2023 C2C Development Trends Report

An overview of cloud technology usage and direction from the Google Cloud customer community.

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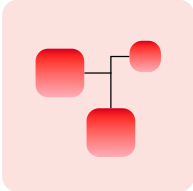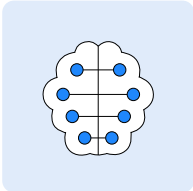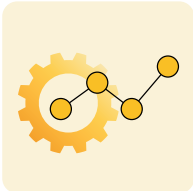
Executive Summary
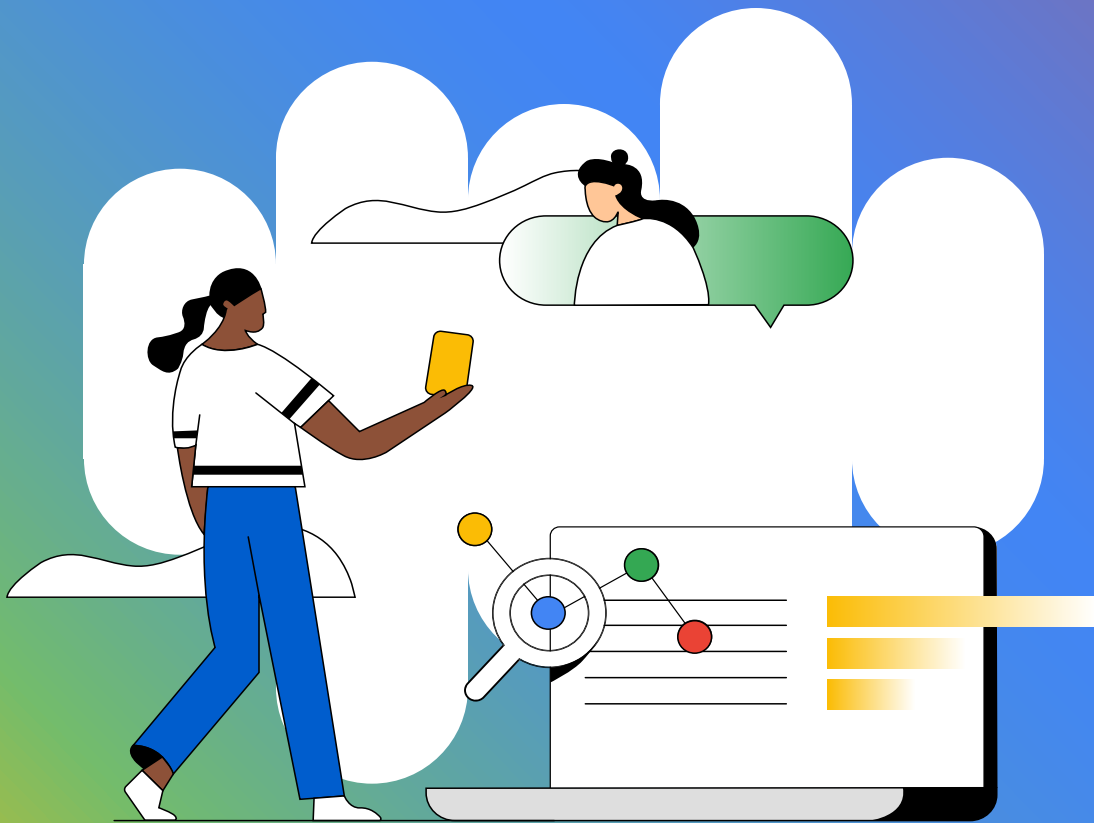
Overview

Background

Cloud computing is a transformative force, empowering businesses of all sizes to harness the power of innovation and achieve their strategic goals. As cloud adoption— and now especially, cloud optimization—continues to surge, understanding the preferences, perceptions, and challenges faced by cloud users is crucial for both cloud providers and for the C2C community.

Generative AI, for example, has marked a significant turning point over the past year for cloud computing and beyond. This transformative technology, currently at the peak in the technology hype cycle, opens up a plethora of new possibilities for cloud users. Its potential to revolutionize various aspects of cloud usage, from providing unique assistance in the development process to becoming a new development goal that teams are competing to master, is undeniable.

This report presents the findings of a survey conducted among Google Cloud users, encompassing both customers and partners. The survey explores various aspects of cloud usage, ranging from technology adoption trends to provider preferences to emerging technologies like generative AI.

C2C stands as a vital hub where Google Cloud users— including developers, architects, data professionals, security experts, and IT leaders—converge to share insights, best practices, and innovations. Understanding the pulse of this community is crucial as it embodies the collective wisdom and experiences that drive the evolution of Google Cloud technology and how we address the needs of our members.
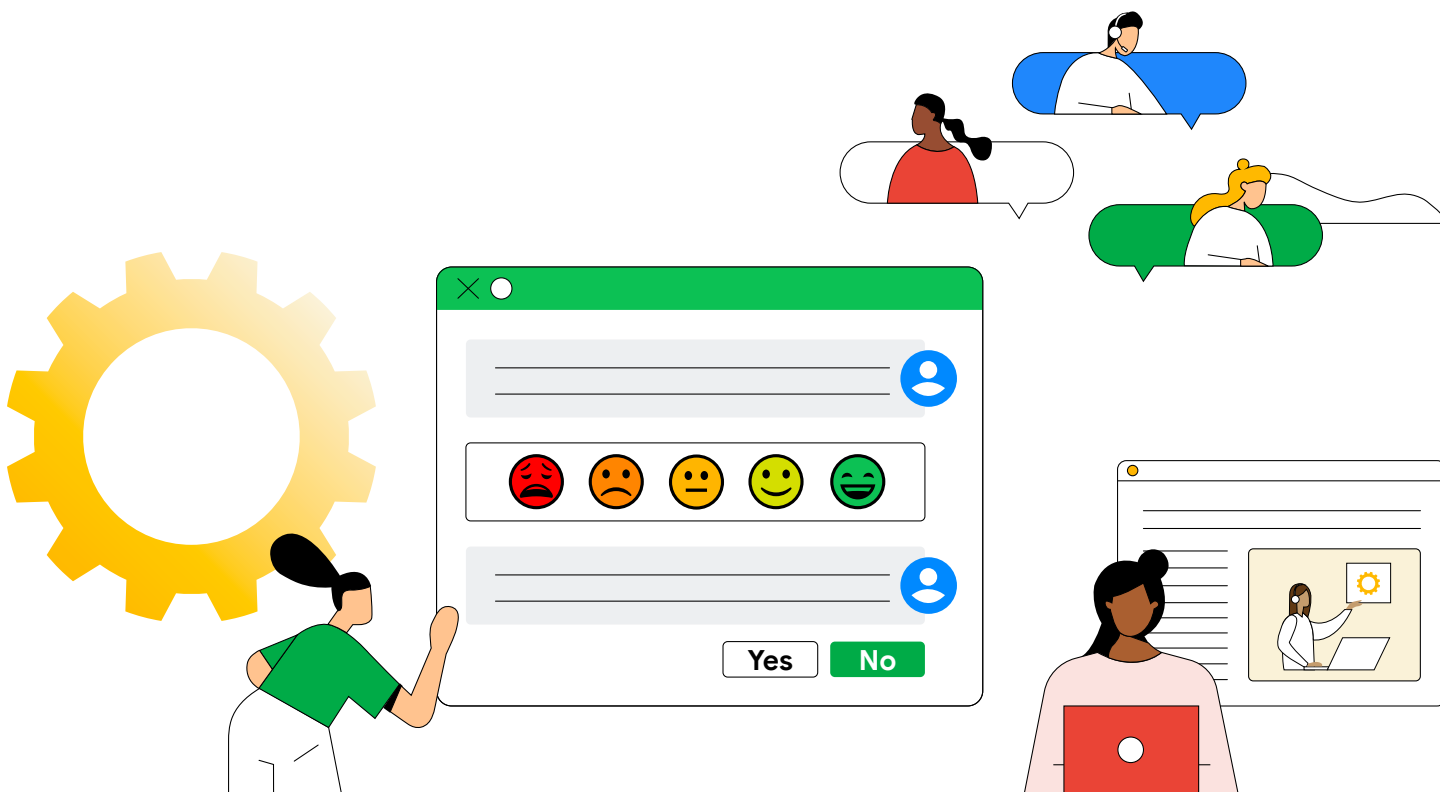
Overview

Objectives

The first edition of this study, in 2022, indicated that AI and ML technologies are gaining traction, but most users still need guidance to adopt them effectively. It also told use that cloud storage and migration tools are in high demand due to business growth pressures, with Google Cloud as the preferred cloud provider for cloud-native applications.

Survey respondents from Google Cloud customer and partner companies needed to identify what type of cloud environment their applications run in and have a level of involvement in the cloud architecture solutions at their organization.

The responses to the survey were generally consistent across the firmographic and demographic information collected from respondents.

This year's survey looked to a few key areas:

Analyze Year-over-Year (YoY) Trends in Cloud Usage:
Understand how cloud usage patterns have evolved among Google Cloud users, examining development project types, back-end cloud technologies, programming languages, and organizational pressures.

Explore Generative AI Adoption and Perceptions:
Investigate the current state of generative AI adoption among Google Cloud users, their understanding of its capabilities, the tools they employ for new development, and the key concerns they face in using, developing, and deploying generative AI solutions.

Evaluate the Cloud Provider Competitive Landscape:
Assess user satisfaction, investment preferences, and reasons for adopting their providers of choice.

Cloud Environment

63%
Primarily Private Or Public Cloud (including multicloud)

37%
Hybrid Cloud (using a mix of cloud and on-premise for a single project)
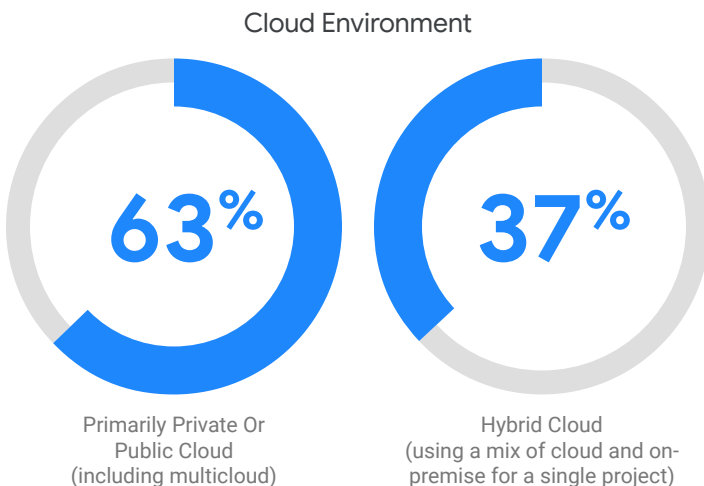
Q: WHAT BEST DESCRIBES THE TYPE OF ENVIRONMENT YOUR APPLICATIONS RUN IN? (N=431)

Decision-Making Role

38%
I am a primary decision-maker on cloud solution options

30%
I identify options and provide recommendations on cloud solution options

30%
I work on adoption, migration, or implementation of cloud solutions
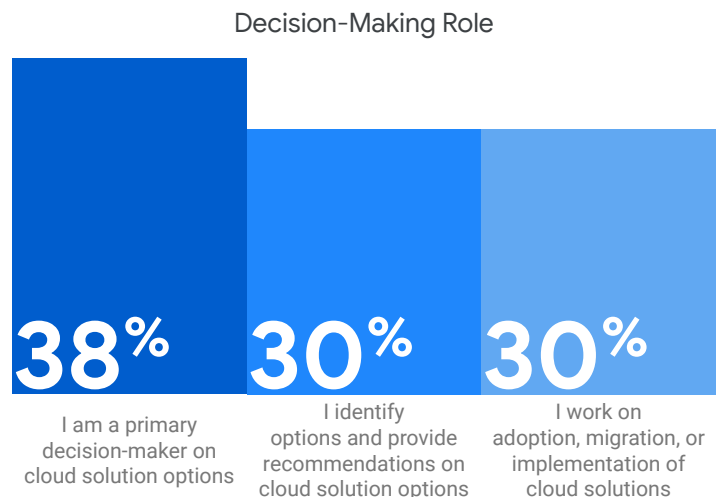
Q: HOW ARE YOU PRIMARILY INVOLVED WITH CLOUD ARCHITECTURE SOLUTIONS IN YOUR DEPARTMENT (OR ORGANIZATION)? *2% SELECTED "OTHER"* (N=431)

Key Findings
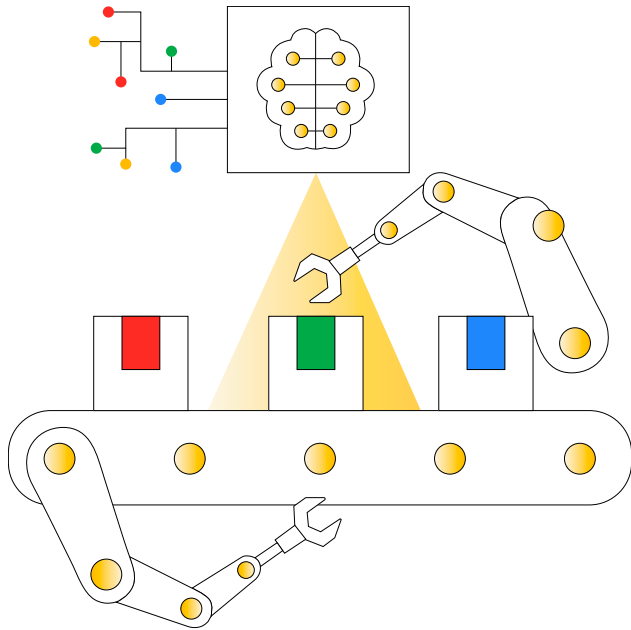
Understanding of AI Lags Despite Surge in Adoption

The AI boom is real: our 2022 study predicted a substantial increase in the use of AI and ML in 2023. Companies are now grappling with rising expectations for end-user AI integration AI and ML application projects, also priming the utilization of AI accelerators in the future.

However, a disquieting trend has emerged: despite this widespread adoption, most organizations are still playing catch-up when it comes to understanding AI, exacerbated by the explosive growth of generative AI in 2023. This knowledge gap presents a unique opportunity to offer support, as nearly all companies anticipate hurdles in generative AI development.

Tech Adoption is Outpacing Available Resources

In 2023, companies are scaling tech faster than their budgets allow, with cost, scaling, and security emerging as top concerns. Plus, data privacy anxieties whisper around the newest player to the adoption game: generative AI. That said, those same companies could embrace AI tools for fraud detection and data augmentation, setting up growth catalysts needed to overcome these hurdles.

Respondents are also likely turning directly to their cloud providers for assistance with scalability, which is the top reason for adopting their cloud service provider.

Key Findings
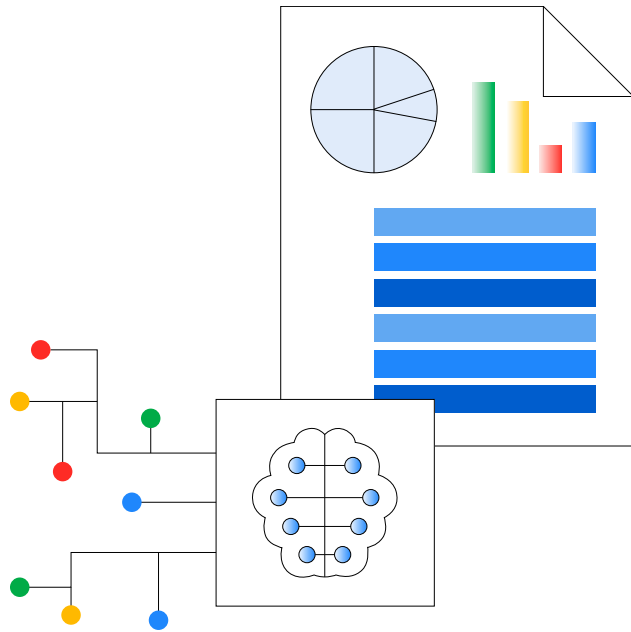
Generative AI is Pervasive, Not Just Science Fiction

Generative AI has taken 2023 by storm, becoming an invaluable teammate for a surprising array of tasks like code writing assistance, learning new skills, and automating document generation or report writing.

But AI's not just a helper—it's an innovator! A striking 38% of respondents are actively building new generative AI products and services, with Google Cloud as the leading platform for deploying AI models, closely followed by OpenAI. The primary use case for exploring or implementing generative AI products and services is chatbots or virtual assistants, paving way for a future filled seamlessly with intelligent helpers.

Google Cloud Stays Ahead of Provider Competition

Google Cloud users are most involved with software as a service (SaaS) development projects. The bulk of these projects are still concentrated for the computer software industry, but it no longer dominates projects as work has expanded at a similar proportion into the professional services and retail / e-Commerce industries.

Consistent with results from 2022, Google Cloud is the most used cloud provider followed by AWS. These providers also continue to be the most committed to open source. IBM Cloud / Watson were evaluated and decided against most by respondents. Google Cloud has seen the most substantial increase in investments over the past 12 months, mainly driven by the migration and scaling up of existing workloads in the cloud.
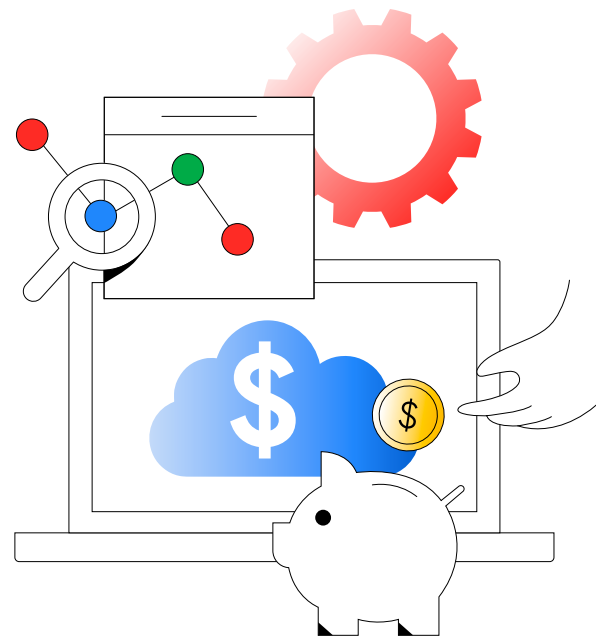
Trends and Pressures

Development Projects

2022 **2023**

Software as a Service (SaaS)
- 71%
- 67%

Apps / Integrations / Extensions
- 65%
- 58%

AI and Machine Learning Tools
- 51%
- 39%

Data Science Tools
- 47%
- 38%

Enterprise Applications (e.g. ERP, CRM, voice, messaging, blockchain)
- 41%
- 40%

Content Management Systems (CMS)
- 31%
- 34%

IoT (e.g. smart city, energy, logistics, agrotech)
- 19%
- 23%

Consumer Devices (e.g. wearables, smart home)
- 14%
- 23%

Games
- 8%
- 12%

Augmented Reality (AR) / Virtual Reality (VR)
- 8%
- 15%
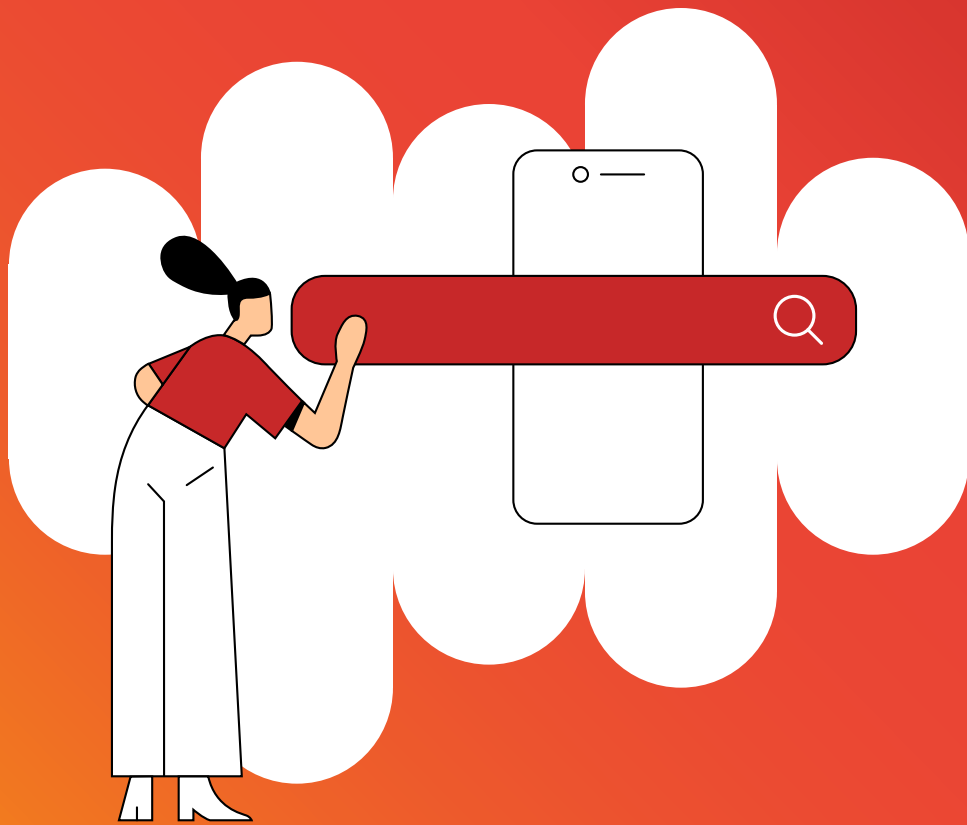
Current Projects

The cloud is booming and bursting with potential! But for companies wielding such powerful tools, the question remains: what are they actually building?

In 2023, our survey shows that software as a service (SaaS) and applications, integrations, and extensions remain the most popular projects for Google Cloud users. This echoes the trend from 2022, with both categories seeing a slight increase in involvement. While these established areas continue to be the focus, there's a strong buzz around emerging technologies like AI and machine learning (ML) tools, as well as data science tools.

We'll dive into more about AI projects when we talk about the latest tech hype: generative AI!

Q: WHAT IS YOUR INVOLVEMENT WITH EACH OF THE FOLLOWING END-USER APPLICATIONS/DEVELOPMENT PROJECTS? (2023 N=431; 2022 N=266)
SHOWING RESULTS FOR "CURRENTLY INVOLVED"
*AR AND VR COMBINED INTO ONE OPTION IN 2023, 15% CURRENT USAGE REPORTED FOR BOTH OPTIONS IN 2022 STUDY

Development Projects

2022 **2023**

AI and Machine Learning Tools
- 35%
- 33%

Augmented Reality (AR) / Virtual Reality (VR)
- 26%
- n/a

Data Science Tools
- 26%
- 30%

IoT (e.g. smart city, energy, logistics, agrotech)
- 25%
- 28%

Enterprise Applications (e.g. ERP, CRM, voice, messaging, blockchain)
- 21%
- 24%

Apps / Integrations / Extensions
- 21%
- 19%

Consumer Devices (e.g. wearables, smart home)
- 20%
- 28%

Content Management Systems (CMS)
- 18%
- 25%

Software as a Service (SaaS)
- 15%
- 15%

Games
- 13%
- 23%

Future Planned Projects

While software as a service (SaaS) and apps remain the focus for Google Cloud projects, the future is brimming with exciting new possibilities. Our survey also reveals exciting trends for the future of cloud development.

Just like in 2022, we see a clear interest in AI and machine learning projects, as well as data science tools. These powerful technologies are unlocking new possibilities, and their increasing popularity shows how companies are embracing their potential.

Meanwhile, augmented reality and virtual reality (AR/VR) offer a glimpse into a truly immersive future. Despite currently having the lowest involvement, it's the area users are most eager to explore, with plans to increase engagement significantly. This suggests a growing interest in utilizing AR/VR's potential for training, visualization, and even entertainment.

It's interesting to note that compared to 2022, respondents overestimated their future involvement in games. This year, games remain the least popular area, both in terms of current and planned projects. This could indicate a shift in priorities towards more data-driven and future-oriented technologies.

Development Projects

Industry	2023	2022	
Computer Software	**33%**	45%	▼
Professional Services	**32%**	30%	
Retail / e-Commerce	**32%**	20%	▲
Financial Services	**31%**	29%	
Telecommunications	**21%**	20%	
Healthcare and Life Sciences	**21%**	20%	
Marketing	**19%**	16%	
Media, Entertainment, and Gaming	**19%**	18%	
Education	**16%**	26%	▼
Government and Public Sector	**16%**	13%	
Supply Chain and Logistics	**15%**	17%	
Automotive	**14%**	9%	
Manufacturing	**13%**	18%	
Energy	**11%**	13%	
Insurance	**10%**	11%	
Consumer Packaged Goods	**10%**	8%	
Travel	**10%**	10%	
Non-Profit	**9%**	8%	
Other	**6%**	3%	

Projects for Industries

Cloud technology isn't just shaping how we create software and explore new frontiers like AI and AR/VR; it's also redefining the industries we work within.

While the computer software industry remains the main driver of application and development projects on Google Cloud, we're seeing exciting shifts in 2023. Professional services, retail and e-commerce (with a significant jump from last year), and financial services are now close contenders, showcasing the cloud's growing reach beyond tech giants.

However, education projects saw a noticeable decline. This could be due to various factors, such as budget constraints or a shift towards other solutions.

Q: WHICH OF THE FOLLOWING INDUSTRIES ARE YOUR CURRENT APPLICATION/ DEVELOPMENT PROJECTS FOR? (PLEASE SELECT ALL THAT APPLY.) (2023 N=431; 2022 N=266) *RETAIL/ E-COMMERCE UPDATED IN 2023; 2022 OPTION ONLY INCLUDED RETAIL AND WAS SELECTED BY 20%
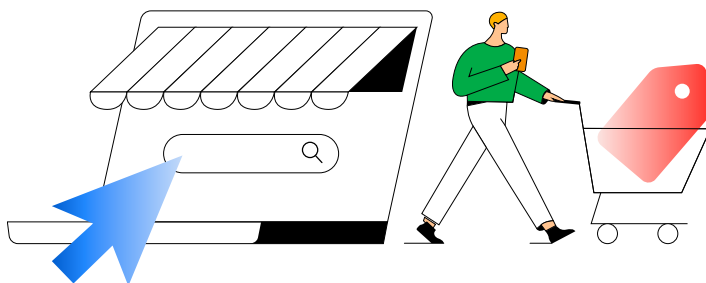
Organizational Pressures
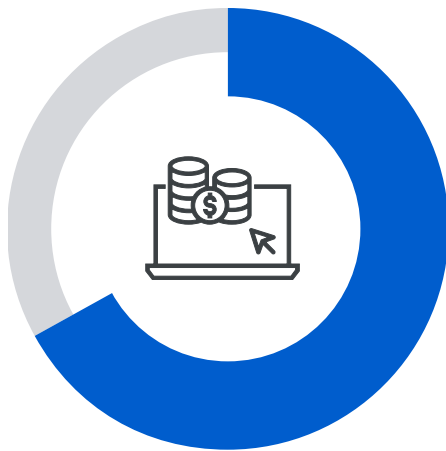
67%
Costs / Budgets

56%
Growth / Scaling

44%
Security
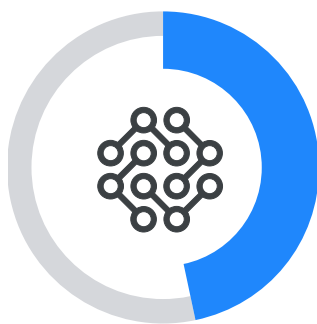
42%
Keeping Pace with
Emerging Technology
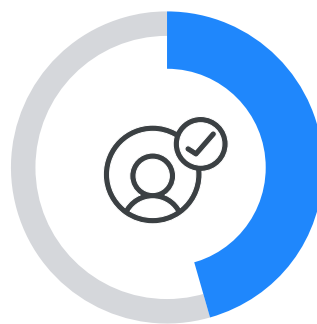
41%
Hiring / Retaining Talent
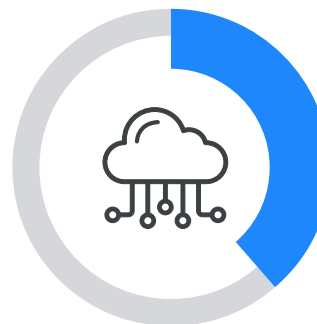
36%
Cloud Migration /
Cloud Challenges

34%
Organizational Challenges

Biggest Pressures

While the cloud offers incredible possibilities, it also presents some challenges that organizations need to navigate. In next one to two years, managing costs and budgets will be the most pressing concern for most companies. This isn't surprising considering the increasing adoption of cloud and the need to balance its benefits with financial constraints. Growth and scaling come in a close second, highlighting the worry of outgrowing current resources or struggling to handle rapid expansion. And finally, security remains a constant concern, reminding us of the importance of data protection in the cloud.

Notably, these top three pressures affect organizations of all sizes equally. This widespread impact underscores the need for cloud solutions that prioritize affordability, scalability, and robust security measures.

Q: WHAT ARE THE BIGGEST PRESSURES YOUR ORGANIZATION WILL BE CHALLENGED WITH WITHIN THE NEXT 12-24 MONTHS? (PLEASE SELECT ALL THAT APPLY.) (N=431)

Technology Usage

Overall Service Usage

Google Cloud offers multiple tools and services, each capable of building powerful solutions. But for developers navigating this vast landscape, the challenge lies in identifying the right options to reach development or business objectives. This section looks at the world of Google Cloud users, analyzing the specific technologies they favor to achieve their goals.

Legend:
- ■ Currently using
- ■ Planning to use in the future
- ■ Have used in the past
- ■ Evaluated, not planning to use
- ■ Heard of, have not used, and not planning to use
- ■ Never heard of it

Category	Currently using	Planning to use in the future
Identity, Security, and Access Management	82%	11%
Compute	81%	10%
Cloud Operations	81%	11%
Storage and Migration	81%	10%
Networking	80%	11%
Virtual Machines	79%	9%
Developer Tools	77%	12%
Cloud Management Tools	76%	16%
Data Analytics	72%	17%
Serverless	71%	16%
Containers and Kubernetes	71%	15%
API Management	66%	19%
AI and Machine Learning	61%	29%
Cloud Migration	53%	18%
Distributed or Edge Computing	41%	26%
AI Accelerators	32%	40%

Q: WHAT IS YOUR ORGANIZATION'S EXPERIENCE WITH THE FOLLOWING TECHNOLOGIES? (N=431)

Technology Usage

Technology Usage Chart

Legend: 2022 (light blue), 2023 (dark blue)

Identity, Security, and Access Management
- 2023: 82%
- 2022: 68%

Compute
- 2023: 81%
- 2022: 68%

Cloud Operations
- 2023: 81%
- 2022: 68%

Storage and Migration
- 2023: 81%
- 2022: 70%

Networking
- 2023: 80%
- 2022: 69%

Virtual Machines
- 2023: 79%
- 2022: 65%

Developer Tools
- 2023: 77%
- 2022: 68%

Cloud Management Tools
- 2023: 76%
- 2022: 61%

Data Analytics
- 2023: 72%
- 2022: 60%

Serverless
- 2023: 71%
- 2022: 56%

Containers and Kubernetes
- 2023: 71%
- 2022: 55%

API Management
- 2023: 66%
- 2022: 64%

AI and Machine Learning
- 2023: 61%
- 2022: 47%

Cloud Migration
- 2023: 53%
- 2022: 53%

Distributed or Edge Computing
- 2023: 41%
- 2022: 38%

AI Accelerators
- 2023: 32%
- 2022: 27%

Current Technology Usage

Cloud technology saw a major surge in 2023, with cloud management tools, serverless options, and containers and Kubernetes, experiencing explosive growth. This clearly demonstrates a growing demand for control, agility, and scalability in cloud deployments.

Topping the list, however, are security, identity and access control, computing power, cloud operations, storage and migration, and networking. This varied selection highlights a focus on security, performance, and operational efficiency as companies navigate the ever-changing cloud landscape.

The most popular technologies directly reflect the challenges companies face. Controlling costs, staying adaptable, and protecting data remain top priorities, driving the adoption of cloud solutions that address crucial needs.

Q: WHAT IS YOUR ORGANIZATION'S EXPERIENCE WITH THE FOLLOWING TECHNOLOGIES? (2023 N=431; 2022 N=266)
DISPLAYING "CURRENTLY USE"

Technology Usage

2022   **2023**

AI Accelerators
- 40%
- 33%

AI and Machine Learning
- 29%
- 27%

Distributed or Edge Computing
- 26%
- 25%

API Management
- 19%
- 16%

Cloud Migration
- 18%
- 18%

Data Analytics
- 17%
- 20%

Cloud Management Tools
- 16%
- 21%

Serverless
- 16%
- 21%

Containers and Kubernetes
- 15%
- 26%

Developer Tools
- 12%
- 12%

Identity, Security, and Access Management
- 11%
- 18%

Cloud Operations
- 11%
- 14%

Networking
- 11%
- 14%

Compute
- 10%
- 15%

Storage and Migration
- 10%
- 16%

Virtual Machines
- 10%
- 17%

Future Planned Usage

The expectations for increased AI usage in 2022 have been realized, with adoption rates solidifying in 2023. This trend is expected to continue, evidenced by strong plans for future utilization of AI accelerators and AI and ML tools within organizations.

While AI accelerators haven't been widely used to date, they lead the pack in terms of planned future technologies. This strategic shift highlights a growing emphasis on AI within organizations, as they seek to unlock its full potential.

The steady increase in AI adoption and the focus on specialized tools like accelerators suggest a future where AI becomes an increasingly integral part of organizational workflows and strategies.

Q: WHAT IS YOUR ORGANIZATION'S EXPERIENCE WITH THE FOLLOWING TECHNOLOGIES? (2023 N=431; 2022 N=266) *DISPLAYING "PLANNING TO USE"*

Technology Usage

Legend: ■ 2022 Current ■ 2022 Future ■ 2023 Current ■ 2023 Future

Software as a Service (SaaS)
- 84% | 10%
- 70% | 16%

Infrastructure as a Service (IaaS)
- 73% | 12%
- 63% | 18%

Platform as a Service (PaaS)
- 72% | 15%
- 65% | 14%

Provider-Managed Cloud Services
- 70% | 15%
- 58% | 19%

Database as a Service (DBaaaS)
- 65% | 17%
- 58% | 20%

User Protection Services
- 46% | 23%
- 45% | 25%
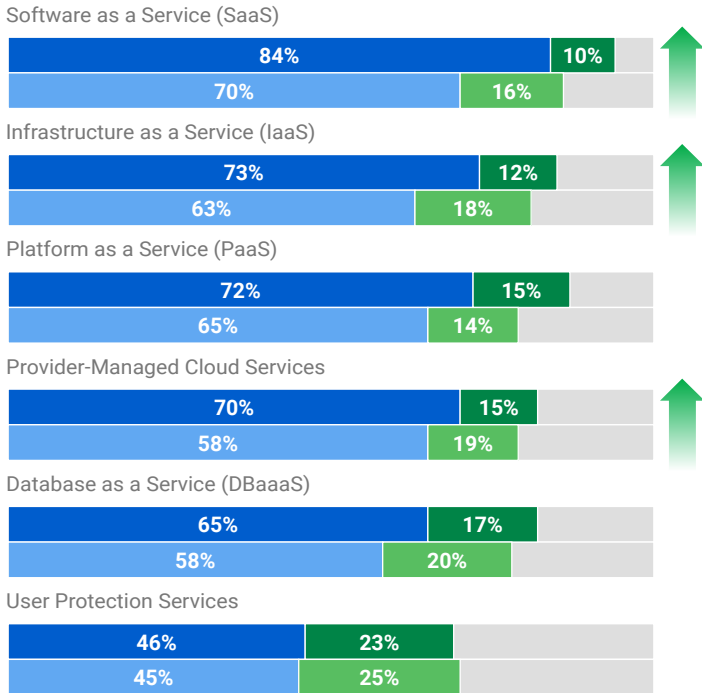
Services

In sync with the surge in technology adoption, other services witnessed a healthy boost in usage across the board. This aligns perfectly with the trends observed in end-user applications and development projects. SaaS, the leading service type used by organizations, saw a remarkable 14% increase from 2022. IaaS and PaaS also remain popular, with over 70% of customers taking advantage of their capabilities.

Looking ahead, the future seems bright for database as a service (DBaaS) and user protection services. These solutions topped the list of technologies respondents plan to utilize in the coming year, indicating a growing focus on data management and security within the cloud.

Languages

Google Cloud developers leave little doubt about their language of choice: Python. With 81% of users opting for its flexibility and simplicity, Python continues to be the undisputed leader for building cloud solutions on this platform.

Respondents who chose "other" noted use of Rust, R, Terraform, HTML, and Kotlin.

Language	Percentage
Python	78%
SQL	56%
Node.js	46%
Java	38%
Go	24%
PHP	21%
.NET	15%
C#	12%
C++	10%
Ruby	6%
Other	10%
Not sure	4%
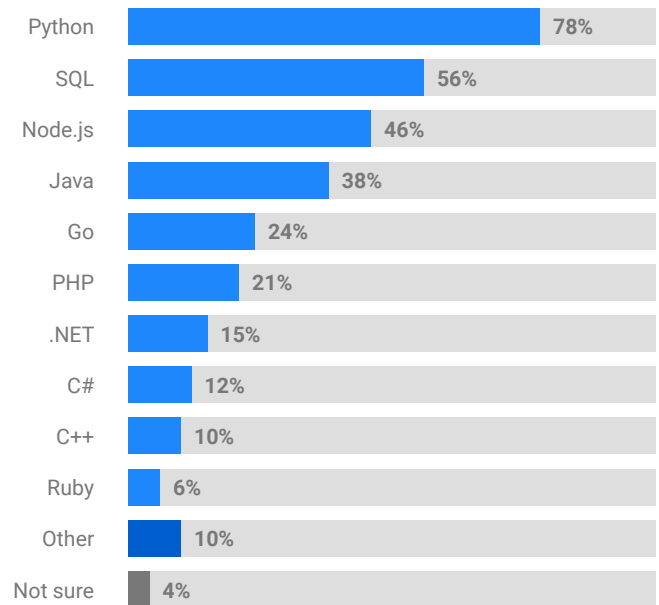
Q: WHAT IS YOUR ORGANIZATION'S EXPERIENCE WITH THE FOLLOWING SERVICES? (2023 N=431; 2022 N=266)
DISPLAYING "CURRENTLY USE" AND "PLANNING TO USE"
Q: WHICH PROGRAMMING LANGUAGES DO YOU USE TO WRITE CODE THAT RUNS IN THE CLOUD? (PLEASE SELECT ALL THAT APPLY). (N=431)

A Look at Generative AI

Familiarity and Usage

19%

I have a **deep understanding** and hands-on experience with generative AI technologies and their applications.

33%

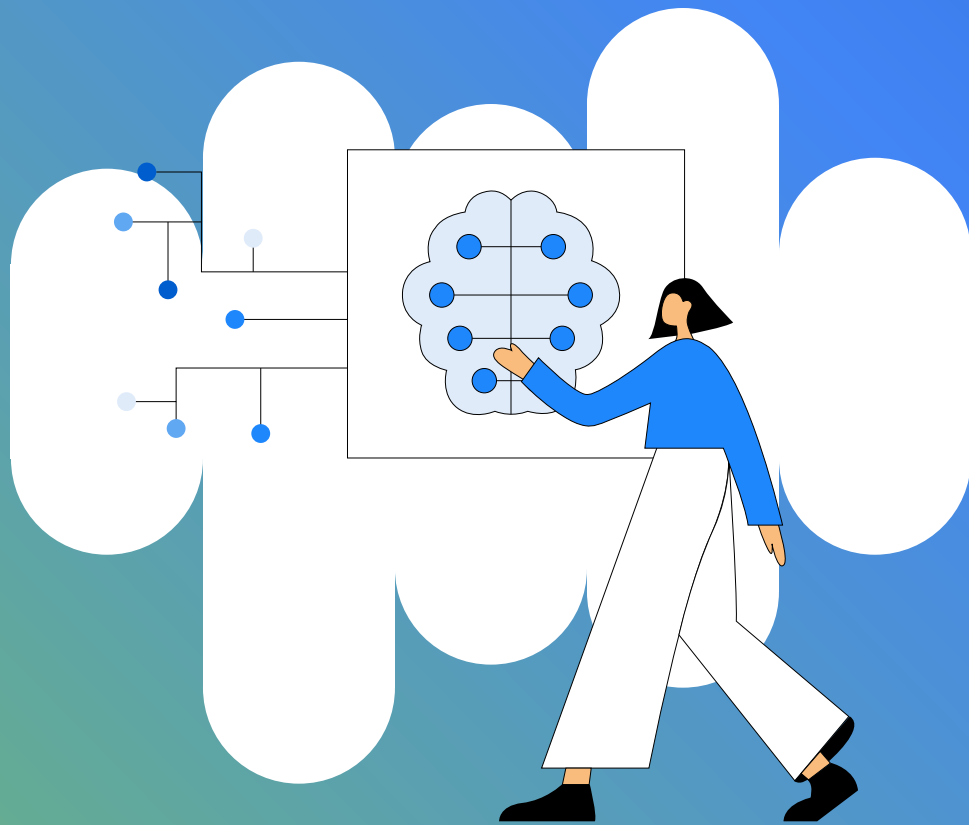I have a **basic understanding** of generative AI but have not yet used it in an enterprise context.

40%

I have a **moderate understanding** of generative AI and have some hands-on experience.

6%

I have heard of generative AI but do not have a clear understanding of its applications.

2%

I am not familiar with generative AI and its potential applications within enterprise environments.
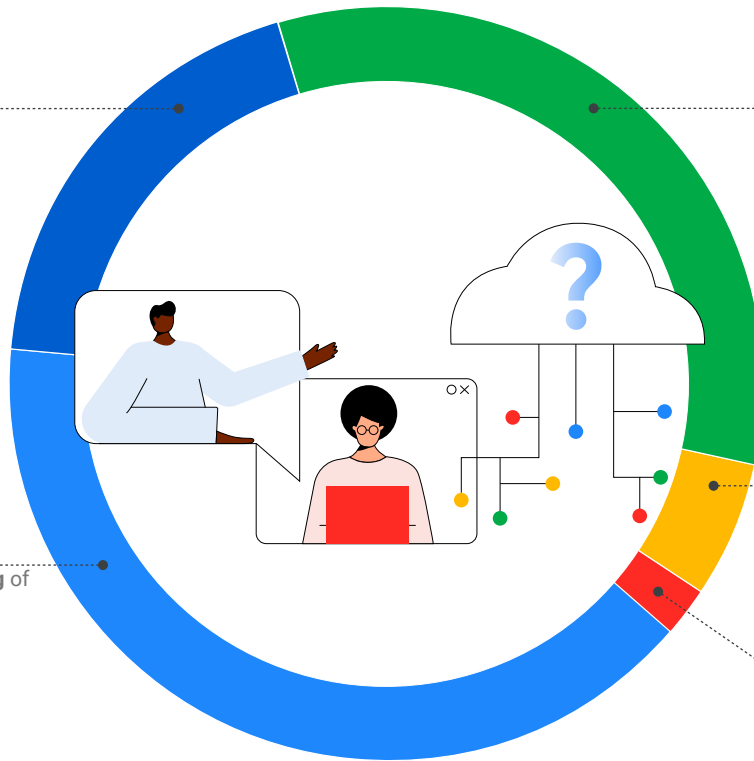
Familiarity with Generative AI

The world of artificial intelligence continues to evolve, and generative AI stands as a powerful new frontier. This technology, capable of creating novel content like text, images, and code, holds immense potential for innovation across various industries. While still in its early stages, generative AI is already transforming the way we interact with technology.

Fortunately, Google Cloud users are already taking steps to familiarize themselves with generative AI. Among respondents, 59% possess either a deep or moderate understanding of this technology, demonstrating a keen interest in both its benefits as a strategic workplace tool and as an area to explore in development.

Who's feeling the most confident? Having a "deep understanding" of and hands-on experience with generative AI tools was most often noted most by CEOs (30%) or 25–34-year-olds (26%).

Q: HOW FAMILIAR ARE YOU WITH THE CONCEPT OF GENERATIVE AI AND ITS APPLICATIONS WITHIN ENTERPRISE ENVIRONMENTS? (N=431)

Familiarity and Usage

Enterprise Decision Making

The landscape of business intelligence is shifting, with generative AI emerging as a powerful tool for informed decision-making. A significant 25% of respondents already use its capabilities within their organizations, integrating AI-driven insights into their strategic choices. And for those yet to embark on this journey, the future seems clear: nearly half (49%) plan to adopt generative AI within the next year, highlighting its rapid and widespread adoption.

This blooming interest transcends job titles and hierarchies. From executives mapping long-term strategies to analysts navigating daily operations, the potential of generative AI to illuminate paths and enhance decision-making resonates across the board. This universal appeal suggests a future where data-driven insights, amplified by the creative power of AI, become the guiding force for organizational success.

Why the cold feet for 6% of respondents? Let's look at the anticipated challenges of gen AI.
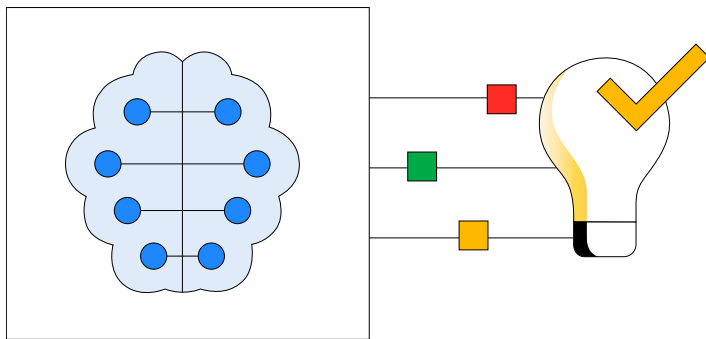
Q: IN WHAT TIMEFRAME DO YOU ANTICIPATE GENERATIVE AI BECOMING PART OF THE ENTERPRISE DECISION MAKING PROCESS AT YOUR ORGANIZATION? (N=431)

25% My organization is **already using** gen AI to make enterprise decisions.

My organization has **no plans** to use gen AI to make enterprise decisions. **6%**

Now
25%

Within the next 3 months
19%

Within the next 6 months
15%

Within the next 12 months
15%

Within the next 1-2 years
10%

Beyond 2 years
3%
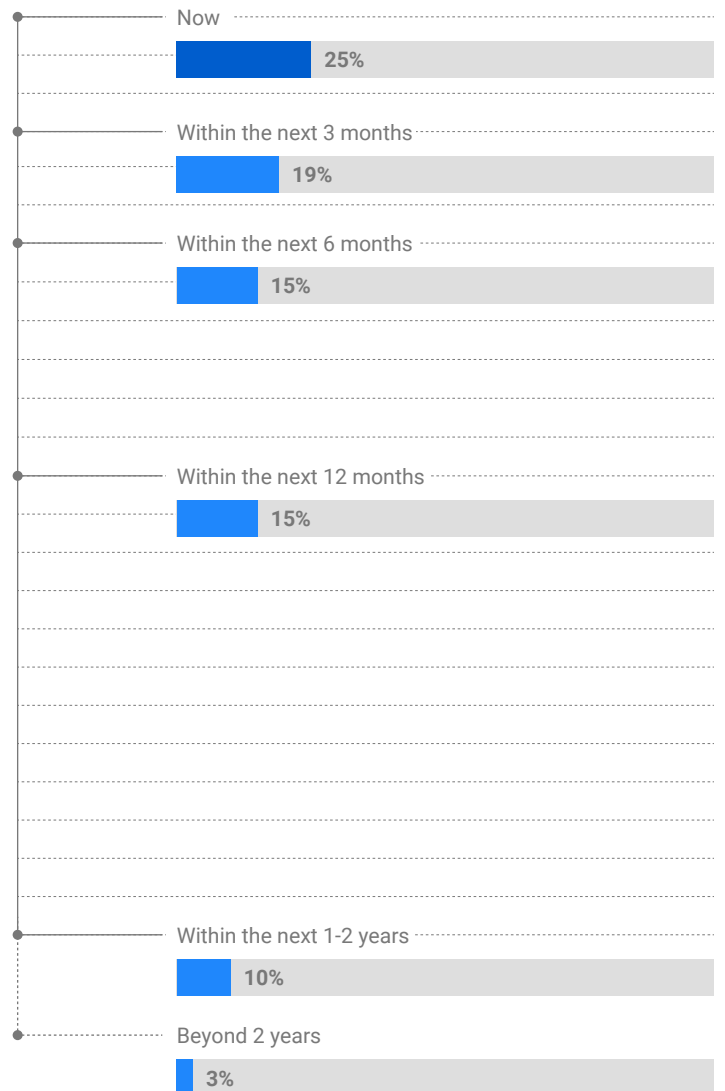
Familiarity and Usage

Development Assistance

The integration of generative AI into cloud-based applications and projects is gaining momentum, with a majority of respondents (or their organizations) already utilizing its capabilities. Notably, the top use cases remain consistent across different organizational sizes, suggesting that regardless of resources or staff availability, AI offers substantial benefits for cloud-based development.

For organizations that are developing new generative AI products or services (30%), it was most noted by IT decision makers (49%) or by respondents who belong to organizations with 50 to 99 employees (56%).

Assisting in writing code — **52%**	Creating synthetic test data or scenarios — **25%**
Learning new skills — **45%**	Enhancing cybersecurity or threat detection — **23%**
Automating document generation or report writing — **43%**	Designing user interfaces or layouts — **20%**
Developing new generative AI products or services — **38%**	Optimizing resource allocation or load balancing — **16%**
Enhancing data visualization or storytelling — **34%**	I use existing generative AI tools to assist in other parts of my job. — **5%**
Automating quality assurance or testing processes — **27%**	I have not used or developed generative AI in my cloud-based apps or development processes. — **9%**

Q: WHICH OF THE FOLLOWING DEFINES HOW YOU OR YOUR ORGANIZATION ENGAGES WITH INTEGRATED GENERATIVE AI TECHNOLOGIES IN CLOUD-BASED APPLICATIONS OR DEVELOPMENT PROJECTS? (PLEASE SELECT ALL THAT APPLY). (N=431) *6% SELECTED 'DON'T KNOW/ NOT SURE'*

Familiarity and Usage

49%
GPT-4

1%
AirOps

1%
Replit Ghostwriter

3%
TabNine

7%
Claude

13%
Auto-GPT

73%
ChatGPT

48%
GitHub CoPilot

15%
OpenAI Codex

5%
AlphaCode

2%
CodeWP

13%
Don't Know

3%
Other

3%
Cohere Generate

47%
Bard
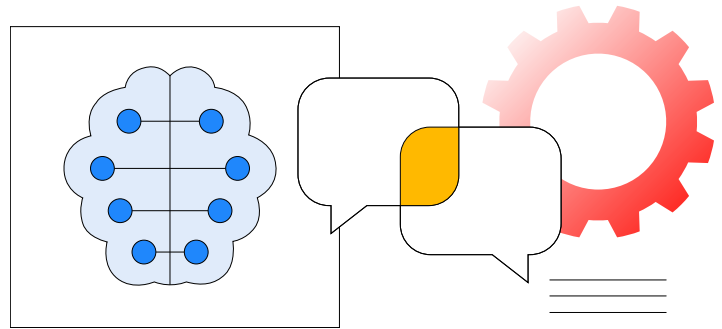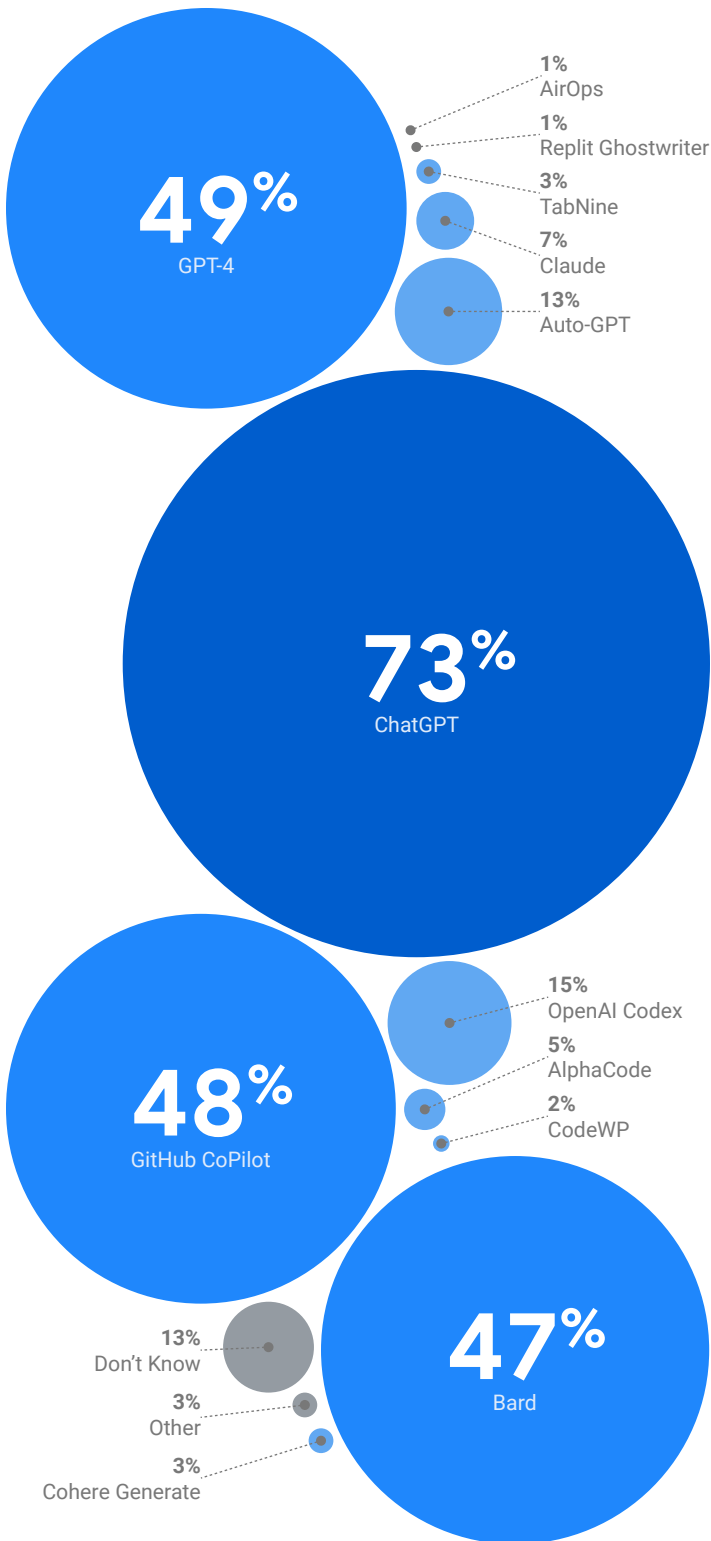
Tools Used for Assistance

When it comes to generative AI tools assisting those working in cloud development, ChatGPT stands out as the clear frontrunner. This dominance aligns with the widespread adoption of AI generative technologies for code-writing assistance across various industries.

While ChatGPT might be the reigning champion, it's important to note that the landscape of generative AI tools is constantly evolving. New players and alternative approaches are emerging, offering different functionalities and catering to specific use cases within cloud development.

Q: [IF USING OR DEVELOPING GENERATIVE AI TECHNOLOGIES IN CLOUD-BASED APPLICATIONS OR DEVELOPMENT PROCESSES.] WHICH OF THE FOLLOWING GENERATIVE AI TOOLS HAVE YOU OR THE DEVELOPMENT TEAM AT YOUR ORGANIZATION USED TO ASSIST IN YOUR CLOUD DEVELOPMENT WORK? (PLEASE SELECT ALL THAT APPLY). (N=394)

Generative AI Development

62%
Google Cloud
(Vertex AI, AI Platform, Colab, etc.)

4%
Salesforce
(Einstein AI)

10%
NVIDIA AI

38%
Microsoft Azure
(OpenAI, GPT, etc.)

61%
OpenAI

3%
Other

23%
Pytorch

35%
TensorFlow

9%
IBM Cloud

23%
Hugging Face

30%
Amazon Web Services
(SageMaker, Bedrock, Titan, etc.)
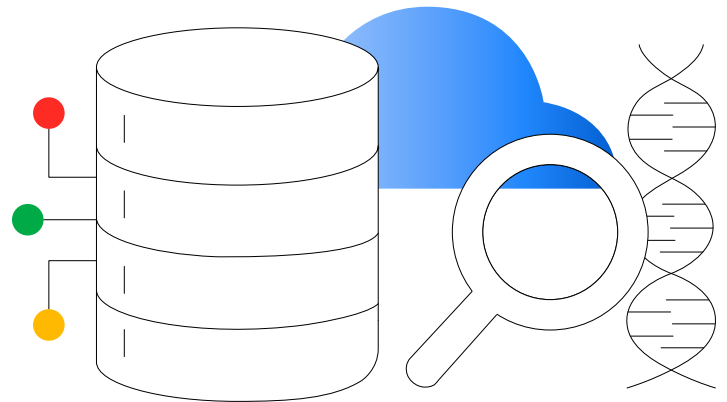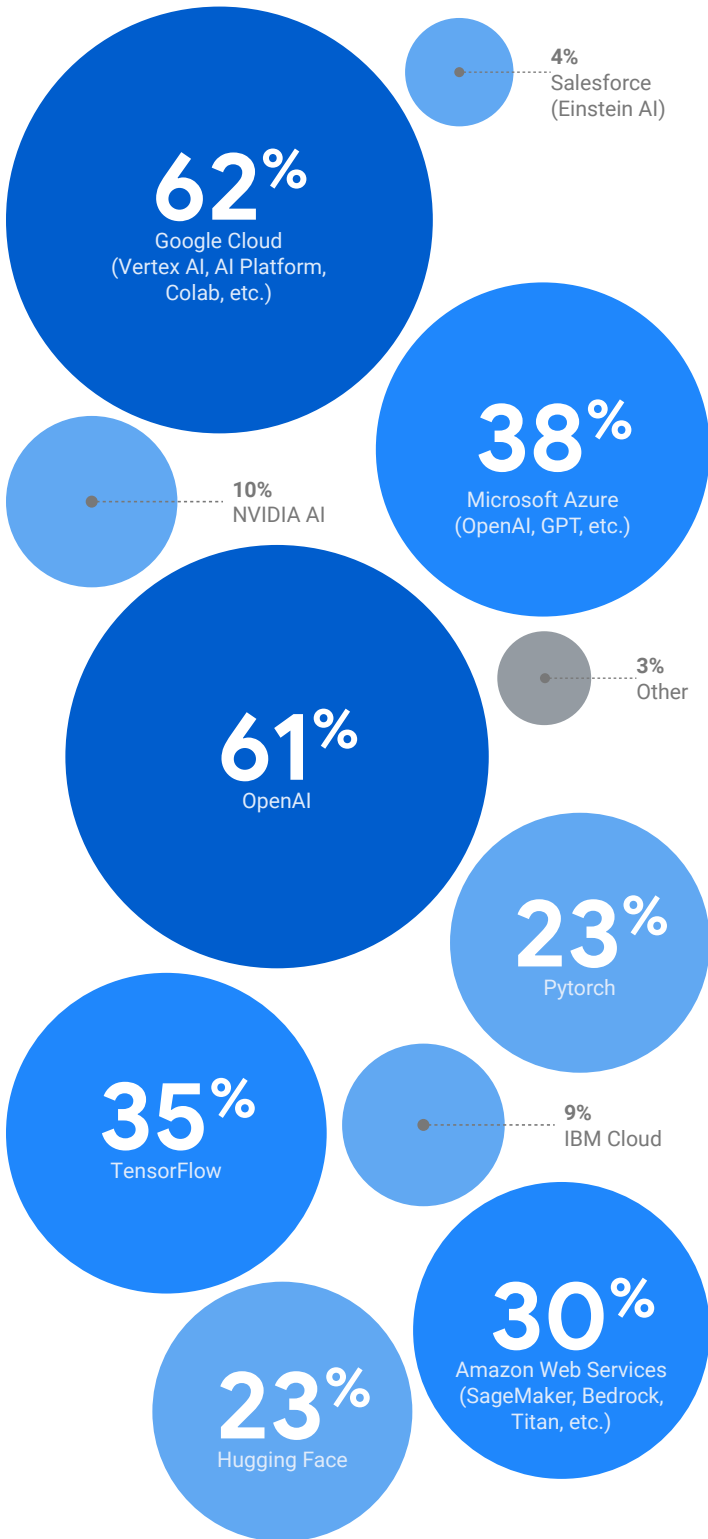
Platforms for Development

Now, let's shift gears and explore the platforms that rocket these AI models into the cloud: generative AI deployment platforms. These platforms offer crucial infrastructure and streamlined integration, enabling the successful launch and management of the AI models organizations are creating.

As expected given the high concentration of Google Cloud users (80% of respondents), Google Cloud emerges as the dominant platform for deploying AI models. Closely trailing behind is OpenAI, capturing a nearly equal share of the market. This competitive landscape highlights the growing importance of cloud-based solutions for facilitating AI model deployment and scalability.

Q: [IF 'DEVELOPING NEW GENERATIVE AI PRODUCTS OR SERVICES' SELECTED]
WHICH CLOUD PLATFORMS OR SERVICES HAVE YOU USED FOR DEPLOYING GENERATIVE
AI MODELS? (PLEASE SELECT ALL THAT APPLY). (N=162)
*7% SELECTED 'DON'T KNOW/ NOT SURE' ; OTHER INCLUDED A RANGE: OWN LLM
DEVELOPMENT, ORACLE, LLAMA.CPP*

Generative AI Development

Development Use Cases

Among the many use cases for new generative AI tools, chatbots and virtual assistants stand dominant. This prominence links to the top pressure point of managing costs and budgets, as chatbots can indirectly cut costs and bolster support.

However, considering the other top pressures of security, growth, and scaling, using generative AI for fraud and threat detection deserves further exploration. Plus, data augmentation and synthesis should be examined as a means to streamline testing, personalize experiences, and unlock new data-driven insights, ultimately fostering growth and scalability.

Use Case	Percentage
Chatbots or Virtual Assistants	66%
Natural Language Processing / Generation	58%
Industry-Specific Tools or Use Cases	43%
Personalized Content Generation	42%
Data Augmentation and Synthesis	35%
Image or Video Synthesis	34%
Recommender Systems	33%
Fraud and Threat Detection	30%
Marketing and Advertising Optimization	28%
Computer Vision Applications	24%
Robotics or Automation Systems	18%
Music or Audio Generation	11%

Q: [IF 'DEVELOPING NEW GENERATIVE AI PRODUCTS OR SERVICES' SELECTED] WHAT SPECIFIC USE CASES HAVE YOU OR YOUR ORGANIZATION EXPLORED OR IMPLEMENTED IN DEVELOPING GENERATIVE AI PRODUCTS OR SERVICES? (PLEASE SELECT ALL THAT APPLY). (N=162)

Challenges

Potential Challenges

Generative AI's future isn't without hurdles. Nearly all respondents (99%) anticipate a diverse range of challenges, with regulatory compliance and data privacy and security emerging as top concerns.

Notably, these concerns resonate equally among those currently developing any type of new AI products and services—not just generative AI. These shared anxieties underscore the crucial need for robust solutions before generative AI can truly reach its full potential.

Regulation and compliance
46%

Return on investment (ROI)
32%

Ensuring data privacy and security
46%

Documentation and resources available
26%

Protection of intellectual property
43%

Customer service and satisfaction
24%

Ethical considerations and biases
42%

Skills and barrier to entry
24%

Data quality and availability for training
40%

Scalability at my organization
21%

Model training and optimization
39%

Job security and potential job replacement
18%

Q: WHICH OF THE FOLLOWING AREAS DO YOU SEE AS POTENTIAL CHALLENGES OF GENERATIVE AI DEVELOPMENT? (PLEASE SELECT ALL THAT APPLY). (N=431)
6% SELECTED 'DON'T KNOW/ NOT SURE'; 1% SELECTED 'OTHER' AND INCLUDED A RANGE: HEALTH DATA INTERACTION, TRANSPARENT TRANSITIONS

Competitive Landscape

Cloud Service Provider Usage

Overall Provider Usage

The modern development team faces a seemingly difficult choice between cloud provider options, each promising a unique blend of services, scalability, and security. But event with so many players in the field, a few platforms consistently capture the attention of developers: Google Cloud, AWS, and Microsoft Azure.
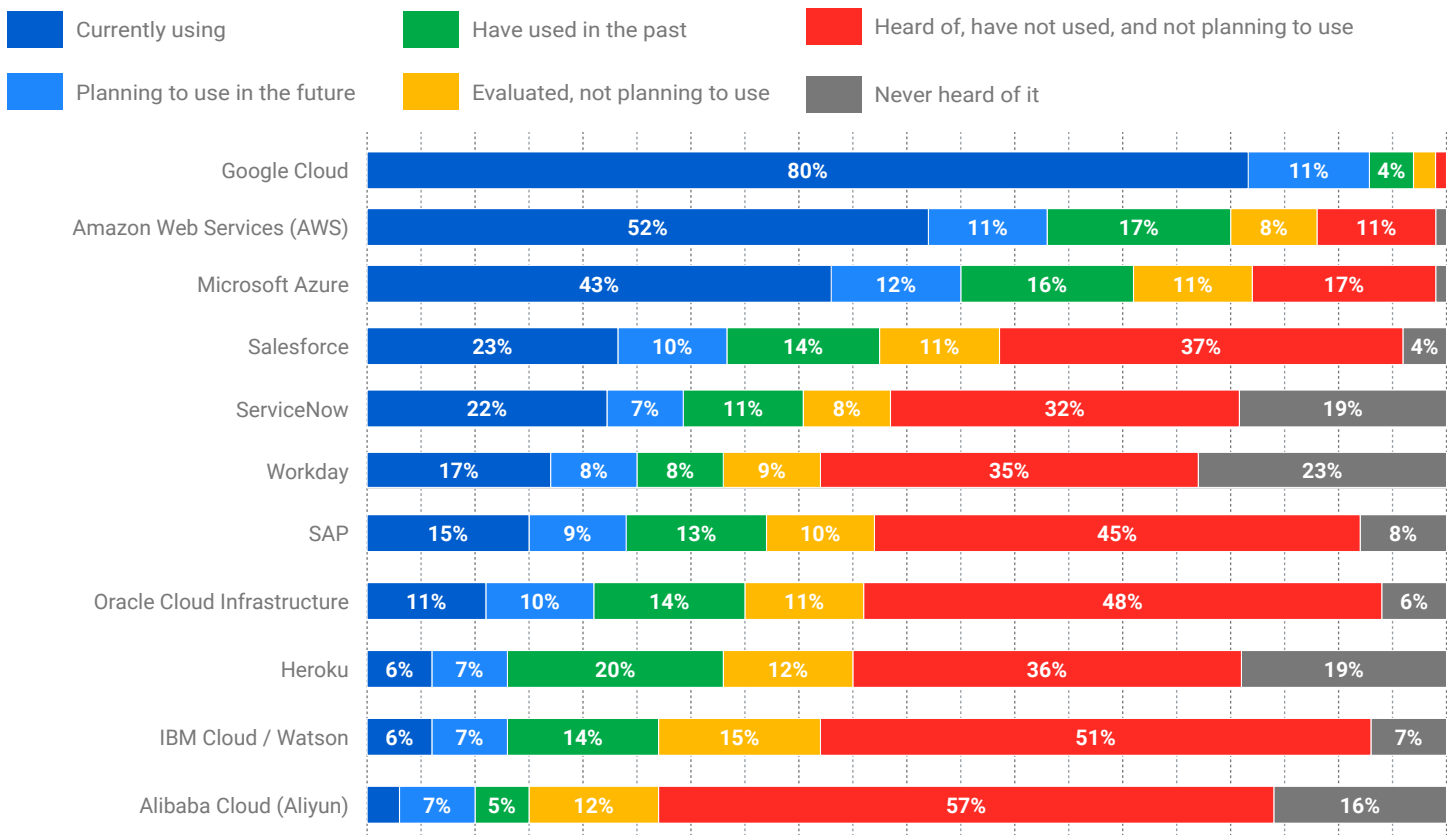
In this section, we'll dive into the factors influencing these choices, the types of investment changes companies are making in these providers, and how their usage is expected to evolve in the future.

Legend:
- Currently using (dark blue)
- Planning to use in the future (light blue)
- Have used in the past (green)
- Evaluated, not planning to use (yellow/orange)
- Heard of, have not used, and not planning to use (red)
- Never heard of it (gray)

Provider	Currently using	Planning to use in the future	Have used in the past	Evaluated, not planning to use	Heard of, have not used, and not planning to use	Never heard of it
Google Cloud	80%	11%	4%			
Amazon Web Services (AWS)	52%	11%	17%	8%	11%	
Microsoft Azure	43%	12%	16%	11%	17%	
Salesforce	23%	10%	14%	11%	37%	4%
ServiceNow	22%	7%	11%	8%	32%	19%
Workday	17%	8%	8%	9%	35%	23%
SAP	15%	9%	13%	10%	45%	8%
Oracle Cloud Infrastructure	11%	10%	14%	11%	48%	6%
Heroku	6%	7%	20%	12%	36%	19%
IBM Cloud / Watson	6%	7%	14%	15%	51%	7%
Alibaba Cloud (Aliyun)		7%	5%	12%	57%	16%

Q: WHAT IS YOUR EXPERIENCE WITH EACH OF THE FOLLOWING CLOUD SERVICE PROVIDERS? (2023 N=431; 2022 N=266)

Cloud Service Provider Usage
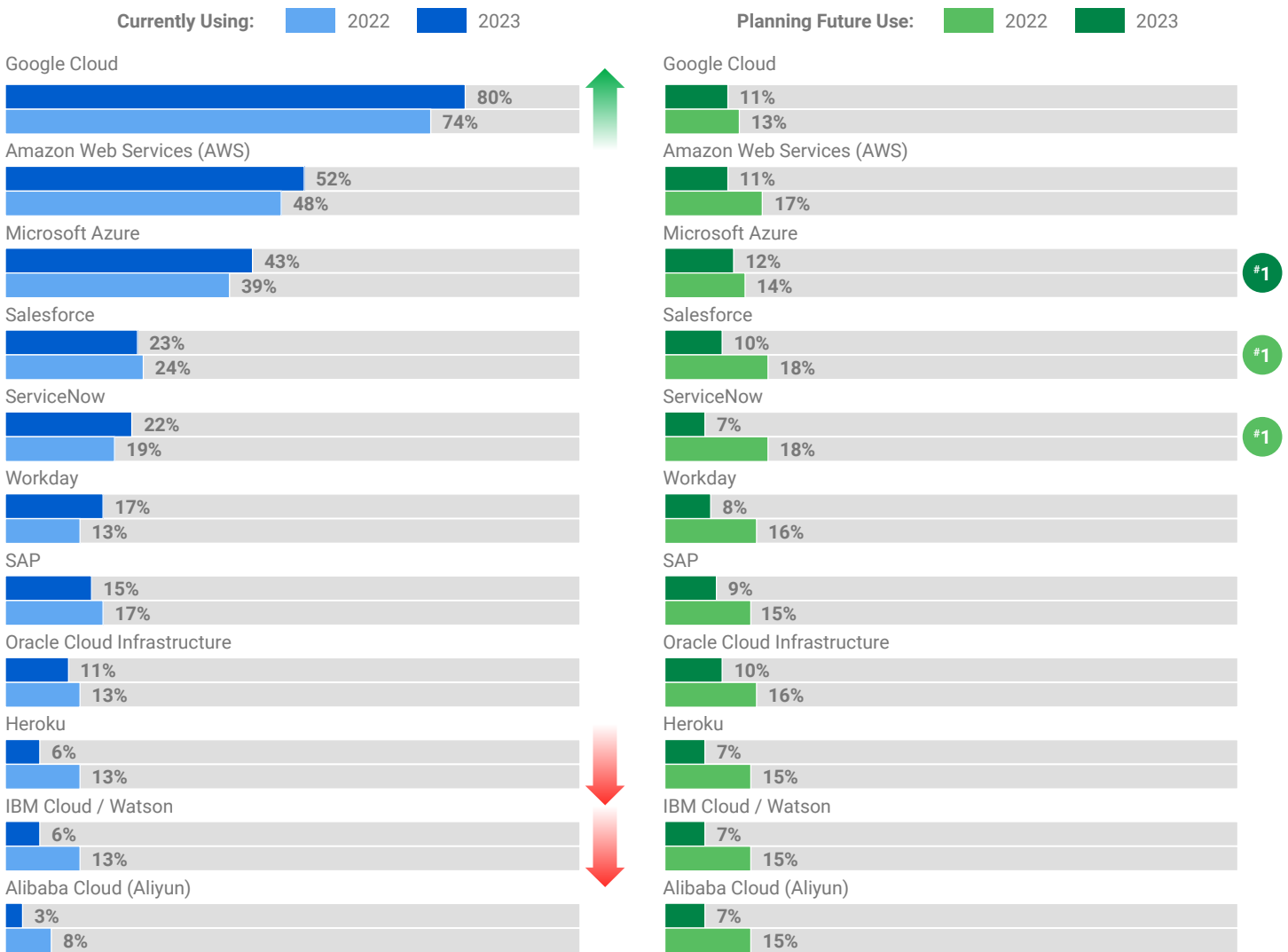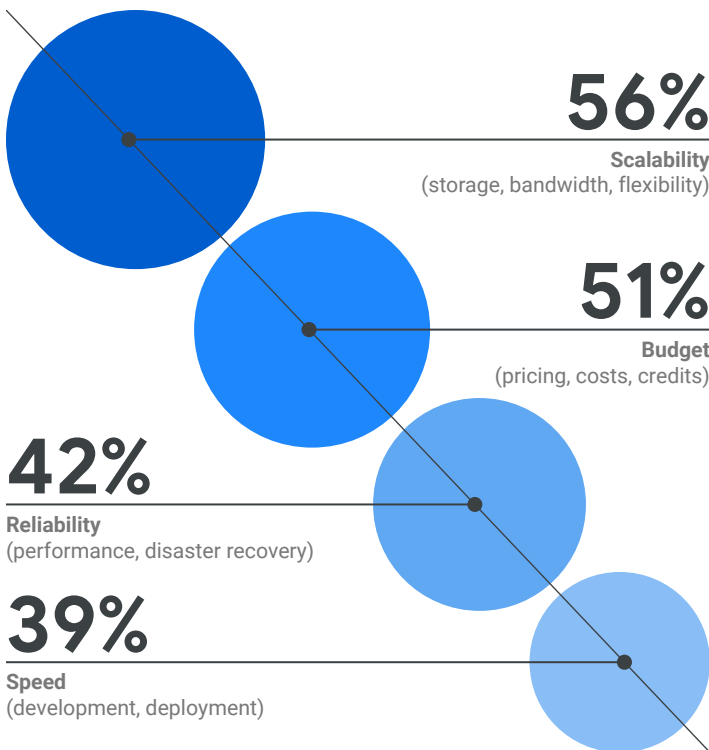
Year-Over-Year Usage Plans

While Salesforce and ServiceNow once seemed poised for significant uptake in 2023, their anticipated growth failed to materialize, and Salesforce even saw a dip in popularity. This year, Microsoft Azure takes the crown for most-favored future provider. Meanwhile, Google Cloud's impressive usage increase from 2022 signifies a steadily expanding footprint and strengthens its competitive position. This trend is expected to continue, with Google Cloud, AWS, and Microsoft Azure remaining the dominant players in the foreseeable future.

Currently Using: 2022 2023 | **Planning Future Use:** 2022 2023

Provider	Currently Using 2023	Currently Using 2022	Planning Future Use 2023	Planning Future Use 2022
Google Cloud	80%	74%	11%	13%
Amazon Web Services (AWS)	52%	48%	11%	17%
Microsoft Azure	43%	39%	12%	14% (#1)
Salesforce	23%	24%	10%	18% (#1)
ServiceNow	22%	19%	7%	18% (#1)
Workday	17%	13%	8%	16%
SAP	15%	17%	9%	15%
Oracle Cloud Infrastructure	11%	13%	10%	16%
Heroku	6%	13%	7%	15%
IBM Cloud / Watson	6%	13%	7%	15%
Alibaba Cloud (Aliyun)	3%	8%	7%	15%

Q: WHAT IS YOUR EXPERIENCE WITH EACH OF THE FOLLOWING CLOUD SERVICE PROVIDERS? (2023 N=431; 2022 N=266)
SHOWING RESULTS FOR "CURRENTLY USING" AND "PLANNING TO USE IN THE FUTURE"

Provider Evaluation

56%
Scalability
(storage, bandwidth, flexibility)

51%
Budget
(pricing, costs, credits)

42%
Reliability
(performance, disaster recovery)

39%
Speed
(development, deployment)

Adoption Reasons

Cost control and growth drive cloud adoption. The leading reasons for embracing cloud providers align perfectly with top organizational pressures: managing budgets and ensuring scalability. To thrive, successful cloud providers must effectively address these critical challenges.

Less important when weighing adoption options were suitability of features or service levels, license and certfication standards, partnership and integration services, and support, documentation, and training.

Q: WHAT ARE THE TOP 4 REASONS FOR ADOPTING THE CLOUD SERVICE PROVIDERS YOU USE? PLEASE SELECT UP TO 4 REASONS. (N=431)

Open Source

Customers' perception of a cloud provider's open-source commitment isn't just branding—it's a trust indicator. Google Cloud and AWS take the lead in this perception, but 30% of respondents remain unsure.

This uncertainty presents an opportunity for cloud providers. By actively showcasing their open-source initiatives, they can build trust, attract new customers, and drive innovation within the cloud ecosystem. A commitment to open source isn't just good for branding, it's a strategic advantage in the ever-evolving cloud landscape.

Q: WHICH OF THE FOLLOWING CLOUD SERVICE PROVIDERS ARE COMMITTED TO OPEN SOURCE? (PLEASE SELECT ALL THAT APPLY.) (2023 N=431; 2022 N=266)
30% SELECTED 'DON'T KNOW / NOT SURE' ; 9% SELECTED ORACLE, 7% HEROKU, ALIBABA CLOUD (ALIYUN) 7%, SALESFORCE 5%, SERVICENOW 4%, SAP 4%, WORKDAY 2%

63%
(vs. 67% in 2022)

36%
(vs. 45% in 2022)

32%
(vs. 35% in 2022)

10%
(vs. 21% in 2022)
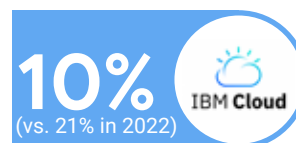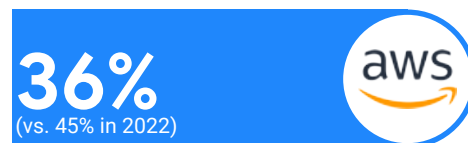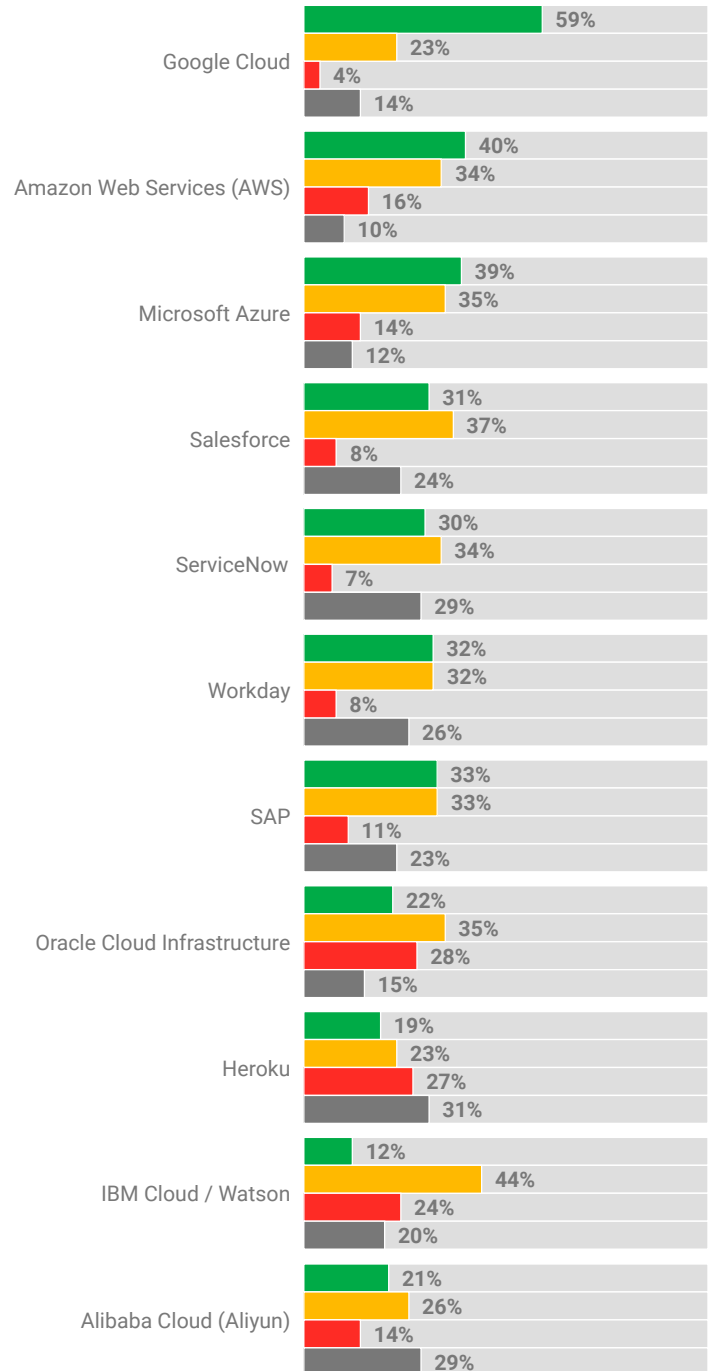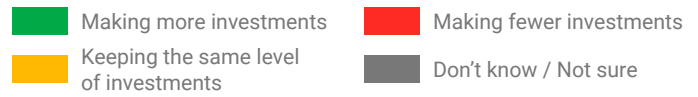
Changing Investments
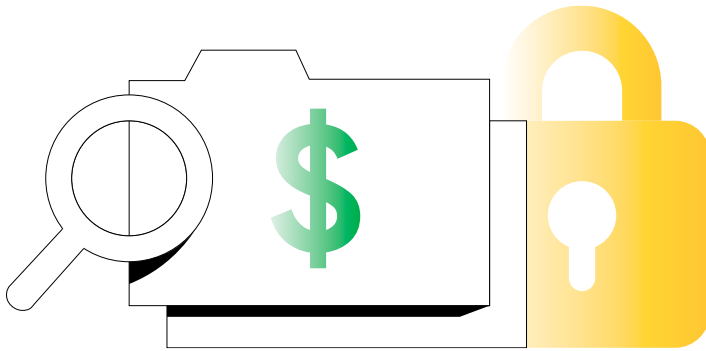
Changes in Investment Levels

Cloud spending follows usage trends, with Google Cloud, Amazon Web Services, and Microsoft Azure attracting the most investment, with Google Cloud leading the charge—a staggering 59% of its users increased their investment levels.

Other providers see a relatively stable investment, suggesting a cautious approach. They need clear differentiation and innovation to attract significant new funds. Subtle shifts within this group may occur, with potential growth in niche areas or specific industries.

What are the leading cloud service providers doing right? See what respondents have to say about Google Cloud, plus some more insight to Amazon Web Services and Microsoft Azure.

Legend:
- Making more investments
- Keeping the same level of investments
- Making fewer investments
- Don't know / Not sure

Google Cloud
- Making more investments: 59%
- Keeping the same level of investments: 23%
- Making fewer investments: 4%
- Don't know / Not sure: 14%

Amazon Web Services (AWS)
- Making more investments: 40%
- Keeping the same level of investments: 34%
- Making fewer investments: 16%
- Don't know / Not sure: 10%

Microsoft Azure
- Making more investments: 39%
- Keeping the same level of investments: 35%
- Making fewer investments: 14%
- Don't know / Not sure: 12%

Salesforce
- Making more investments: 31%
- Keeping the same level of investments: 37%
- Making fewer investments: 8%
- Don't know / Not sure: 24%

ServiceNow
- Making more investments: 30%
- Keeping the same level of investments: 34%
- Making fewer investments: 7%
- Don't know / Not sure: 29%

Workday
- Making more investments: 32%
- Keeping the same level of investments: 32%
- Making fewer investments: 8%
- Don't know / Not sure: 26%

SAP
- Making more investments: 33%
- Keeping the same level of investments: 33%
- Making fewer investments: 11%
- Don't know / Not sure: 23%

Oracle Cloud Infrastructure
- Making more investments: 22%
- Keeping the same level of investments: 35%
- Making fewer investments: 28%
- Don't know / Not sure: 15%

Heroku
- Making more investments: 19%
- Keeping the same level of investments: 23%
- Making fewer investments: 27%
- Don't know / Not sure: 31%

IBM Cloud / Watson
- Making more investments: 12%
- Keeping the same level of investments: 44%
- Making fewer investments: 24%
- Don't know / Not sure: 20%

Alibaba Cloud (Aliyun)
- Making more investments: 21%
- Keeping the same level of investments: 26%
- Making fewer investments: 14%
- Don't know / Not sure: 29%

Q: HOW HAS YOUR LEVEL OF INVESTMENT IN <PROVIDER RESPONDENT CURRENTLY USING INSERTED> CHANGED OVER THE LAST 12 MONTHS?

Changing Investments

Zooming In: Google Cloud

The surge in Google Cloud investment isn't just a financial phenomenon; it's a testament to the platform's growing appeal and expanding capabilities. Among both customers and partners, the primary driver for increased spending is clear: migration and scaling up of existing workloads and projects. This isn't simply about cost-cutting (though that remains a factor), but rather a recognition of Google Cloud's ability to handle growing demands, unlock new possibilities, and deliver tangible value.

"We're **investing more** in Google Cloud because it offers scalability, powerful data tools, security, global reach, and a commitment to sustainability, **all in one package that fits our needs perfectly.**"

"We have **no requirement for further investment** at this stage. We're happy with our current estate on Google Cloud Platform."

"**We're consolidating** to Amazon Web Services, and hence migrating away from Google Cloud."

Reasons for making **more** investments in Google Cloud	Reasons for making **the same level** of investments in Google Cloud	Reasons for making **fewer** investments in Google Cloud
Migrating or scaling up existing workloads into Google Cloud	Keeping usage the same; **only using what we need**	Keeping costs in mind, scaling back for **cost savings**
Growth (of market, company, or new solutions, tools, or apps to support)	Keeping costs in mind, not increasing due to **budget constraints**	Moving to a **different cloud provider**
Google Cloud is **superior to competitors** (performance, UI, support, price, security)	New to Google Cloud and **just started using the platform**	Scaling back because we **overestimated our initial investment**

Q: HOW HAS YOUR LEVEL OF INVESTMENT IN GOOGLE CLOUD CHANGED OVER THE LAST 12 MONTHS?
Q: WHY IS YOUR ORGANIZATION [MAKING MORE INVESTMENTS/MAKING THE SAME/MAKING FEWER INVESTMENTS] INTO GOOGLE CLOUD? PLEASE BE SPECIFIC.

Changing Investments

Zooming In: AWS

Amazon Web Services maintains its own impressive trajectory. Customers are drawn to its perceived superior performance, intuitive UI, comprehensive support, competitive pricing, and robust security, making it a reliable and secure home for their workloads. This trust translates to partner growth, as they cater to the surging demand for AWS solutions.

However, the competitive landscape keeps things dynamic. Both customers and partners report some instances of decreased investment, often driven by a transition to other vendors, particularly Google Cloud.

Q: HOW HAS YOUR LEVEL OF INVESTMENT IN AMAZON WEB SERVICES CHANGED OVER THE LAST 12 MONTHS? | Q: WHY IS YOUR ORGANIZATION [MAKING MORE INVESTMENTS/MAKING THE SAME/MAKING FEWER INVESTMENTS] INTO AMAZON WEB SERVICES?

AWS is **superior to competitors**

Growth of company or apps to support

Migrating or scaling to AWS

Only using **what we need**

Using a competitor cloud provider

Budget constraints

Moving to a competitor cloud provider

Cost savings

Lack of support on AWS

Zooming In: Microsoft Azure

Azure's investment landscape sees customer growth driving demand for its robust infrastructure and new tools, while partners capitalize on the market momentum.

However, shifts to competitors, sunsetting workloads, and strategic misalignment occasionally lead to decreased investment, underscoring the dynamic cloud landscape and the interplay of market forces, technological advancements, and individual business priorities.

Q: HOW HAS YOUR LEVEL OF INVESTMENT IN MICROSOFT AZURE CHANGED OVER THE LAST 12 MONTHS? | Q: WHY IS YOUR ORGANIZATION [MAKING MORE INVESTMENTS/ MAKING THE SAME/MAKING FEWER INVESTMENTS] INTO MICROSOFT AZURE?

Growth of company or apps to support

Migrating or scaling to Azure

Azure is **superior to competitors**

Only using **what we need**

Only using **for certain services**

Moving to a competitor cloud provider

Cost savings

Lacking features we need
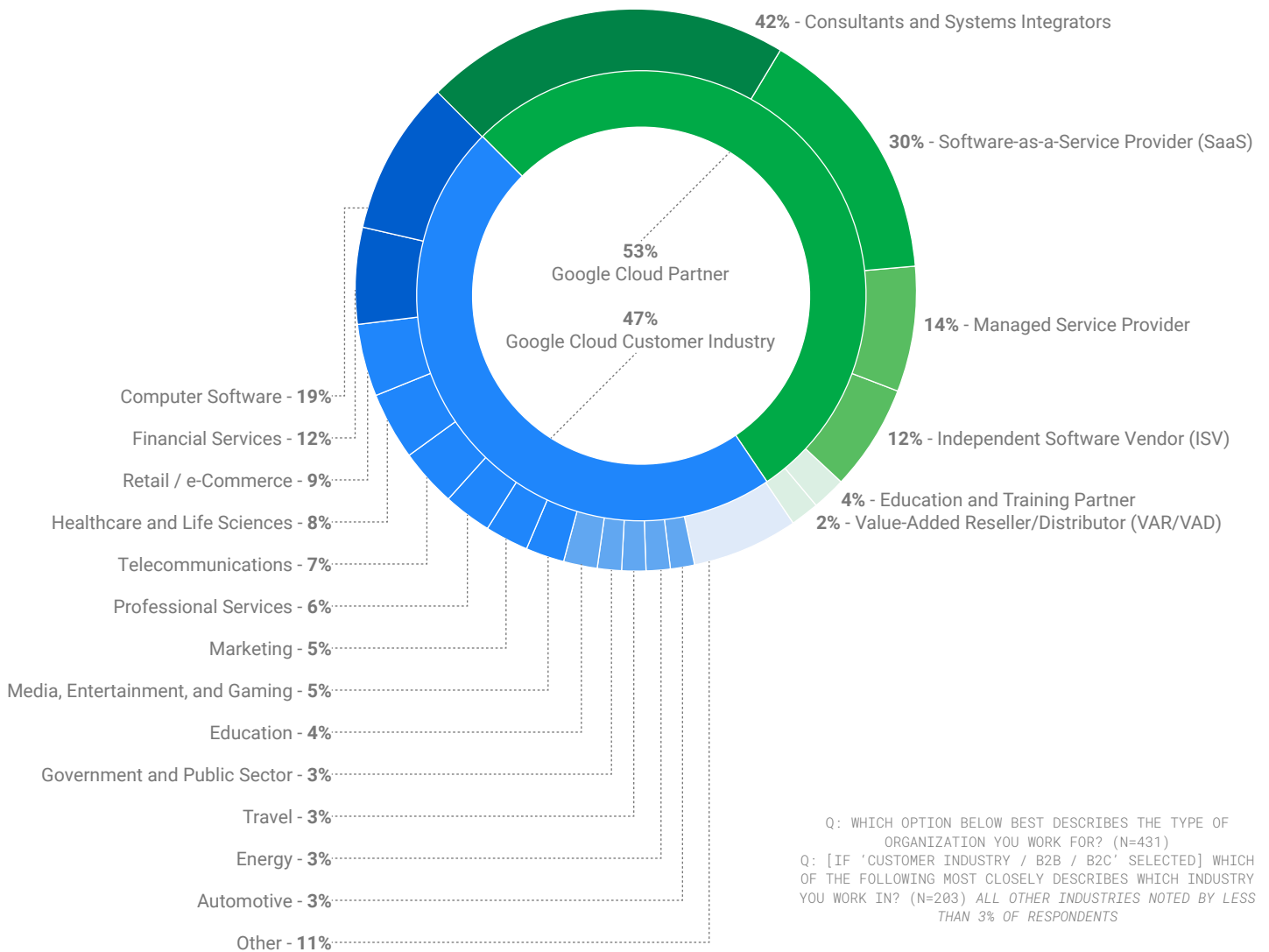
Who Took the Survey?
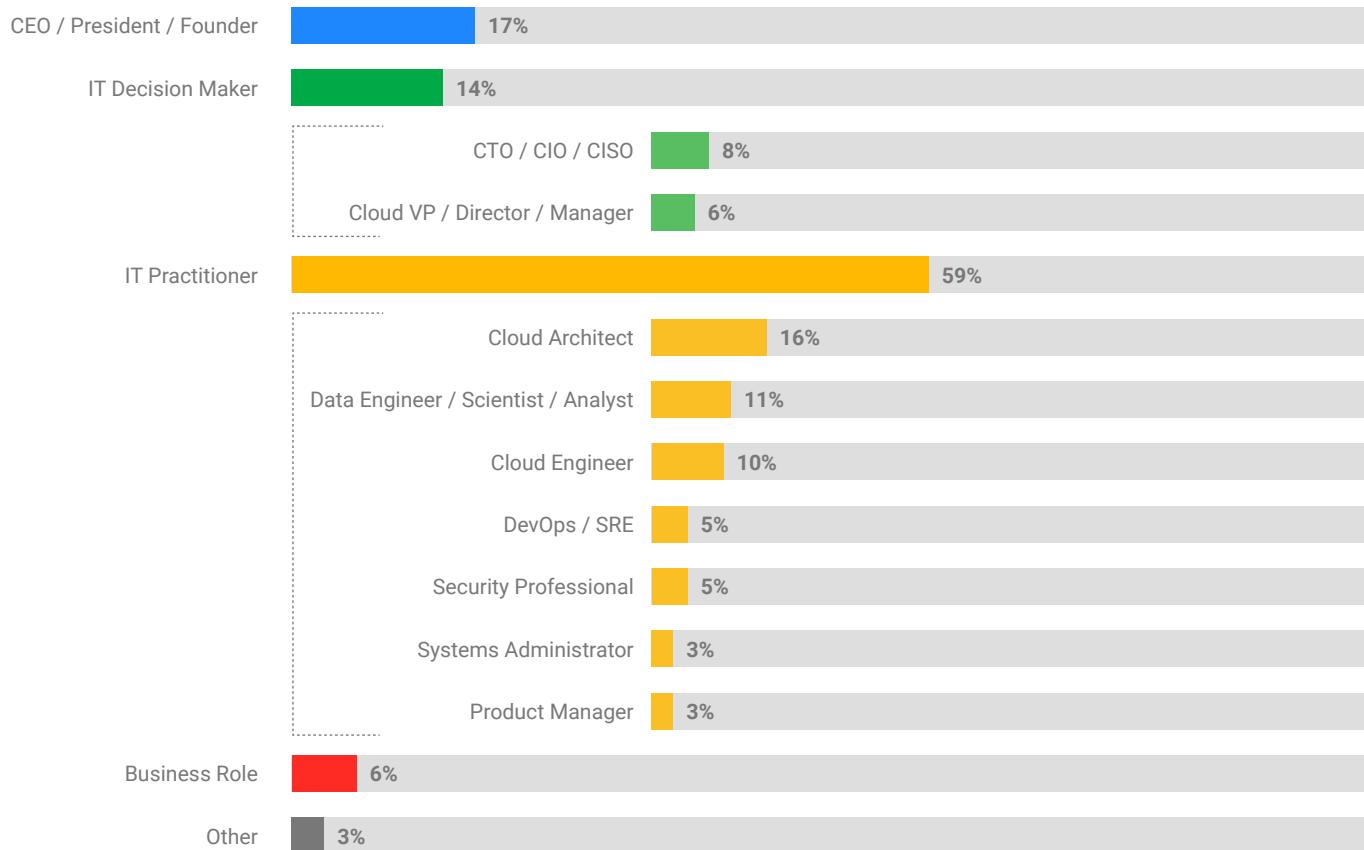
Firmographics

Collecting Firmographic Information

Understanding the who behind the data is just as crucial as the what. Firmographics allow us to segment answers by repondent groups like organization type, role, or company size, all of which affect the the way we analyze the data represented in this report.
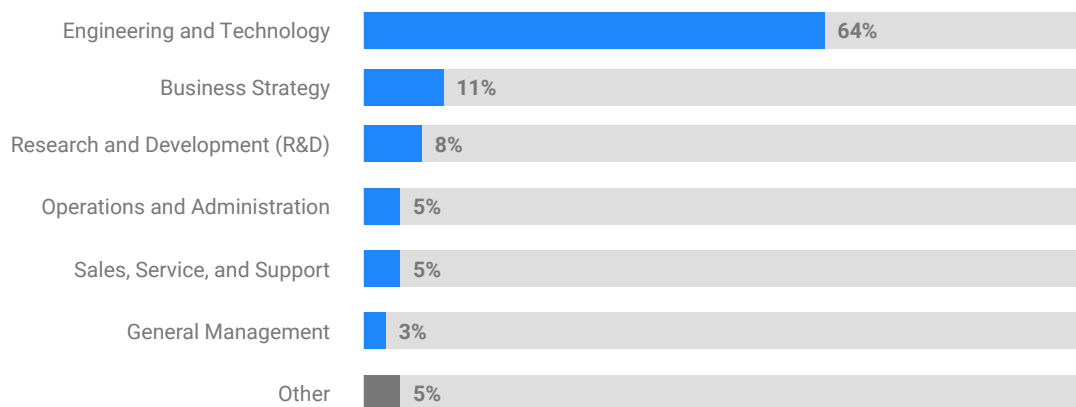
Organization Type and Industry

42% - Consultants and Systems Integrators

30% - Software-as-a-Service Provider (SaaS)

14% - Managed Service Provider

12% - Independent Software Vendor (ISV)

4% - Education and Training Partner
2% - Value-Added Reseller/Distributor (VAR/VAD)

53%
Google Cloud Partner

47%
Google Cloud Customer Industry

Computer Software - **19%**
Financial Services - **12%**
Retail / e-Commerce - **9%**
Healthcare and Life Sciences - **8%**
Telecommunications - **7%**
Professional Services - **6%**
Marketing - **5%**
Media, Entertainment, and Gaming - **5%**
Education - **4%**
Government and Public Sector - **3%**
Travel - **3%**
Energy - **3%**
Automotive - **3%**
Other - **11%**

Q: WHICH OPTION BELOW BEST DESCRIBES THE TYPE OF ORGANIZATION YOU WORK FOR? (N=431)
Q: [IF 'CUSTOMER INDUSTRY / B2B / B2C' SELECTED] WHICH OF THE FOLLOWING MOST CLOSELY DESCRIBES WHICH INDUSTRY YOU WORK IN? (N=203) *ALL OTHER INDUSTRIES NOTED BY LESS THAN 3% OF RESPONDENTS*

Firmographics

Role

Role	Percentage
CEO / President / Founder	17%
IT Decision Maker	14%
CTO / CIO / CISO	8%
Cloud VP / Director / Manager	6%
IT Practitioner	59%
Cloud Architect	16%
Data Engineer / Scientist / Analyst	11%
Cloud Engineer	10%
DevOps / SRE	5%
Security Professional	5%
Systems Administrator	3%
Product Manager	3%
Business Role	6%
Other	3%

Q: WHICH OF THE FOLLOWING MOST CLOSELY DESCRIBES YOUR JOB ROLE? (N=431)

Department

Department	Percentage
Engineering and Technology	64%
Business Strategy	11%
Research and Development (R&D)	8%
Operations and Administration	5%
Sales, Service, and Support	5%
General Management	3%
Other	5%

Q: WHICH OF THE FOLLOWING MOST CLOSELY DESCRIBES THE DEPARTMENT WHERE YOU WORK? (N=431)

Firmographics

Company Size

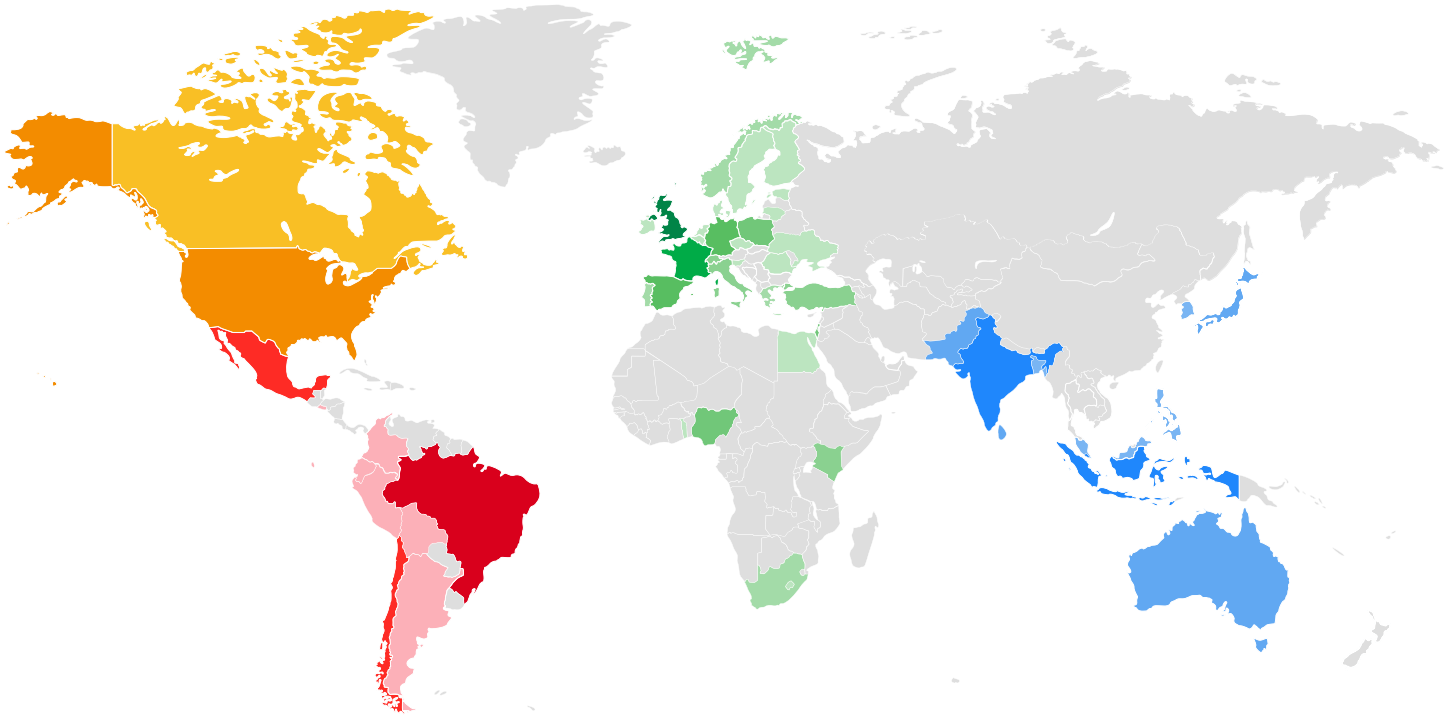|	
Just me (e.g. freelancer, startup, etc.)	5%
2-5 employees	11%
6 - 20 employees	17%
21 - 49 employees	5%
50 - 99 employees	8%
100 - 249 employees	6%
250 - 499 employees	7%
500 - 999 employees	7%
1,000 - 4,999 employees	5%
5,000 - 9,999 employees	5%
10,000 employees or more	22%
Don't know / Not sure	1%
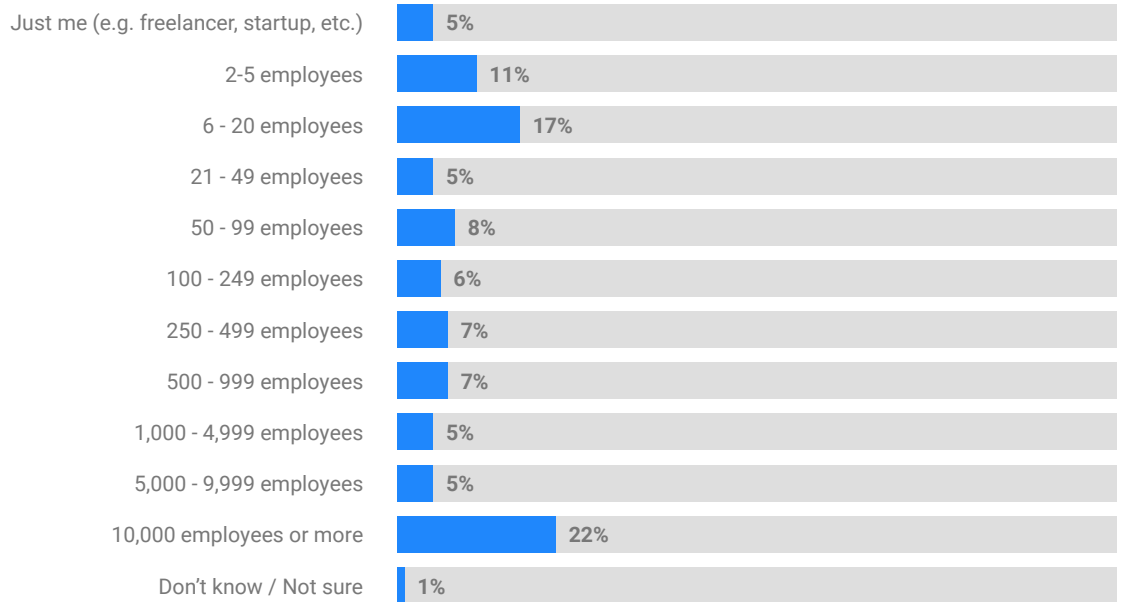
Q: WHAT IS THE SIZE OF YOUR ORGANIZATION? (N=431)

Company Years Active

< 1 year	9%
1-2 years	13%
3-5 years	19%
6-10 years	16%
11-15 years	8%
16+ years	33%
Don't know / Not sure	2%
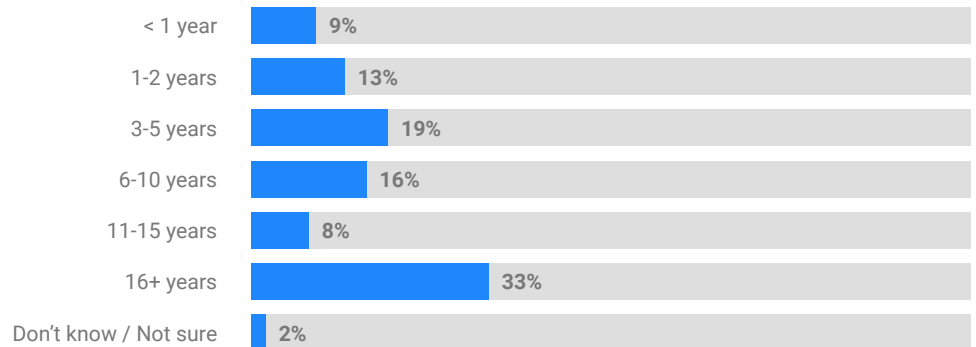
Q: HOW MANY YEARS HAS YOUR COMPANY BEEN ACTIVE? (N=431)

Demographics

Global Representation

C2C is proud to serve a global community of Google Cloud users. While users worldwide might find themselves on the same cloud platform, their motivations and challenges often stem from distinct regional realities.
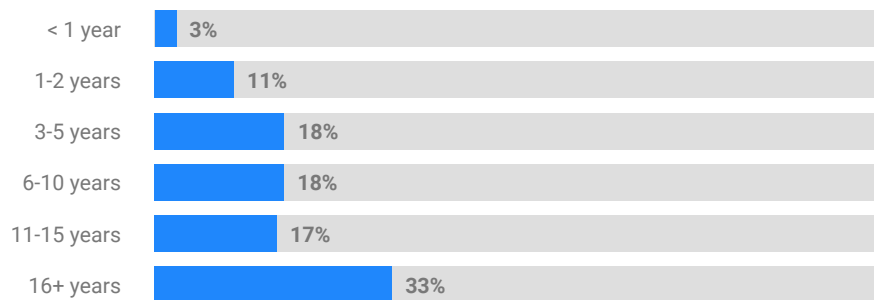
Q: IN WHICH COUNTRY DO YOU CURRENTLY WORK? (N=431)

41%
EMEA

32.5%
North America

12%
LATAM

14.5%
J/APAC
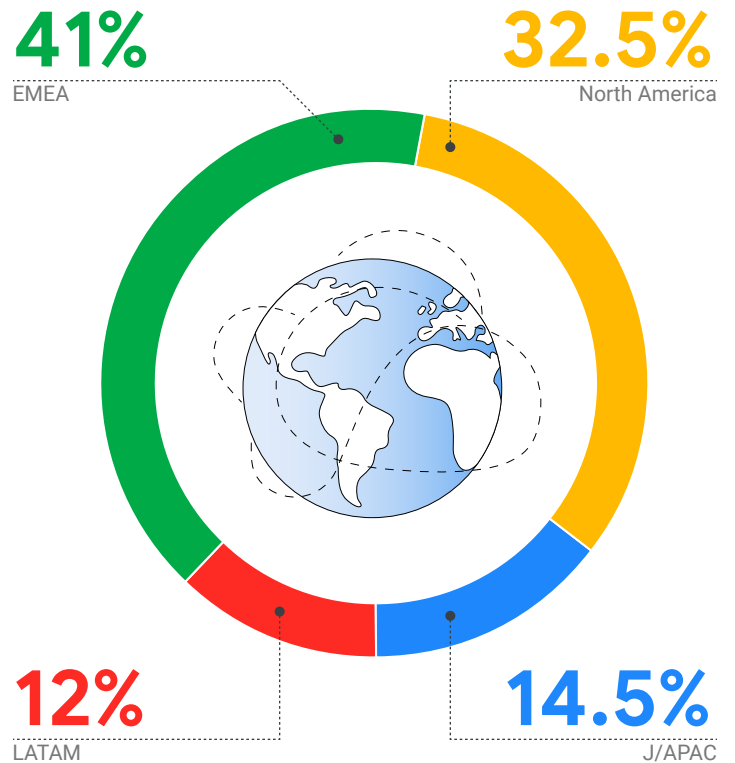
Demographics

Collecting Demographic Information

While firmographics paint a picture of the business landscape, demographics reveal the human element within it. Collecting data on factors like age, gender, and education level helps us understand the individuals driving company decisions. In the cloud technology industry and development roles, these factors may influence an individual's long-term career trajectory and the balance of personal workloads in the workplace.

Time In Industry

< 1 year	3%
1-2 years	11%
3-5 years	18%
6-10 years	18%
11-15 years	17%
16+ years	33%

Q: HOW MANY YEARS HAVE YOU BEEN ACTIVE IN YOUR INDUSTRY? (N=431)

Education

|	
Some high school	9%
High school diploma/GED	15%
Some college	7%
Associate's Degree	5%
Bachelor's Degree	51%
Master's Degree	48%
Trade School	1%
Cloud Certification(s)	46%
Self-Guided Course(s)	42%
Tech Bootcamp(s)	21%
Other	3%
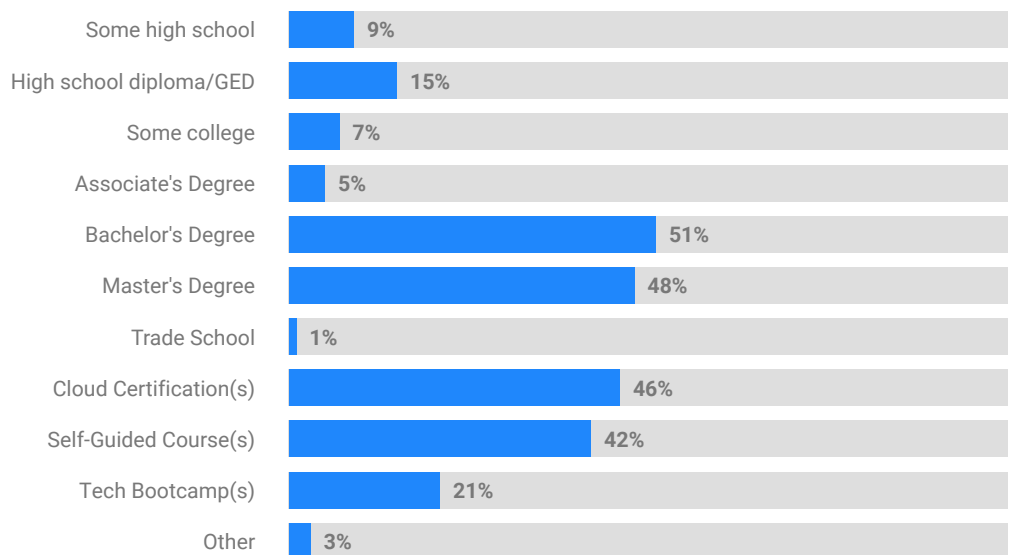
Q: WHAT TYPE(S) OF EDUCATION AND/OR TRAINING HAVE YOU COMPLETED AS IT RELATES TO YOUR CAREER? (PLEASE SELECT ALL THAT APPLY.) (N=431)
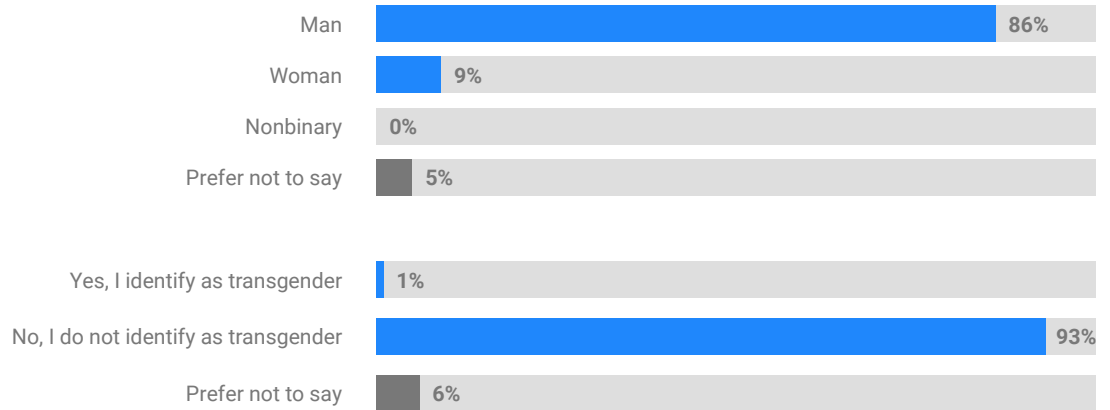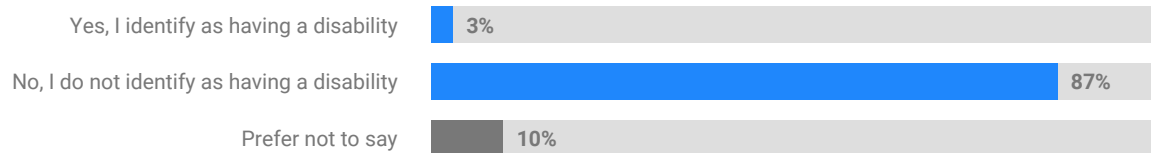
Demographics

Age

18-24	6%
25-34	28%
35-44	37%
45-54	19%
55 or above	4%
Prefer not to say	5%
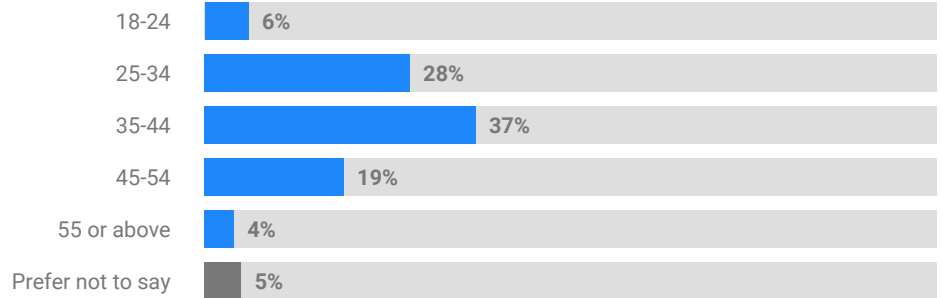
Q: WHICH OF THE FOLLOWING BEST DESCRIBES YOUR AGE? (N=431)

Gender

Man	86%
Woman	9%
Nonbinary	0%
Prefer not to say	5%

Yes, I identify as transgender	1%
No, I do not identify as transgender	93%
Prefer not to say	6%

Q: WHICH OF THE FOLLOWING BEST DESCRIBES YOUR GENDER? 2023 (N=431) | Q: DO YOU IDENTIFY AS TRANSGENDER? (N=431)

Disability Status

Yes, I identify as having a disability	3%
No, I do not identify as having a disability	87%
Prefer not to say	10%

Q: WHICH OF THE FOLLOWING BEST DESCRIBES YOUR DISABILITY STATUS? (N=431)

Further Reading
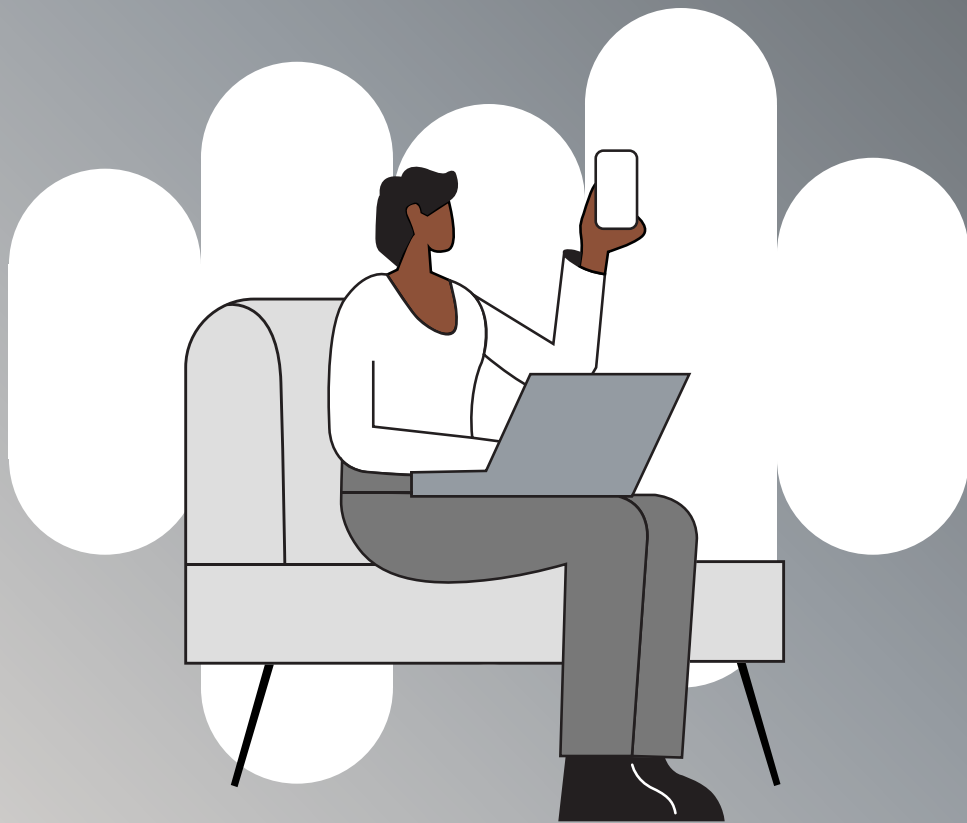
Credits

Publication Authors

Alex Maksymec
Research Manager, C2C
Program objectives and oversight, data visualization,
writing, and publication design
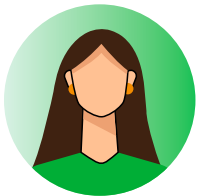
Olivia Kamps
Brand Designer, C2C
Illustrations and design review

Research Team

Marissa Gilbert
Research Director, UGS Research

Blake Baltazar
Senior Project and Research Analyst, UGS Research

Sponsorship

Thank you to the Google Cloud Developer Relations team for bringing this project to C2C.
As a point of guidance, your contribution is vital to continue our important work.

Matt Thompson
Director, Developer Relations, Google Cloud

About C2C

Powered by people like you.

C2C brings together Google Cloud customers from around the globe to share ideas, insights, and strategies in a space that's built for authentic, peer-to-peer cloud conversation. Whether you're looking to overcome challenges, drive business growth, or dive into technical details, you can tap into the collective wisdom of cloud professionals like you.
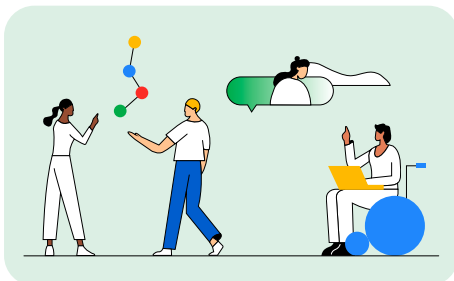
"After just one C2C event, I made connections in the double figures who I still keep in touch with. It's a vibrant community for partners and customers alike. There is a very natural atmosphere and the content is very engaging and informative."

- Simrin Gill
Cobry

"C2C connected me to the Google Cloud PM in charge of the product we are using. I am going to be sure to attend all the C2C events that I can and tell my peers."
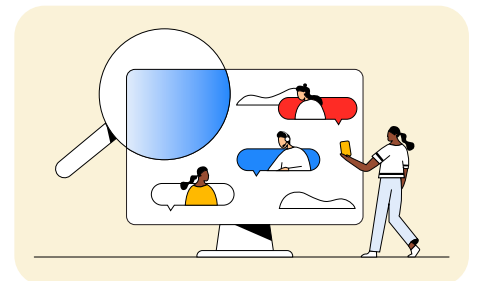
- Ethan Lo
Premise

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