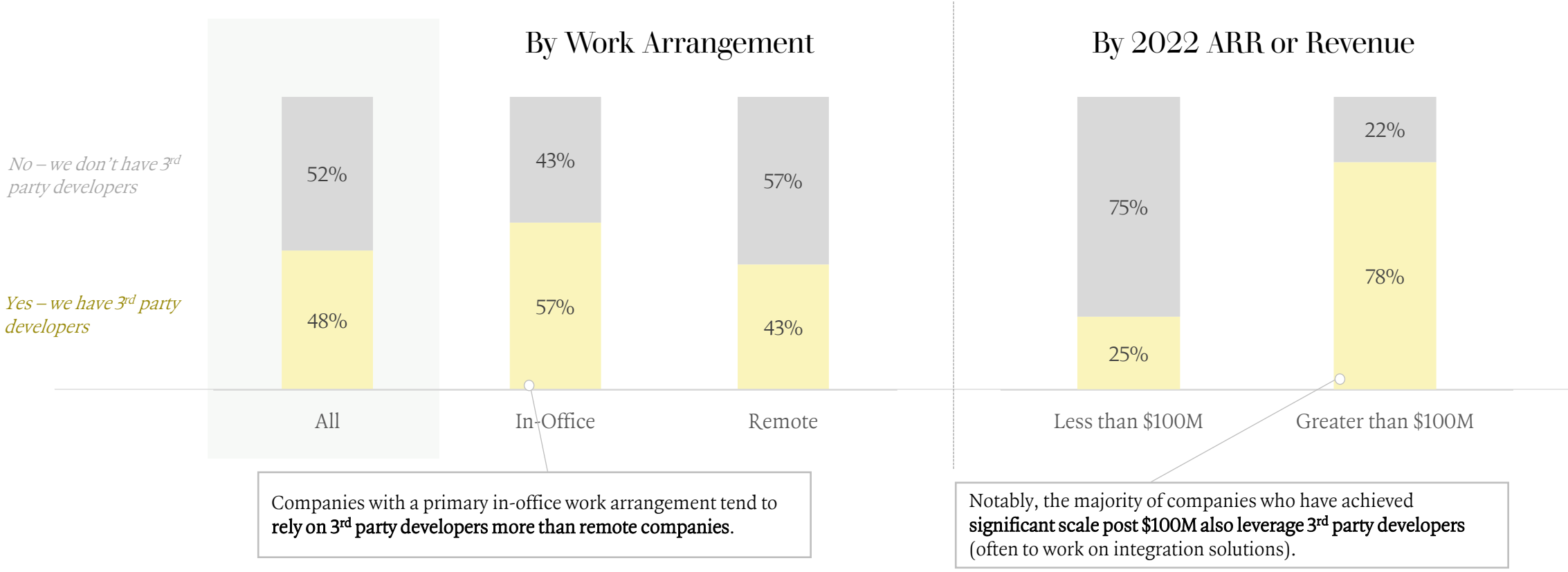
Team Structure | 3rd Party Developers

Around 50% of companies surveyed are using 3rd party developers, with in-office and later-stage companies relying more heavily on these resources

3rd Party Developers

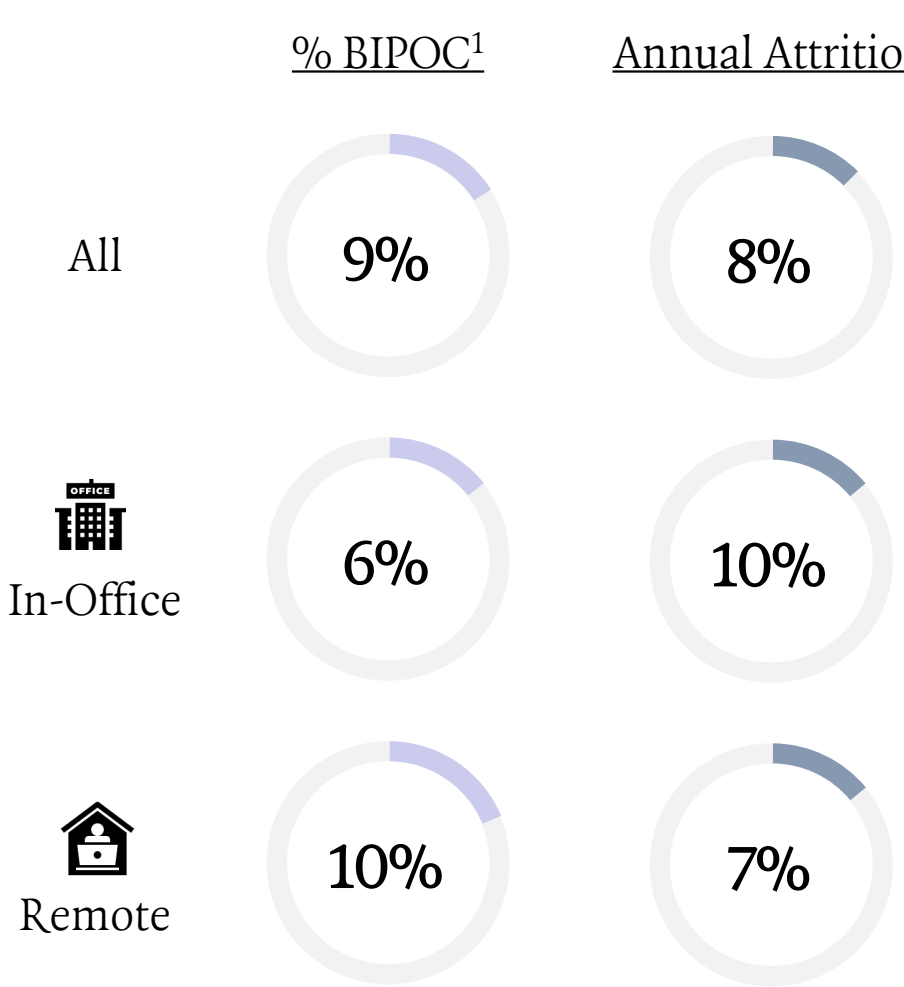
Average, % of Responses

3rd party developers typically make up a median 6% of the total engineering organization and are treated the same as other developers in terms of quality or responsibility.



Team Structure | Org Health

Diversity on engineering teams has remained a challenge for most companies, with women making up a median 21% and BIPOC employees making up a median 9% of R&D teams



Compared to results from our 2021 survey, the **percentage of women in engineering organizations has stayed relatively consistent** at a median of 22% (compared to 20% last year).

Companies with an in-office work arrangement appeared to have a higher percentage of women in this dataset. However, we believe this is most likely driven by the company sectors / business models in this dataset rather than a correlation to work arrangement (based on external research, we typically would expect to see remote organizations with a higher percentage of women).

Notably, **remote organizations have a higher percentage of diverse employees and lower attrition** than in-office companies.

1 Asian / South Asian not included in BIPOC %

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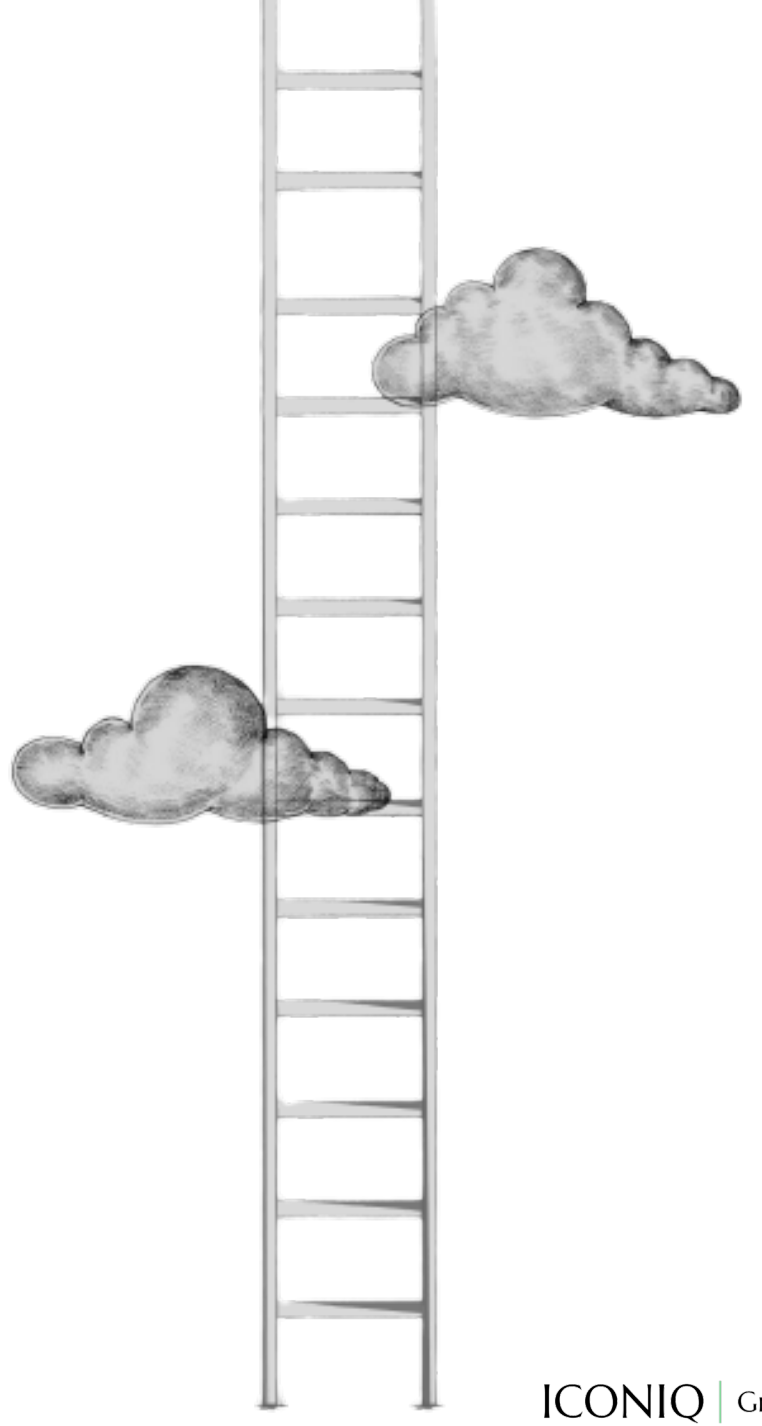
R&D Spend

A detailed look at the data:

- Annual Spend on R&D
- R&D Headcount
- Developer Tech Stack



Spend | Annual Spend on R&D

R&D continues to be a key differentiator for software companies, with companies spending around 40% of their total revenue on R&D in 2022; companies also expect to increase their R&D spend by 21% Y/Y in 2023

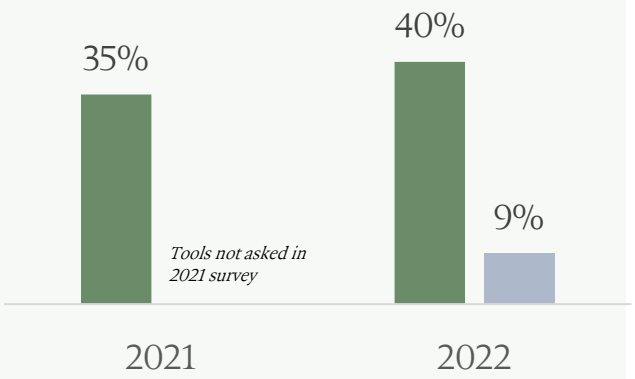
R&D Spend as a % of ARR

Tool & Technology Spend as a % of ARR

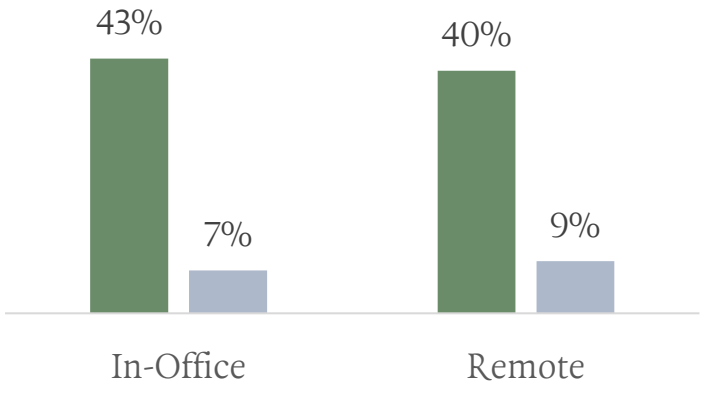
R&D Spend as a % of ARR

Median

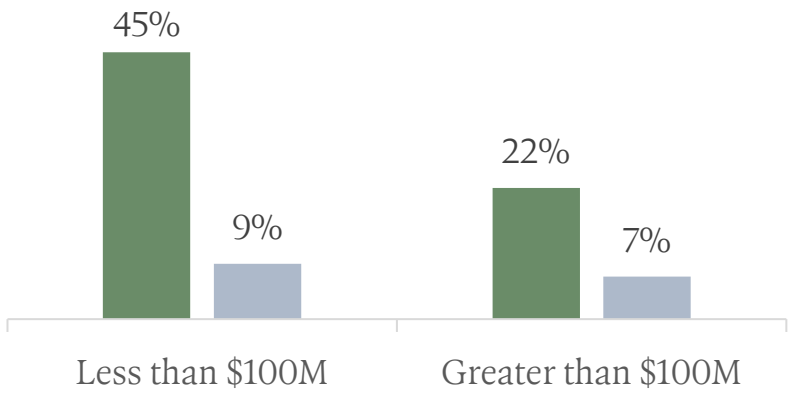
All Respondents



By Work Arrangement



By 2022 ARR or Revenue



By what % are you expecting to increase R&D spend in 2023?

▲ 21%

Y/Y Increase, Median of responses

As covered in our 2022 Growth & Efficiency report, R&D as a % of revenue gradually decreases as companies reach scale post $100M in ARR. However, over the past few years companies have continued to invest meaningfully in R&D as a key differentiator, with median R&D as a % of revenue increasing from 35% in 2021 to 40% in 2022. Companies also expect to increase their annual R&D spend by 21% Y/Y in 2023.

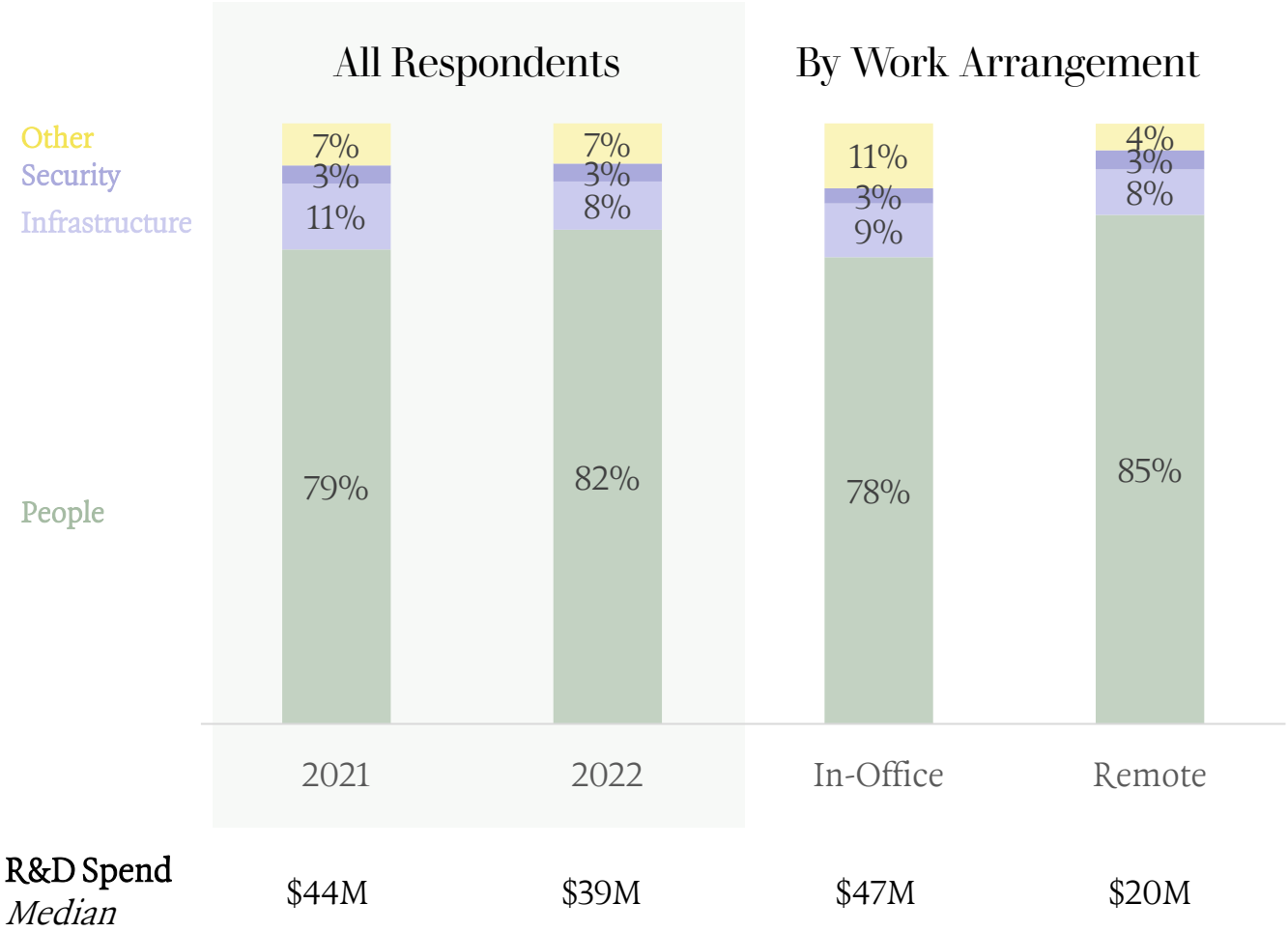
Companies with a remote-first work arrangement are spending a higher proportion of R&D and tools/technology (as a % of revenue) than office-first counterparts – likely driven by the need for more tools to enable asynchronous collaboration. Remote-first companies also expect to increase R&D spend next year more than office-first peers.

Spend | Spend by Category

People costs typically make up the majority of R&D spend and 2022 continued to see an increase from 2021, likely driven by the exceptionally competitive hiring market. As companies scale, non-people costs such as security and other costs typically start to make up a bigger proportion of total spend

2022 R&D Spend Split by Category

Average



Compared to results from our 2021 survey, people costs have **increased from 79% of total R&D spend to 82% in 2022** likely driven by rises in compensation and an exceptionally competitive hiring market over the last year. Despite a challenging macro environment, **engineering resources seem to remain key hires for most companies**. As explored in our previous study on *Cost Management in A Turbulent Environment*, **senior-level engineers remain in high demand**.

However, as companies scale, **non-people costs typically increase as a proportion of total R&D spend**, driven by investment in security and other costs.

Companies with an **office-first work arrangement tend to see a higher proportion of "Other" costs** compared to hybrid / remote companies.

Costs typically listed in the "Other" bucket include:

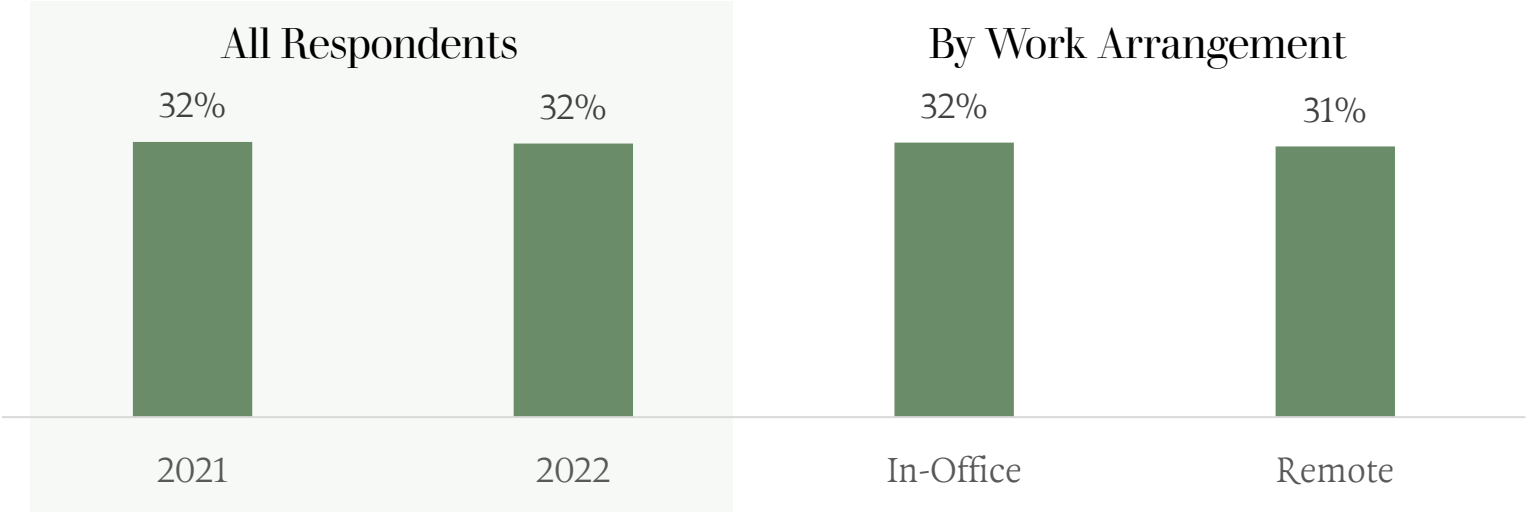
- Engineering tools
- Travel and entertainment
- Office equipment, rent
- Training and Development
- Professional Fees and Consulting Services

Spend | Headcount

R&D headcount typically makes up ~30% of the total organization, with a median implied spend of $203K per R&D FTE – a finding that is consistent across work models and has remained flat YoY. Companies surveyed expect to increase R&D headcount by a median of 13% for 2023

R&D Headcount as % of Total Org

Median



Total R&D Headcount *Median*	158	164	154
Total Org Headcount *Median*	487	497	476
R&D Spend per R&D FTE *Median*	$203K	$272K	$167K

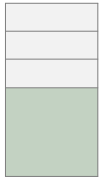
Expected 2023 R&D Headcount

▲ 13%

Y/Y Increase, Median of responses

Spend | Distribution By Role

Engineers typically make up 50% of the total engineering organization, with managers / leadership making up the second biggest layer. As organizations scale, engineering headcount increases linearly while other non-development roles remain relatively flat



R&D Headcount by Role

Median

Roles included in "Other" typically include program managers, scrum masters, security, and operations

ARR or Revenue Range	Engineer (IC)	Architect	Product Manager	Quality Assurance	Design	Data Science	Machine Learning	Manager / Leadership	Other	Total Engineering FTE	Total Organization FTE
Less than $50M	40-50	0-10	0-10	0-10	0-10	0	0	10-20	0	*~80*	*~200*
$50 - $100M	70-80	0-10	10-20	10-20	0-10	0-10	0-10	20-30	0-10	*~160*	*~500*
$100 - $300M	110-120	0-10	20-30	20-30	10-20	0-10	0-10	20-30	0-10	*~270*	*~800*
$300M+	310-320	0-10	30-40	20-30	10-20	0-10	0-10	120-130	60-70	*~680*	*~1300*
% of R&D Org	52%	2%	9%	6%	6%	2%	2%	15%	7%		
% of Total Org	17%	~0%	3%	3%	2%	~0%	~0%	5%	1%		

Compared to last year (12%), companies surveyed this year have a larger middle-management layer (15%).

R&D SPEND

The Developer Tech Stack

The DevOps lifecycle into six distinct phases, each with its own set of tools; more detail on each category can be found in our 2020 Developer Tech Stack study

Read the full Developer Tech Stack study

DevOps Lifecycle: Seven Tool Categories

Project Management

Tools used to track and manage project flow within and across teams

Airtable Jira

Development *Review* *Deployment* *Monitoring & Security*

Development	Verification	Code Management	CI/CD	Monitoring	Defense
Tools that enable the writing, design and building of software	Tools that help with the review and testing of code	Source code management tools	Tools used to deploy code; CI/CD	Tools that monitor performance	Tools that let software teams discover, triage and fix errors and threats
Example Tools: Visual Studio, SMARTBEAR AQTime Pro	CODACY, Selenium	GitHub, GitLab	AWS CodeDeploy, Jenkins	DATADOG, Grafana	exabeam, Checkmarx

The full organizational tech stack, top tools, and trends for next year will be explored in our upcoming November study

Certain tools referenced here are Growth portfolio companies. Example tools shown for illustrative purposes only. Trademarks are the property of their respective owners. None of the companies illustrated have endorsed or recommended the services of ICONIQ.

Spend | Top Engineering Tools

Project management and collaboration tools like Atlassian's product suite tops the most used tools in 2022, followed by tools focused on data and security

Project Mgmt | Development | Review | Deployment | Monitoring / Security

Top 10 Engineering Tools	Description	% of Companies Using	Median Spend
Atlassian (JIRA, Confluence, Trello) 1	Provider of collaboration, development, and issue tracking software for teams	89%	~$100K
Github 2	Code hosting services enabling collaborative development of software	67%	~$40K
PagerDuty 3	Incident management tool allowing teams to identify and triage issues	61%	~$50K
Snowflake 4	Data platform providing access to the Data Cloud, enabling solutions for data warehousing, data lakes, data engineering, data science, and data sharing	61%	~$100K
Sentry 5	Self-hosted and cloud-based application monitoring platform	56%	~$5K
AWS 6	Portfolio of cloud computing solutions and services	50%	~$1.2M
Datadog 7	Monitoring, security and analytics platform enabling rea-time observability and application monitoring	50%	~$400K
Crowdstrike 8	Self-hosted and cloud-based application monitoring platform	33%	~$40K
Gitlab 9	DevOps software package that helps automate builds, integration, and verification of code	28%	Not Disclosed
Jenkins 10	Open-source automation server that automates CI/CD building, testing, and deployment	28%	Open Source

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ABOUT

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Analytics & Insights

Seeking to empower our portfolio with proprietary analytics and insights across business operations and strategy

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Analytics & Insights

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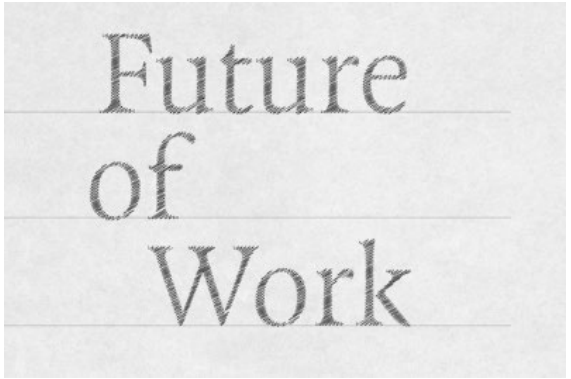
Additional Insights

Topline Growth & Operational Efficiency



Future of Work Series

Path to IPO Series

Go-To-Market Series

Find this content and more at
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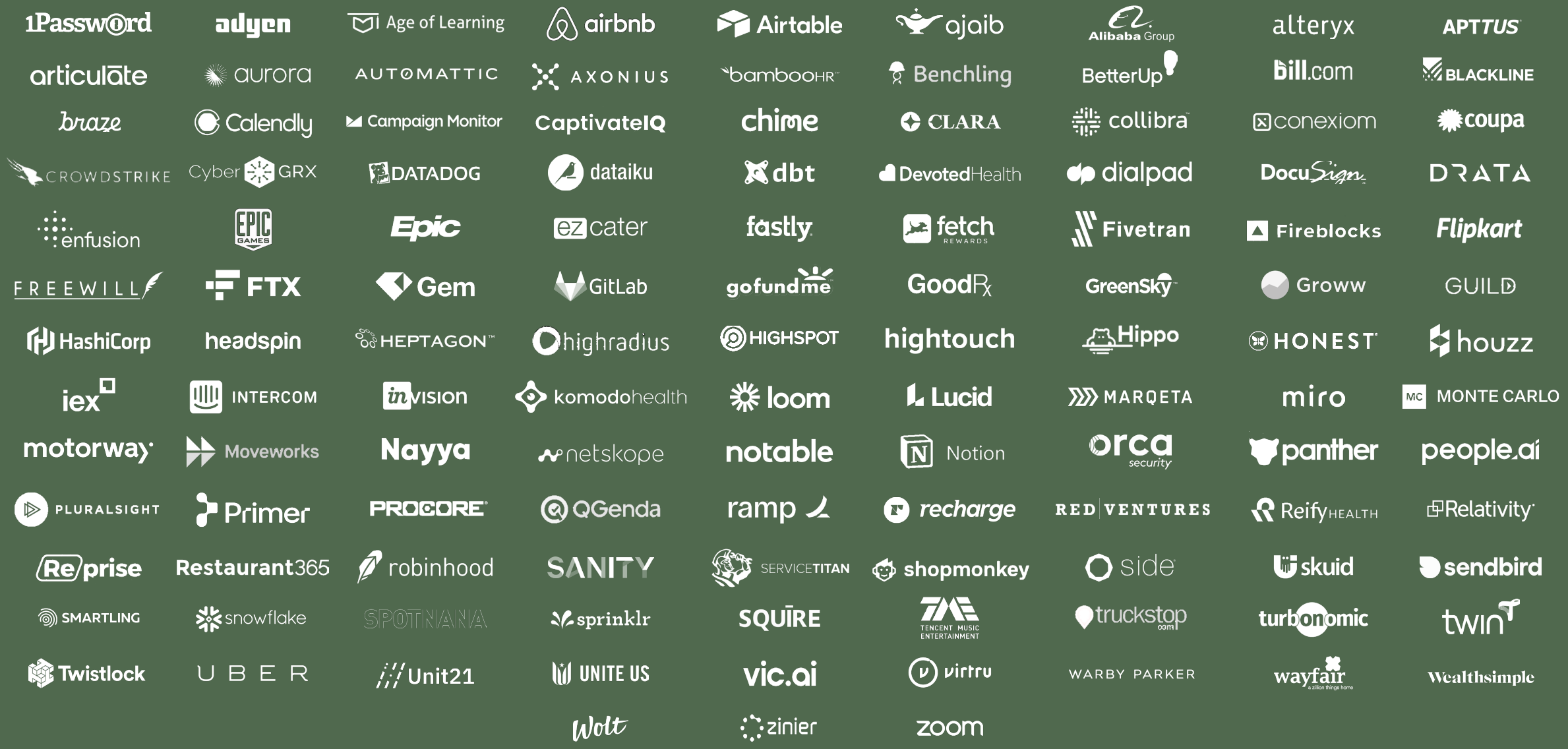
WE PARTNER WITH VISIONARIES

DEFINING THE FUTURE OF THEIR INDUSTRIES

TO TRANSFORM THE WORLD

A Portfolio of Category Leaders



These companies represent the full list of companies that ICONIQ Growth has invested in since inception through ICONIQ Strategic Partners funds as of the date these materials were published (except those subject to confidentiality obligations). Trademarks are the property of their respective owners. None of the companies illustrated have endorsed or recommended the services of ICONIQ.

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Dedicated team with strong investing and operating experience

OUR VALUES

Teamwork | Excellence | Integrity

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