

CLOUD FINOPS

**COLLABORATIVE, REAL-TIME CLOUD VALUE
DECISION MAKING, 2ND EDITION**

**BY J. R. STORMENT
AND MIKE FULLER**

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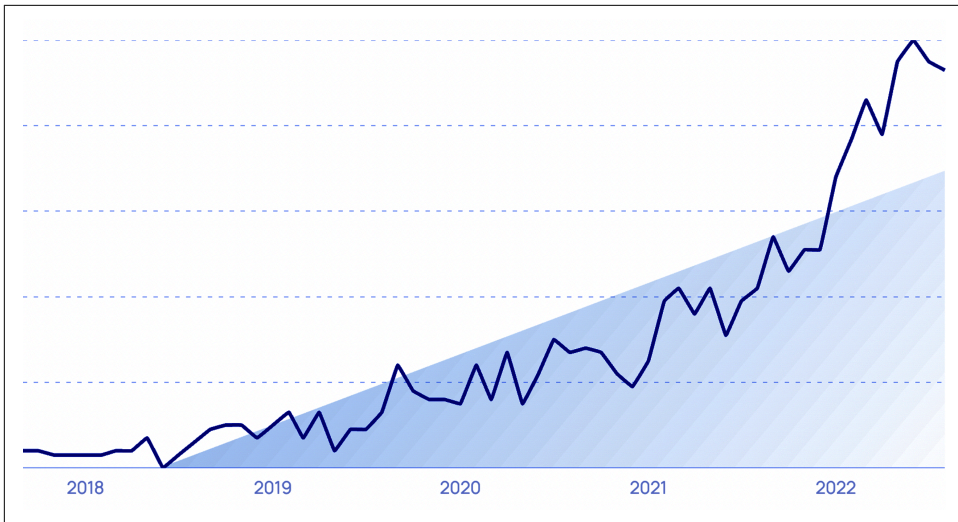


Figure 1-1. Search requests for the term “FinOps” between 2018 and 2022 (source: [speakeasystrategies.com](https://www.speakeasystrategies.com))

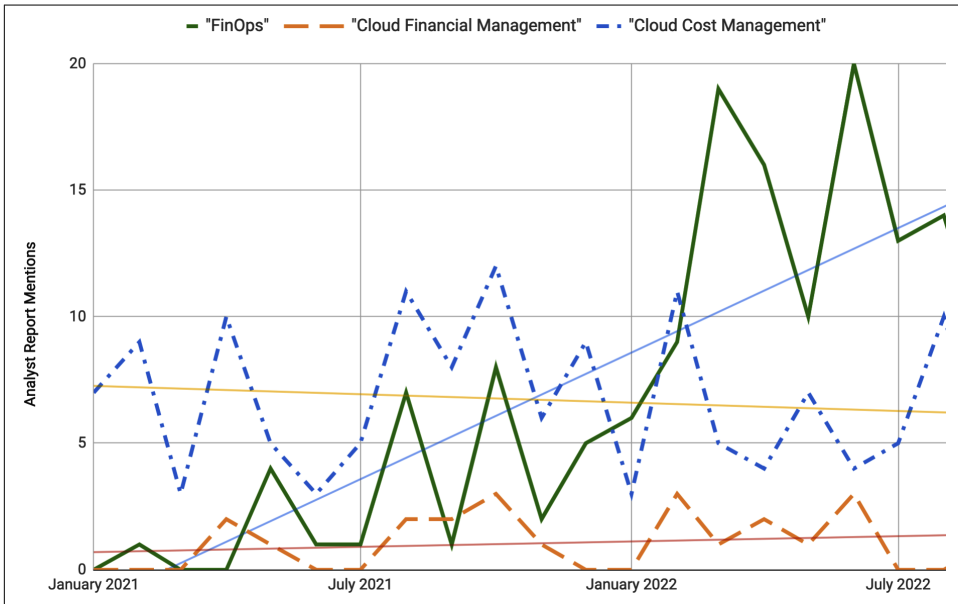


Figure 1-2. Analyst articles mentions of different names for FinOps (source: *speakeasy-strategies.com*)

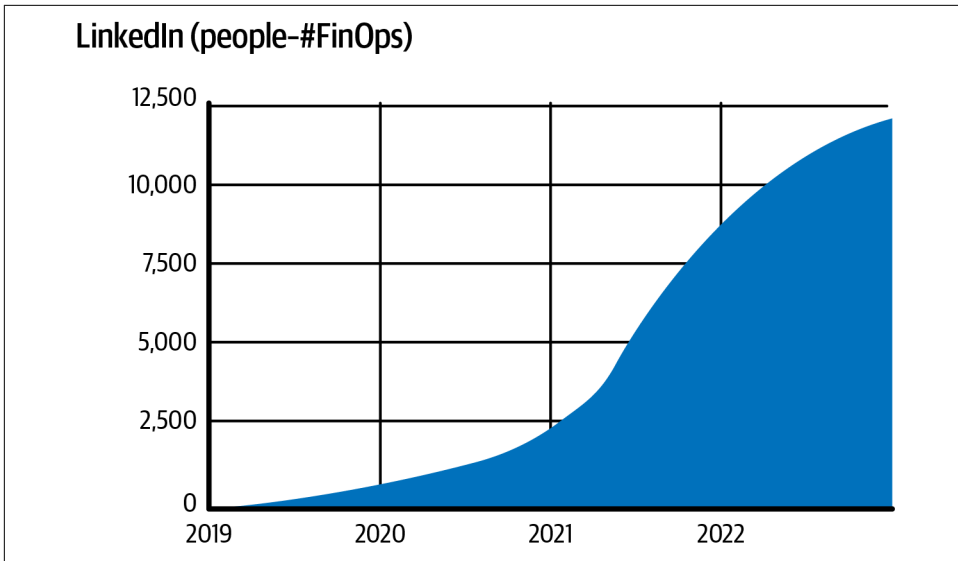


Figure 1-3. Count of people on LinkedIn listing FinOps as a skill set

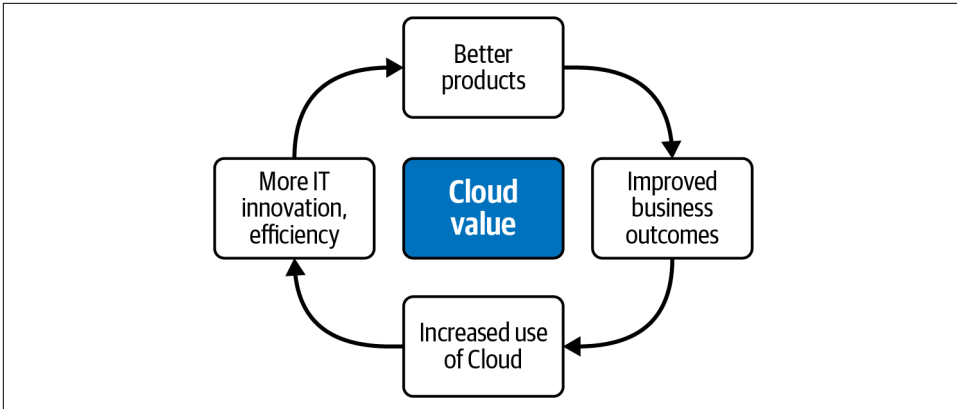


Figure 2-1. Cloud value proposition from the FinOps Certified Professional course

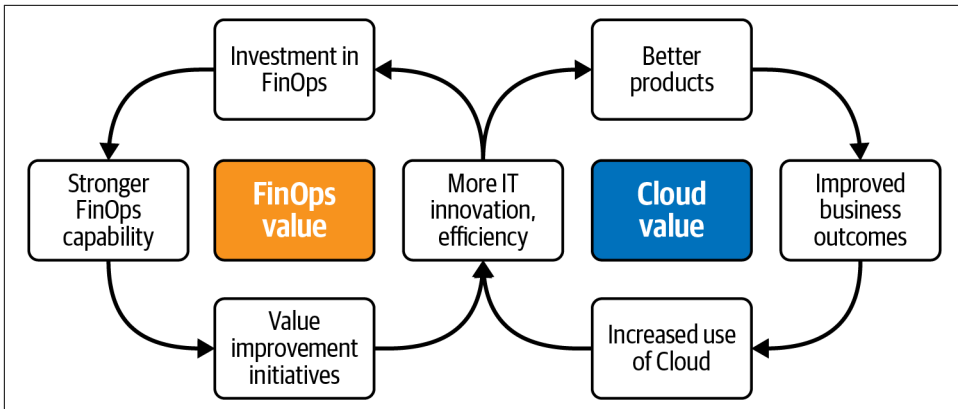


Figure 2-2. Organizations should sustain their FinOps investment as long as it is justified by improvements in cloud business value (from the FinOps Certified Professional course)

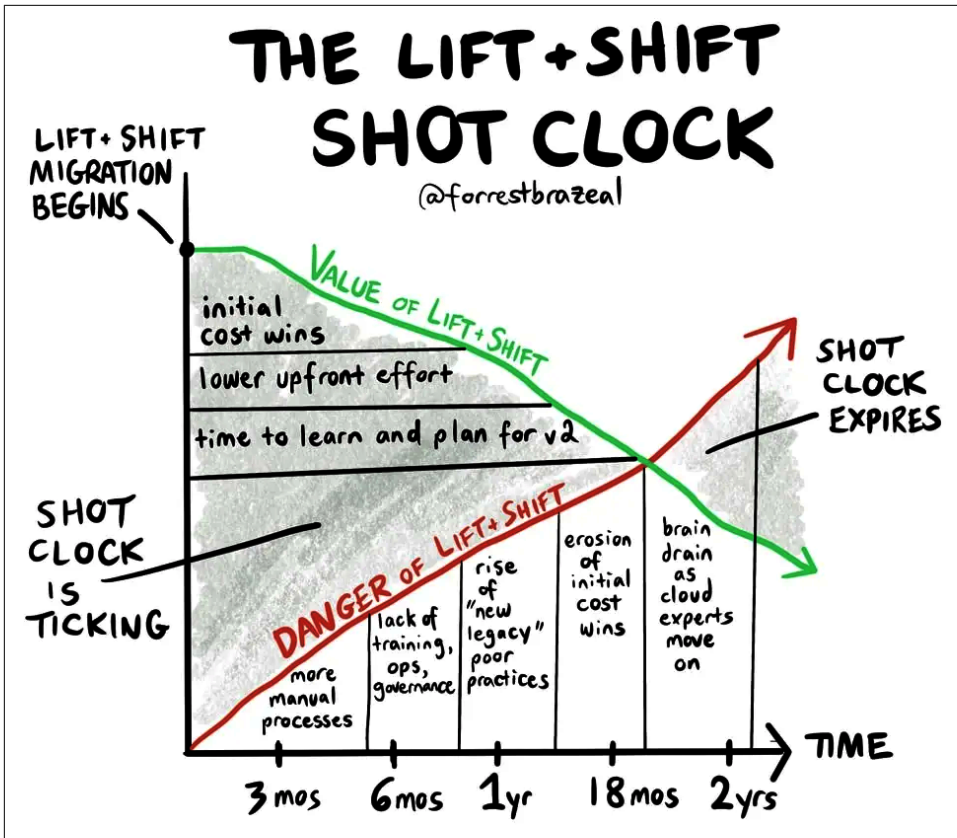


Figure 2-3. The lift-and-shift shot clock illustration by Forrest Brazeal published by *ACloudGuru*, February 2020

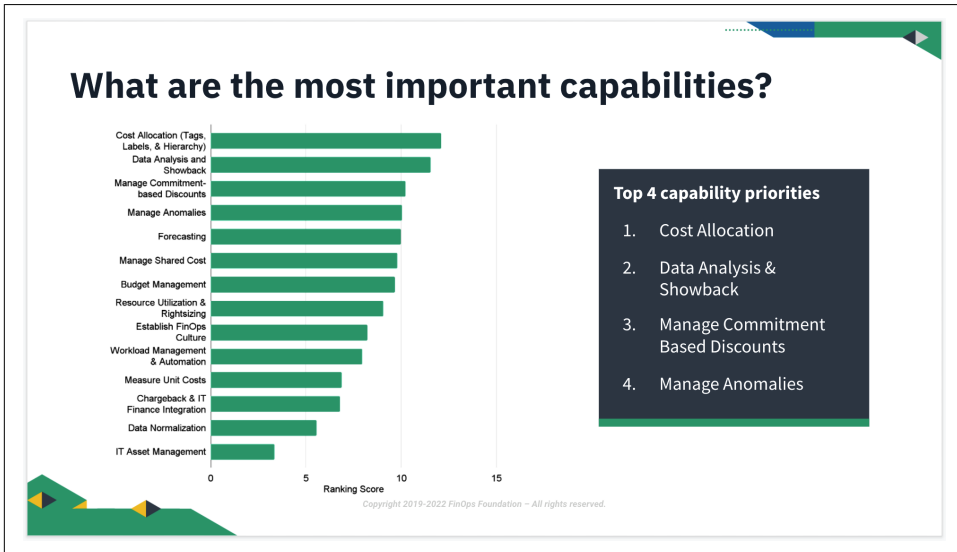


Figure 2-4. Stack ranked list of the top FinOps Framework capabilities show that cost allocation and data analysis and showback are the most important parts of a FinOps practice (source: 2022 State of FinOps report)

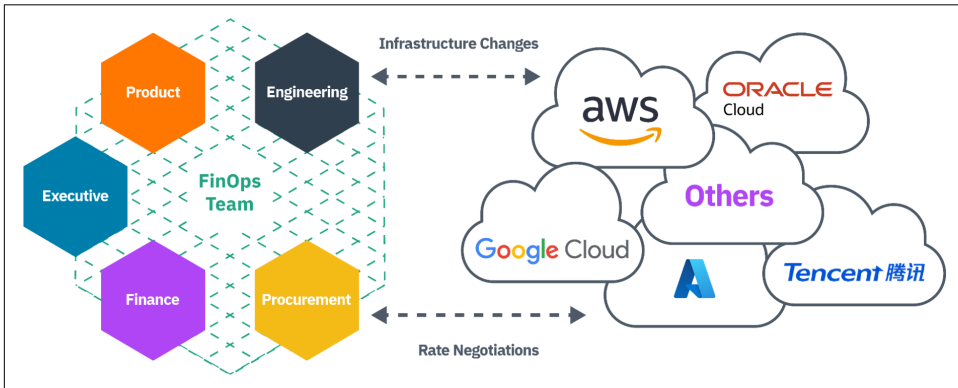


Figure 3-1. Team interaction around FinOps

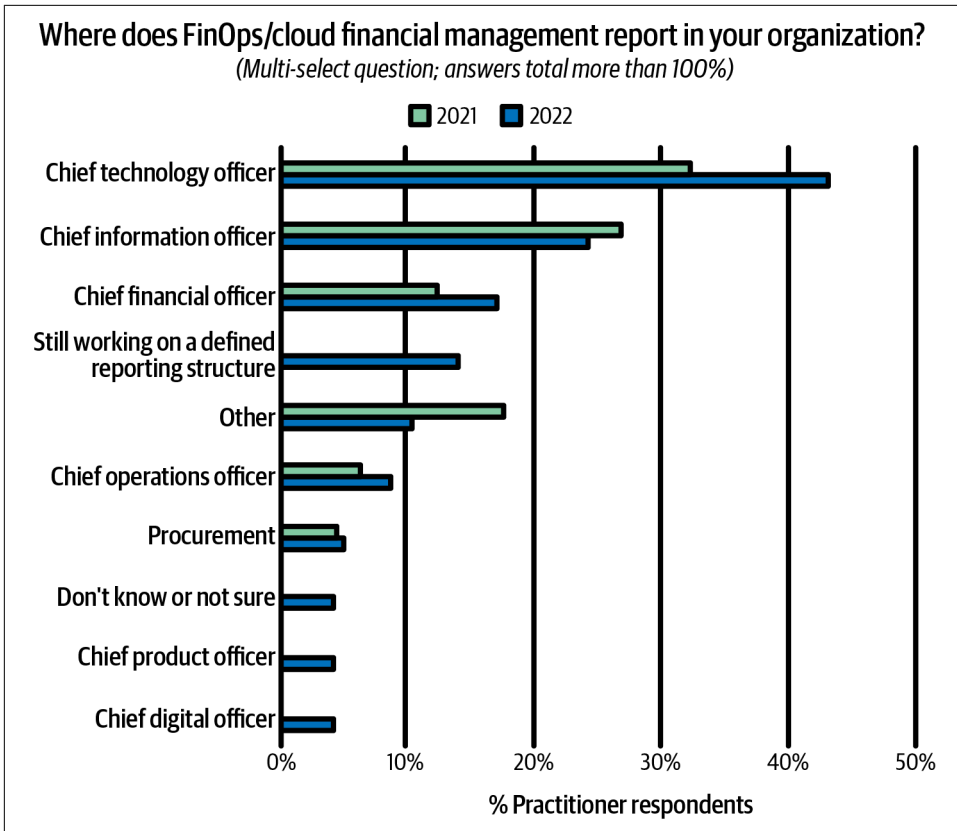


Figure 3-2. Most common executive FinOps reports to, from the *2022 State of FinOps report*

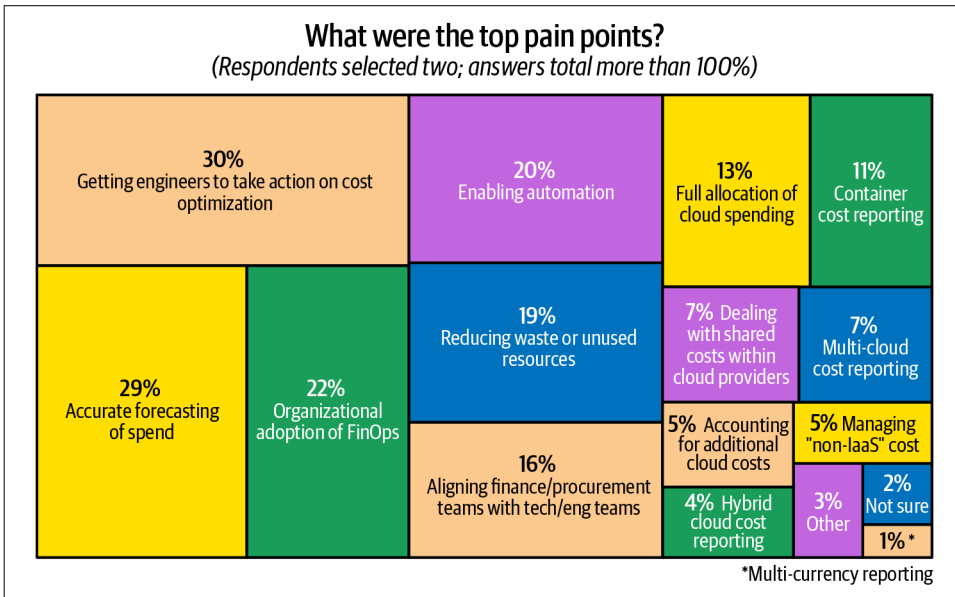


Figure 3-3. Survey responses in the FinOps Foundation State of FinOps 2022 survey, showing motivating engineers as the top challenge

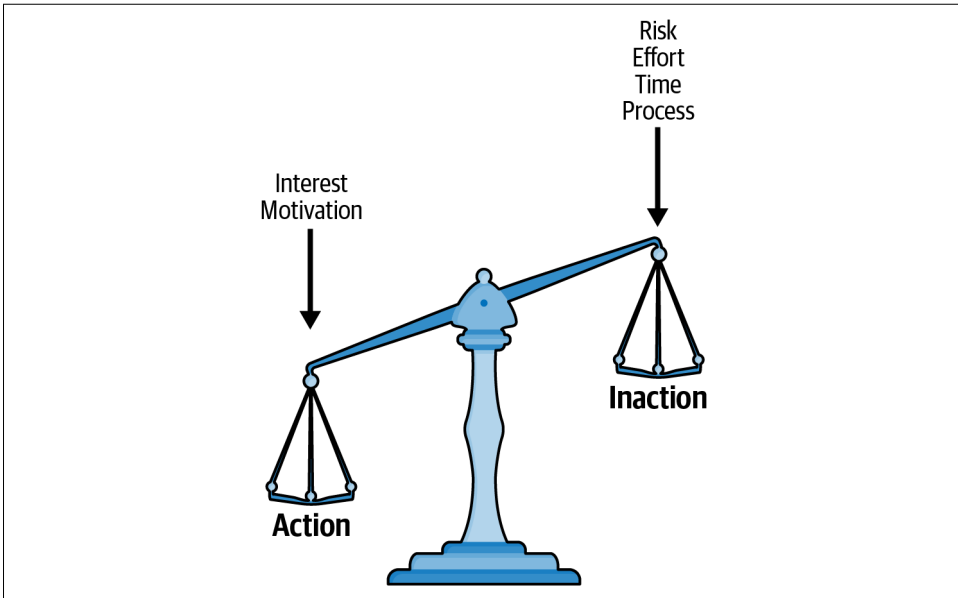


Figure 3-4. The action scale

2019-07-22T00:00:00Z/2019-07-22T01:00:00Z,,AWS,Anniversary,01234567890,2019-07-01T00:00:00Z,2019-08-01T00:00:00Z,09876543210,DiscountedUsage,2019-07-22T00:00:00Z,2019-07-22T01:00:00Z,AmazonEC2,BoxUsage:m3.medium,RunInstances,us-east-1b,i-odd86597c590879b9,1.0000000000,USD,0.0000000000,0.0000000000,0.0402772184,0.0402772184,"Linux/UNIX (Amazon VPC), m3.medium reserved instance applied",Amazon Elastic Compute Cloud,,,,,2.5 GHz,,,No,,,,,,3,,,,,,General purpose,m3.medium,,,No License required,US East (N. Virginia),AWS Region,,,,,3.75 GiB,,,,,Moderate,Linux,RunInstances,,,Intel Xeon E5-2670 v2 (Ivy Bridge/Sandy Bridge),,64-bit,Intel AVX; Intel Turbo,Compute Instance,,,,,,AmazonEC2,ASDZTDFMC5425T7P,,,,,1 x 4 SSD,,,,,Shared,,,,,,BoxUsage:m3.medium,1,,,,,3yr.convertible,No Upfront,0.0670000000,0.0670000000,Reserved,Hrs,,,arn:aws:ec2:us-east-1:01234567890:reserved-instances/36768f14-be7f-455f-9657-6d1c4e06401a,,,Infrastructure Svcs-Software,,mfuller.serviceA,,Infrastructure Svcs,Infrastructure Svcs,,,2.0,2.0000000000,,,,,,2,,,,us-east-1,Amazon Elastic Compute Cloud,,,m3,,,serviceA,,0.0670000000,0.0670000000,0.0670000000,0.0670000000,,,,,0.00000000,,0.04300000,,0.04300000,,,,,Public,"38.953116,-77.456539",,,,,s3://billing-reports/cost_reports/hourly_with_resources/20190701-20190801/2755e466-dc41-4a04-9d9e-f1771805729b/hourly_with_resources-059.csv.gz,,Amazon Web Services, Inc.",Used,,,,,,awseb-emyky2mqvf-stack-AWSEBAutoScalingGroup-WAUJKY5MFRGL,,14292253,1947602408,infrastructure svcs,,,,,,2019-07
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Figure 5-1. Sample line from the AWS CUR billing data

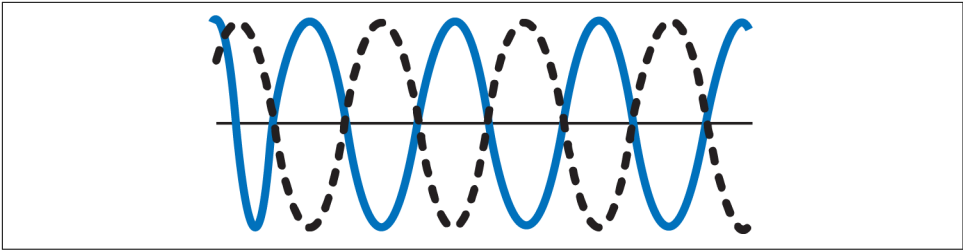


Figure 5-2. Phase shift overlap

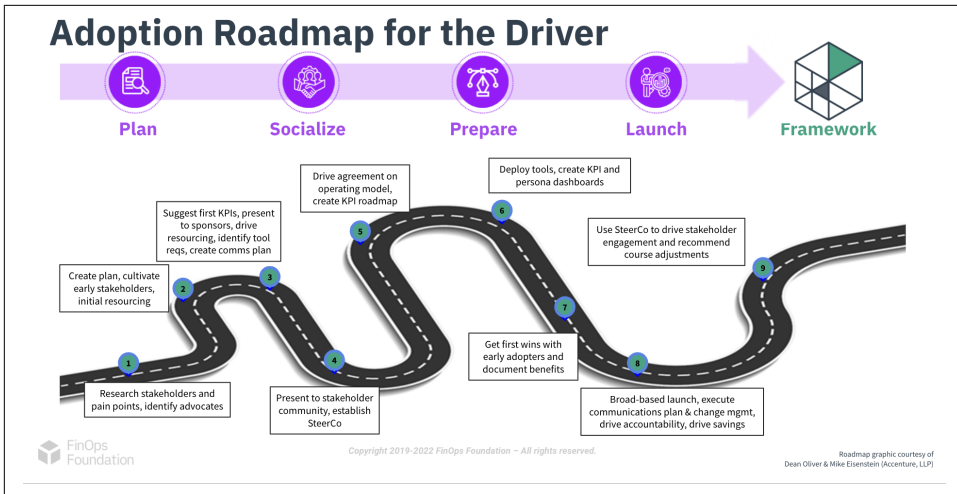


Figure 6-1. *The FinOps Adoption Roadmap*, original source Mike Eisenstein and Dean Oliver (Accenture, LLP)

Table 6-1. Simplified assessment of the maturity of framework capabilities in an existing practice

Domain	Capability	Maturity		
		Early	Middle	Advanced
Understanding cloud usage and cost	Cost allocation		Current	Grow
	Managing shared costs	Current	Grow	
Performance tracking and benchmarking	Forecasting		Build	
Cloud rate optimization	Managing commitment-based discounts		Current	Grow
Cloud usage optimization	Resource utilization and efficiency			Build
Real-time decision making	Measuring unit costs	Build		
Organizational alignment	FinOps intersection with other frameworks	Current		Grow

Table 6-2. Examples of focus areas that FinOps can help solve for different personas

Persona	Focus
Business leaders	Leverage cloud to be more competitive
Engineering	Innovate while increasing cost efficiency and speed of delivery
Finance	Understand, allocate, and predict cost accurately

Table 6-3. Sample hiring plan for a CTO-reporting practice

Financial year	Data engineers	Analysts	Automation engineers	Team leads	Funding required
FY22	2	1	1	1	
FY23	2	2	2	1	+2
FY24	3	3	2	2	+3
FY25	4	5	3	2	+4

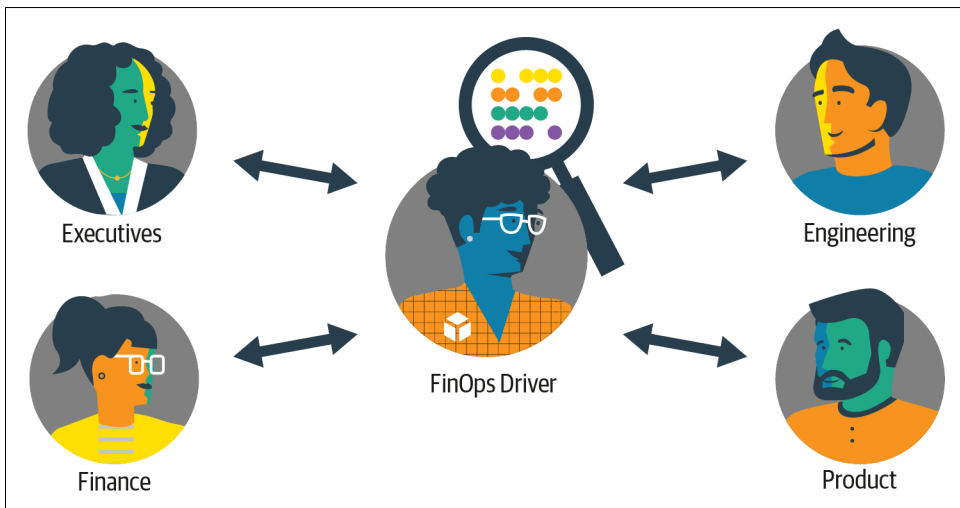


Figure 6-2. Persona interactions with the FinOps driver

Table 6-4. Common CEO business and FinOps objectives

Objectives	Frustrations	Key metrics	FinOps benefits
Accelerate company growth YoY	Unpredictable, sometimes chaotic, cloud spend	Revenue growth	Manage risk
Strategic competitive advantage	Unable to see link between engineering initiatives and business objectives	Gross margins	Connect engineering decisions with business outcomes
Faster time-to-market	Unsure of the return on their company's cloud investment	COGS (cost of goods sold)	Predict how cloud spend will grow as the business grows
Deliver innovative, market-leading solutions cost effectively		Unit cost economics	Guide organization to make good cloud investments

Table 6-5. Common CTO/CIO and FinOps objectives

Objectives	Frustrations	Key metrics	FinOps benefits
Accelerate company growth YoY	Extreme pressure to either justify or bring down the cloud bill	Revenue growth	Predict how cloud spend will grow as the business grows
Strategic competitive advantage	No guardrails on spend	Gross margins	Drive organization to make good cloud investments
Faster time-to-market	Unsatisfied engineers	COGS	Enable engineering organizations to gain more freedom to utilize newer cloud technologies and deliver solutions to market faster
Deliver innovative, market-leading solutions cost effectively	Business continuity	Unit cost economics	
	Reliability	Time to market for new features/product	
		Engineering productivity	
		Track R&D versus production spend	
		Maintain operations within budget	

Table 6-6. Common CFO and FinOps objectives

Objectives	Frustrations	Key metrics	FinOps benefits
Cost visibility and granularity, and accuracy	Unpredictable, sometimes chaotic, cloud spend	Revenue growth	Increased accountability for cloud cost
Overall cost-per-unit/COGS reduction	Unsure of the return on their company's cloud investment	Gross margins	Increased reliance on budget and forecast models
Managing costs during growth, disproportionate cost reduction during flat/declining periods	Cost fluctuations and innovation do not align to budgeting cycles	COGS	
		Unit cost economics	Direct impact on company bottom line
		Predictability	

Table 6-7. Common engineering lead objectives

Objectives	Frustrations	Key metrics	FinOps benefits
Drive accountability to engineering teams that are responsible for the application/services	Unsatisfied engineers as their workload keeps rising	Revenue by infrastructure costs	Increased visibility to cloud cost
Provide guidance to engineering teams to have a cost-effective application/service by identifying anomalies and best practices	Long delivery cycles	Cost per deployed service and service utilization rates	Connection to cloud cost and unit economics
Work together with engineering teams to identify rate reductions and possible cost avoidance	Cannot predict the impact on the budget	Showback and chargeback of IT costs to the business	More accountability for utilization
Cost allocation	Difficult to identify service or application ownership		Incentive toward solid architecture principles to factor efficiency
	Cannot predict the costs closely enough for developing new features and products		

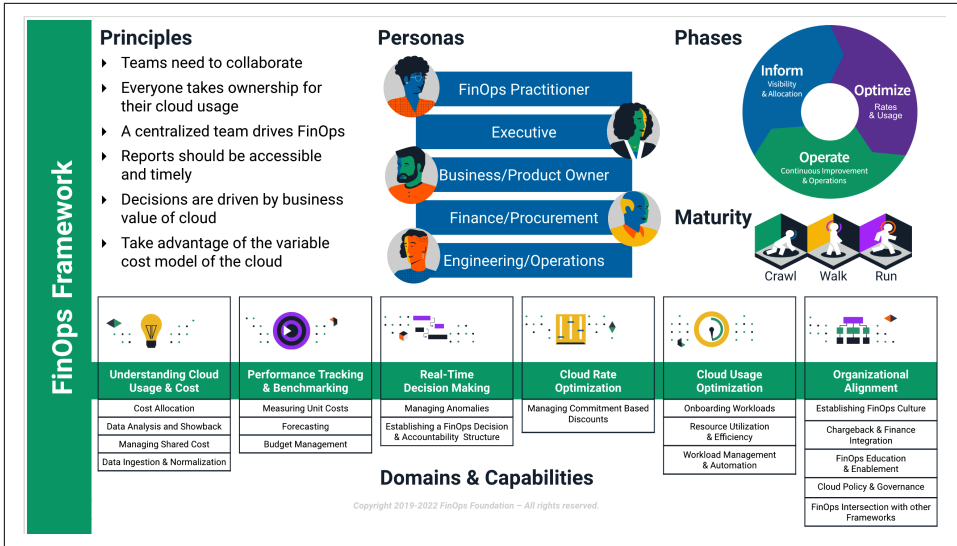


Figure 7-1. The FinOps Foundation Framework poster 2022 available *online*

Table 7-1. Framework domains and their primary outcomes

Domain	Primary outcome
Understanding cloud usage and cost	Drives accountability and transparency
Performance tracking and benchmarking	Defines what good looks like
Real-time decision making	Enables a fast feedback loop for data-driven decisions on spend
Cloud usage optimization	Ensures efficient use of cloud resources, while reducing wasted spend
Cloud rate optimization	Uses the various commitment-based discount programs to reduce the amount you pay for consumed resources
Organizational alignment	Aligns your cloud usage with your organizational goals and structure

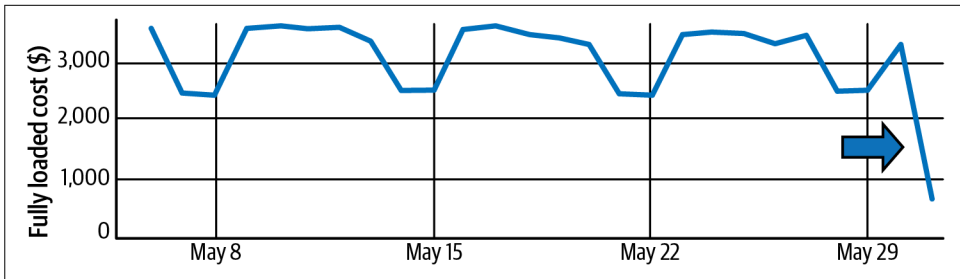


Figure 8-1. Cloud cost data showing a drop in the most recent days due to delays on data delivery

Weekly FinOps report

Top services this week	
Service name	Weekly cost
Application 1	\$10,000
Application 2	\$8,000
Application 3	\$7,500
Application 4	\$6,300

Team A – Service costs

Service name	Weekly cost
Application 5	\$2,000
Application 6	\$560
Application 7	\$200
Application 8	\$1,250

Figure 8-2. Example weekly FinOps report to be presented to a team

Service name	Weekly cost	Difference from last week
Application 8	\$1,250	+ 1,000
Application 6	\$560	+ \$50
Application 5	\$2,000	+\$15
Application 7	\$200	- \$25

Figure 8-3. Service costs including weekly difference

Compare current instance with recommended options Info							
Consider an alternate configuration to the current instance type.							
	Options ▼	Instance type ▼	On-Demand price ▼	Price difference ▼	Performance risk ▼	vCPUs ▼	Memory ▼
☐	Current	m5.xlarge	\$0.192 per hour	\$0.000 per hour	-	4	16 GiB
☒	Option 1	r5.large	\$0.126 per hour	- \$0.066 per hour	Very low	2	16 GiB
☐	Option 2	t3.xlarge	\$0.1664 per hour	- \$0.026 per hour	Medium	4	16 GiB
☐	Option 3	m5.xlarge	\$0.192 per hour	\$0.000 per hour	Very low	4	16 GiB

Figure 8-4. The AWS Compute Optimizer console, showing recommendations for right-sizing an EC2 instance

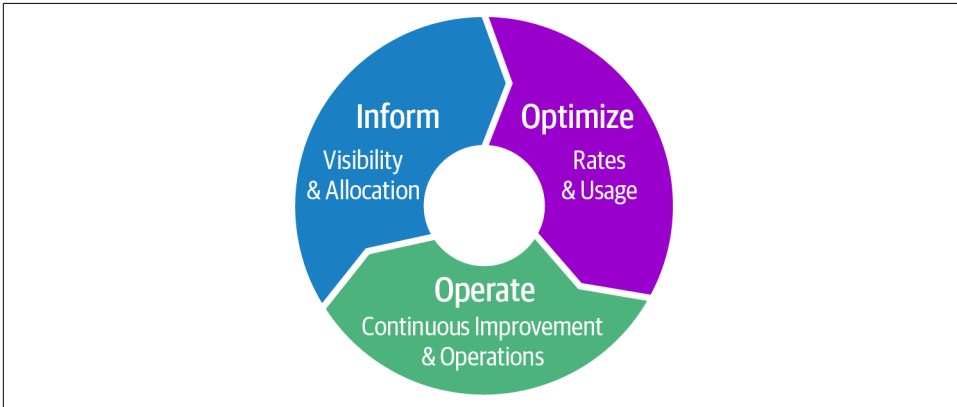


Figure 9-1. The FinOps lifecycle

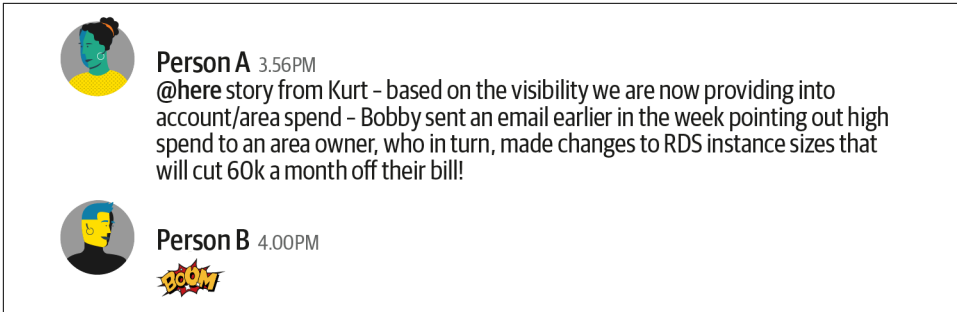


Figure 9-2. A real conversation about the results of cost visibility

Table 10-1. Metrics of low, medium, and high performers in public cloud

	Low performers	Medium performers	High performers
Visibility and allocation of cloud spend	Reliant on vendor invoices and manual reconciliation	>1 day for partial visibility with limited retention of granular historical data	<1 hour or near-real-time visibility of all spend with all current and historical data retained
Showback or chargeback	Inability to provide teams an accurate accounting of cloud spend	Cloud spend is allocated to teams based on estimated usage of resources	Teams understand their portion of cloud spend based on actual consumption
Team budgets	Teams have no budgets	Teams have budgets	Teams budget and track spend against budgets
RI and CUD management	0%–20% of cloud services purchased via reservations	40%–50% of cloud services purchased via reservations	80%–100% of cloud services purchased via reservations
Find and remove underutilized services	Every few months	Weekly	Automated and policy driven
Unit economics	May not use	More technical, team-based cost per compute hour, etc.	More business-focused cost per customer, etc.

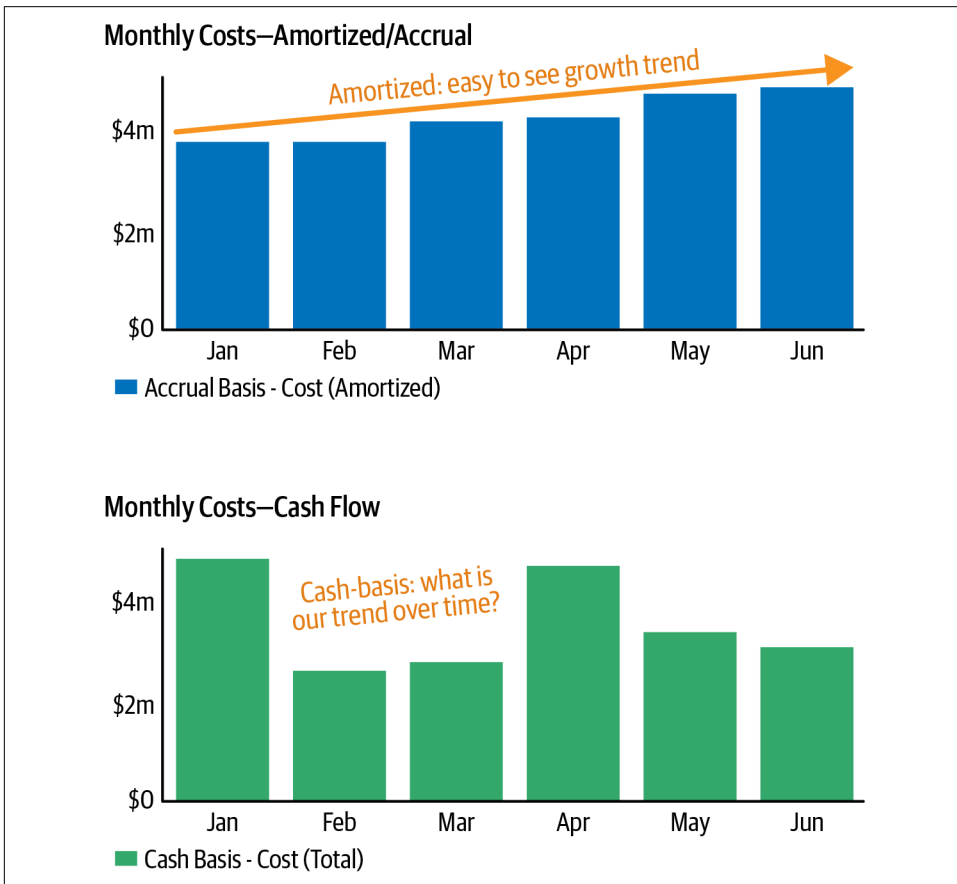


Figure 11-1. Monthly costs with and without amortization

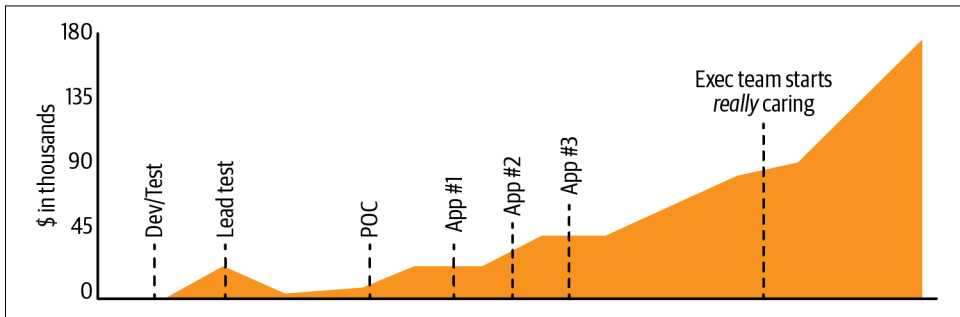


Figure 11-2. Spend growth with significant events

Table 11-1. Cost allocation example with centralized support charge

Business units	Cost	% of total (excluding enterprise support)
Sales operations	\$50K	50%
Engineering—QA	\$30K	30%
Engineering	\$20K	20%
Enterprise support charge	\$10K	
Total	\$110K	100%

Table 11-2. Cost allocation example with amortized support charge

Business units	Allocation amount	Allocation percentage
Sales operations	\$55K	50%
Engineering—QA	\$33K	30%
Engineering	\$22K	20%
Total	\$110K	100%

Table 12-1. Comparison of cloud vendor allocation options

	AWS	Google Cloud Platform	Microsoft Azure
Hierarchy	Accounts (management and member)	Projects	Subscriptions and resource groups
Meta hierarchy	AWS Organizations	Folders	Management groups, departments
Key/value pairs	Tags	Labels and tags	Tags
Number of tags per resource	50 (some services allow only 10)	64	50 (some services allow only 15)
Tags automatically allocated to your detailed billing data	No—manual selection required	Yes—some limits apply	Yes—some limits apply
Tag restrictions	Some services limit supported characters	Lowercase letters, numeric characters, underscores, and dashes	Some characters not supported
Tags can be applied to	Most services' resources (constantly changes; see AWS documentation for all current details), accounts (via AWS Organizations)	Most services' resources, projects, and folders	Most services' resources, Azure resource groups

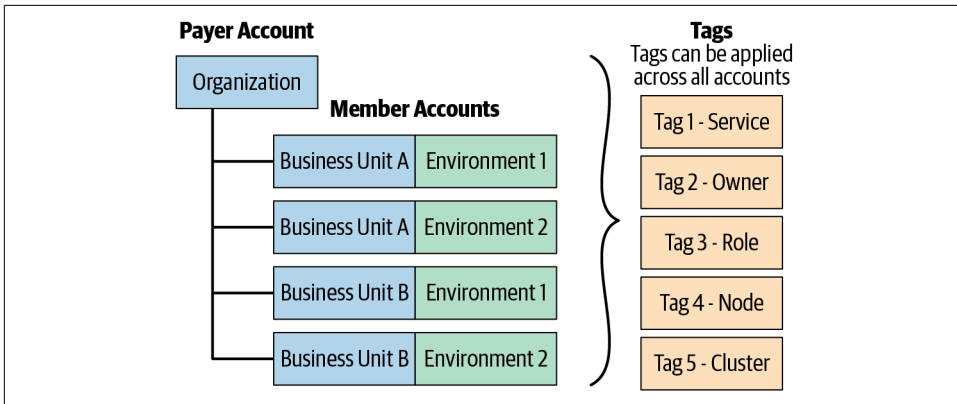


Figure 12-1. Common cost allocation strategy for AWS accounts

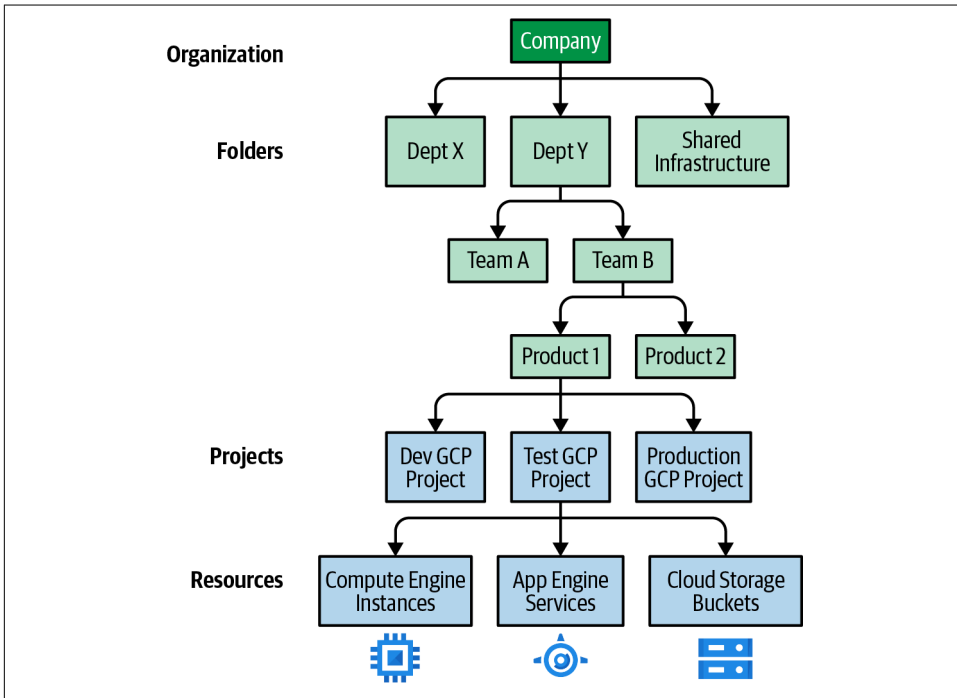


Figure 12-2. Cost allocation inside Google Cloud

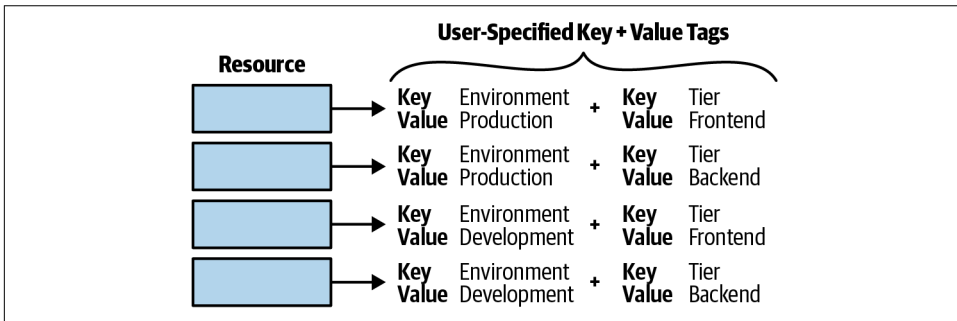


Figure 12-3. Tags on cloud resources

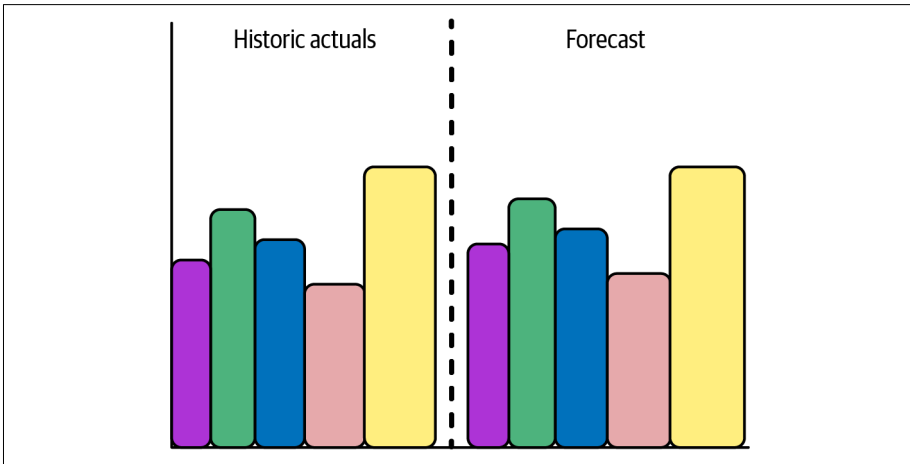


Figure 13-1. Naive forecasting assumes your next period of spend will mirror the last

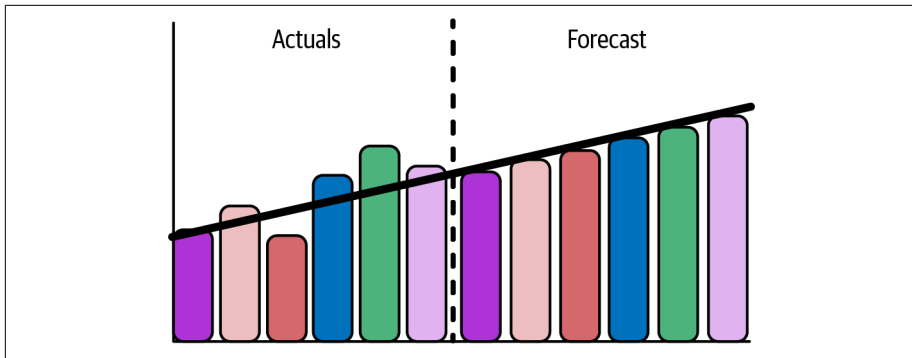


Figure 13-2. Trend-based forecasting

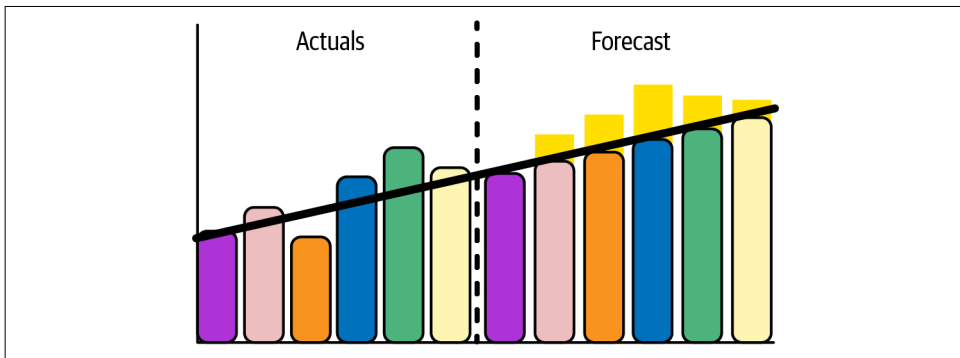


Figure 13-3. Driver-based forecasting

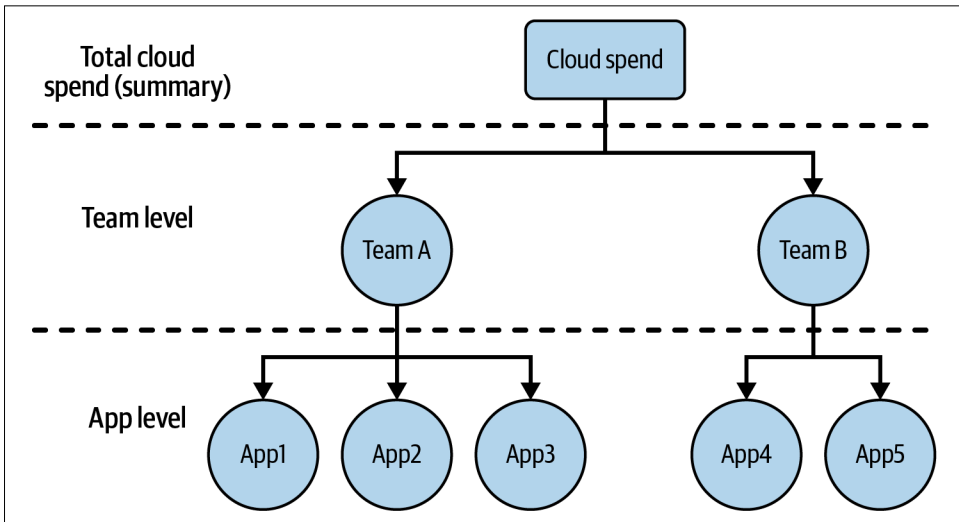


Figure 13-4. An example cloud spend hierarchy

Table 13-1. Forecast changes week over week

Application	Monthly forecast (week 1)	Monthly forecast (week 2)	Difference
App1	\$15,000	\$15,000	\$0
App2	\$25,000	\$30,000	+\$5,000
App3	\$10,000	\$9,000	-\$1,000
App4	\$5,000	\$6,000	+\$1,000
App5	\$30,000	\$30,000	\$0
Total	\$85,000	\$90,000	\$5,000

Table 13-2. Forecast changes week over week

Forecast type	Application	Forecast Month 1	Forecast Month 2	Forecast Month 3
Automated	App1	\$15,000	\$16,000	\$17,000
	App2	\$25,000	\$30,000	\$35,000
	App3	\$10,000	\$8,000	\$6,000
	App4	\$5,000	\$5,000	\$5,000
	App5	\$30,000	\$40,000	\$50,000
Manual	Project A	\$0	\$25,000	\$35,000
	Project B	\$0	\$0	\$10,000
	Total	\$85,000	\$124,000	\$158,000

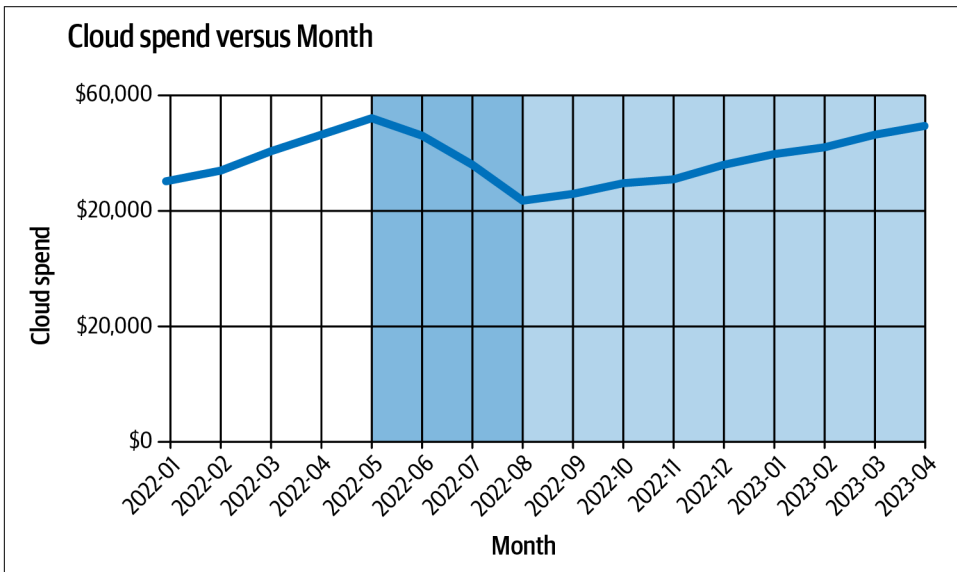


Figure 13-5. Sample cloud spend with FinOps activities starting in 2022-05

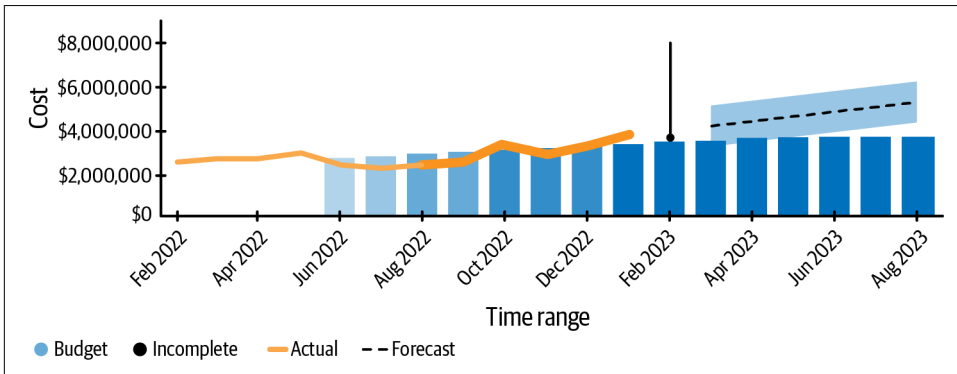


Figure 13-6. A single graph showing the six-month forecast, projected budgets, and actual budgets/use for the previous six months

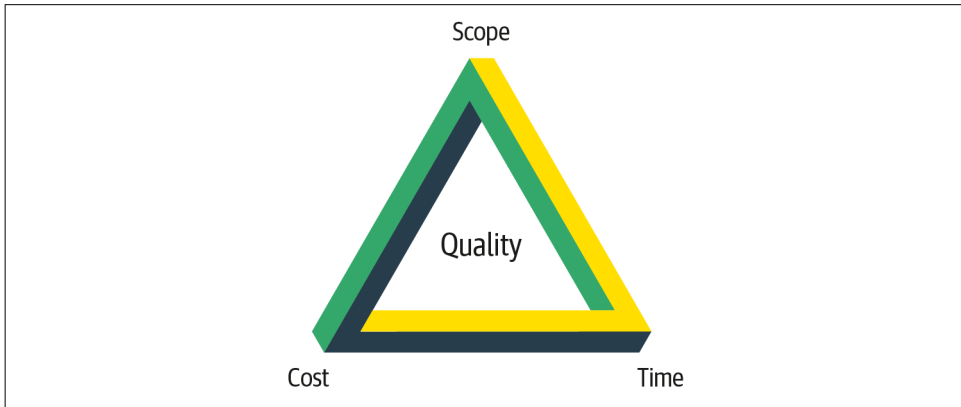


Figure 14-1. The Iron Triangle

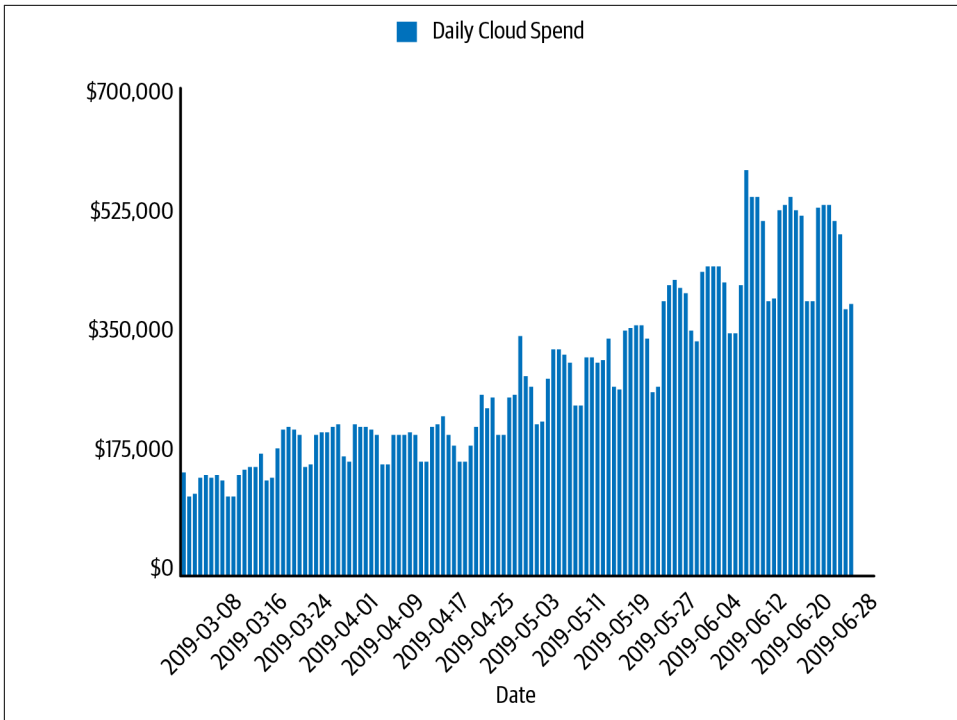


Figure 14-2. Graph of daily spend over a few months

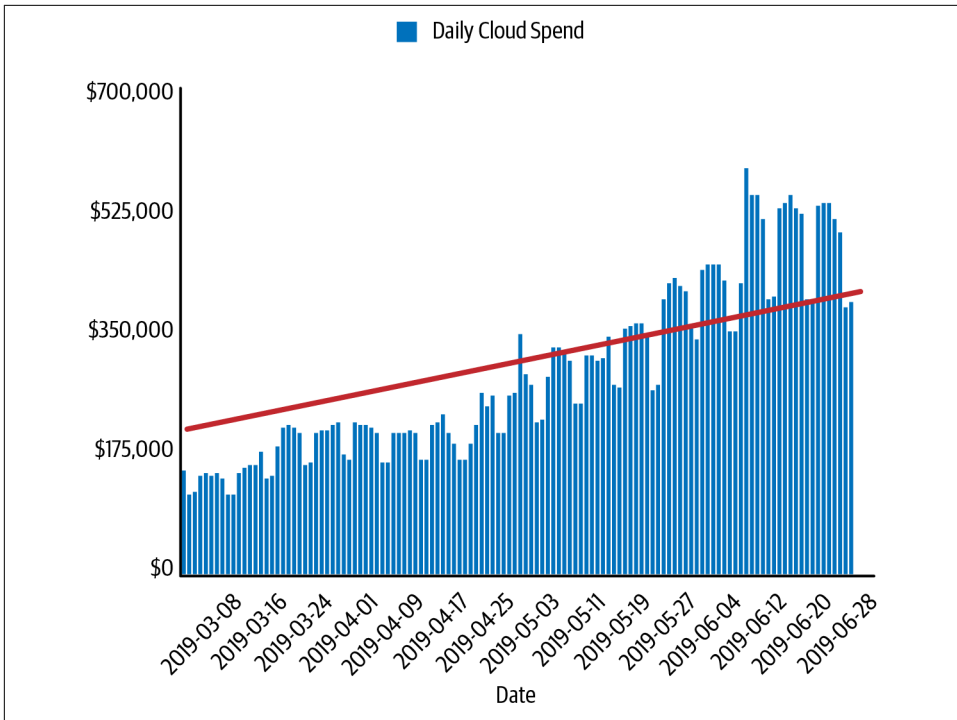


Figure 14-3. Graph of daily spend over a few months with the addition of a target line

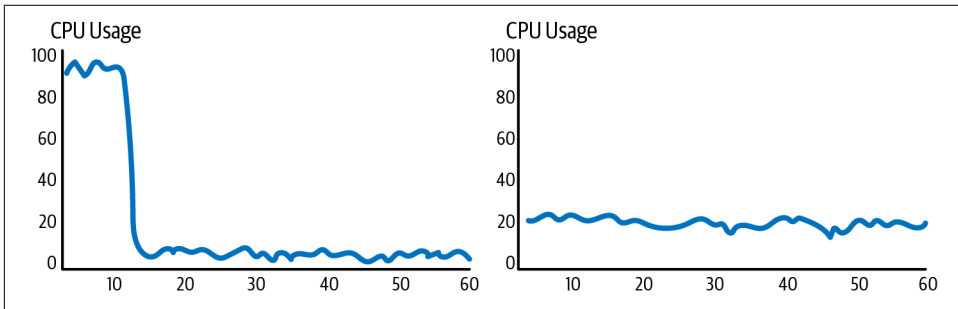


Figure 15-1. Graphs showing two CPU workloads: one has a short 90%+ peak and then remains at <10% for the rest of the hour, while the other is consistently at 20%

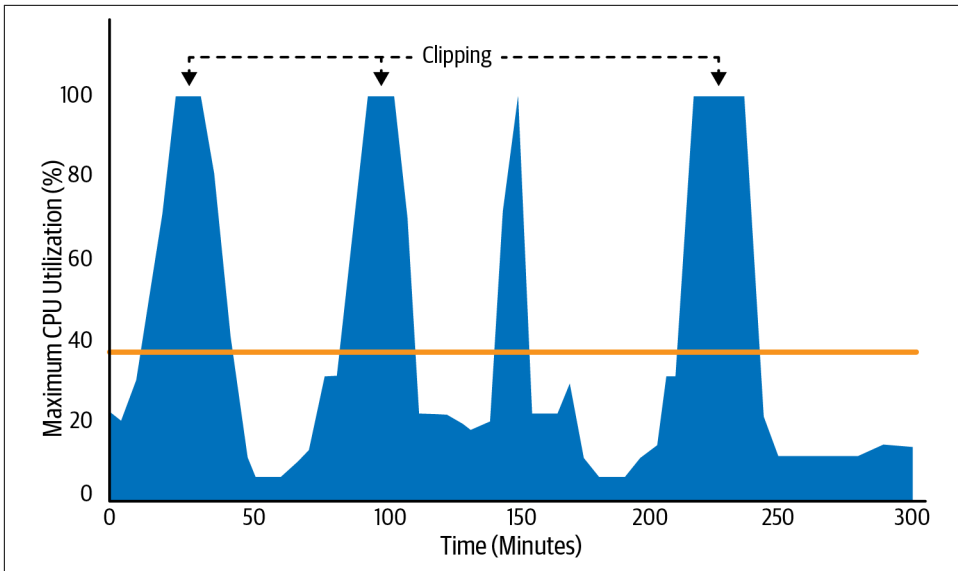


Figure 15-2. Resizing based on averages will cause clipping

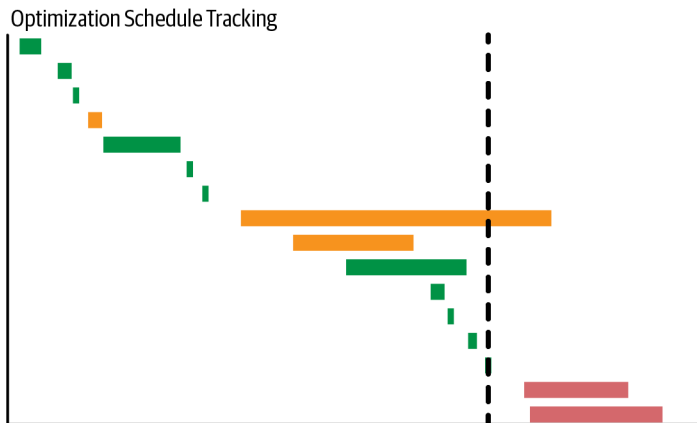


Figure 15-3. Schedule tracking of optimization tasks

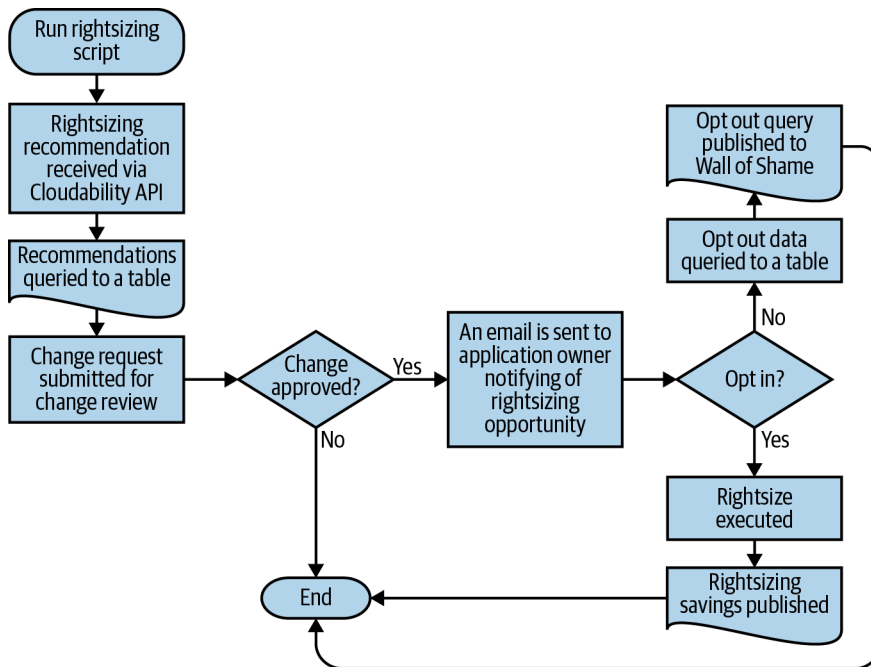


Figure 15-4. Automated rightsizing workflow

Hello,
Your AWS Instance has been identified as a possible candidate for rightsizing.
Instance ID: i-09876543as
Name: dev-test-01
Account: 1234-5678-9901
Current Instance Type: c5.16xlarge
Recommended Instance Type: m5.xlarge
If you do not opt out of this change the FinOps Team will apply this rightsizing recommendation
`on the 23-Sept-2009.
The rightsizing process is as follows:
- Stop instance
- Change the instance type
- Start instance
To opt out please visit the following link: [https://finops.internal.example.com/rightsizing/opt-out/
?InstanceId=i-09876543as](https://finops.internal.example.com/rightsizing/opt-out/?InstanceId=i-09876543as)
Thanks

Figure 15-5. Sample email notification for automated rightsizing

Table 16-1. Comparison of reservation options across the big three cloud service providers

	AWS	Google	Azure
Public price	On-demand	On-demand	Pay-as-you-go
Spot	Spot	Spot/preemptible	Spot VM
Sustained use discount	N/A	Sustained Use Discounts (SUDs) ^a	N/A
Reserved	RI/SPs	CUDs/Flexible CUDs	Reserved VM instances/SPs
Volume discounts	Volume discounts	Volume discounts	Volume discounts

^a SUDs are being phased out for new instance families, because customers favor the predictability of CUDs.

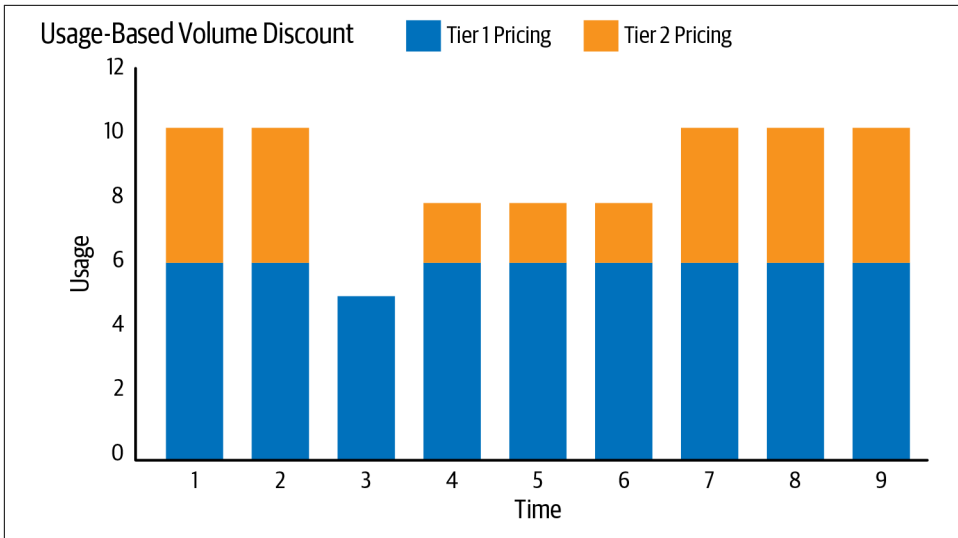


Figure 16-1. Usage-based volume discount graph

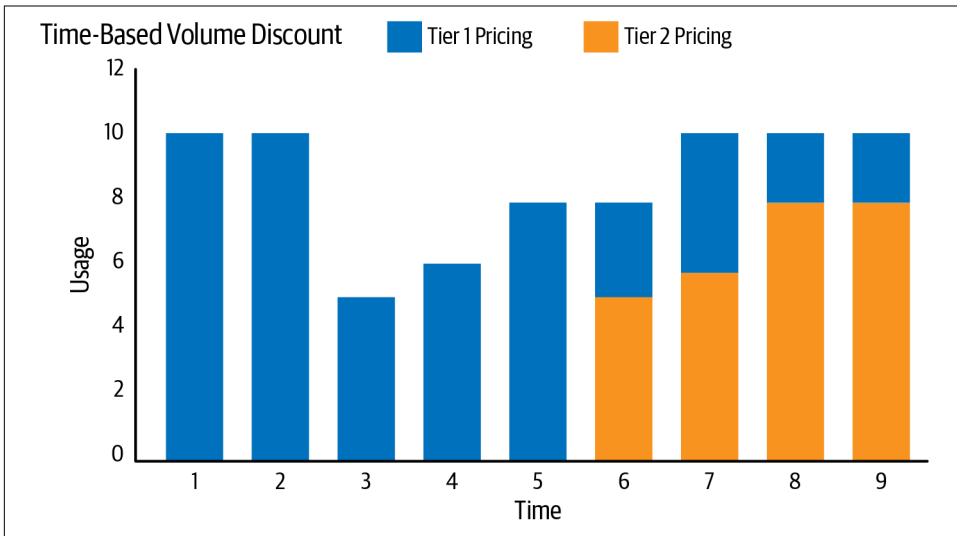


Figure 16-2. Time-based volume discount graph

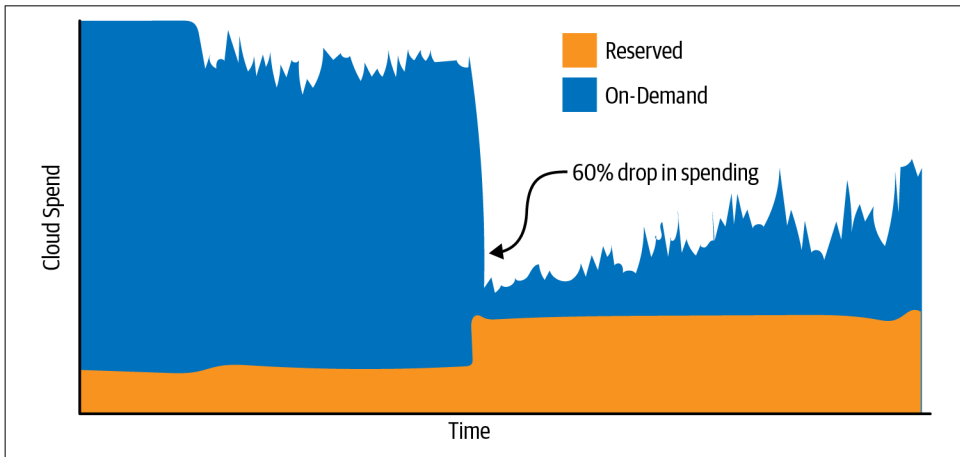


Figure 17-1. The impact of reservations on cloud spend

Table 17-1. Comparison of reservation offerings across the top three cloud service providers

	AWS	Google	Azure
Program name	Reserved Instances/Savings Plans	Committed Use Discounts/ Flexible CUDs	Reservations/Savings Plans
Payment model	All up front, partial, no up front (different discount rates)	No up front	All up front, monthly (same price)
Term	One or three years	One or three years	One, three, or five years
Instance size flexibility	Yes	N/A	Yes
Convert or exchange	Standard, No Convertible, Yes	Yes, splitting and merging	Yes
Cancelable	No; however, some RIs can be sold via a marketplace	No	Yes, up to a yearly value limit
Sustained use discounts	No	Yes ^a	No

^a SUDs are being phased out for new instance families, because customers favor the predictability of CUDs.

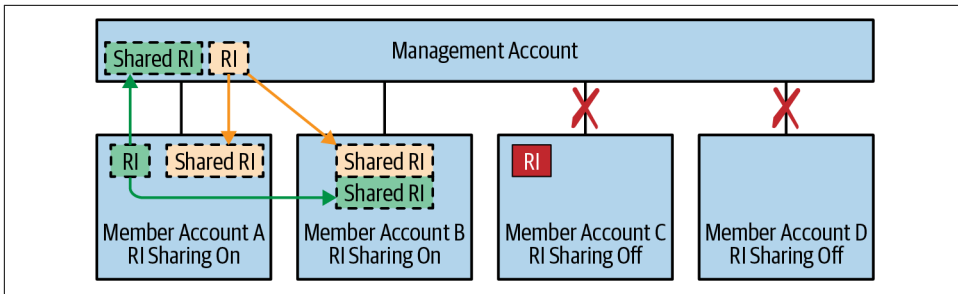


Figure 17-2. Discount interactions with RI sharing

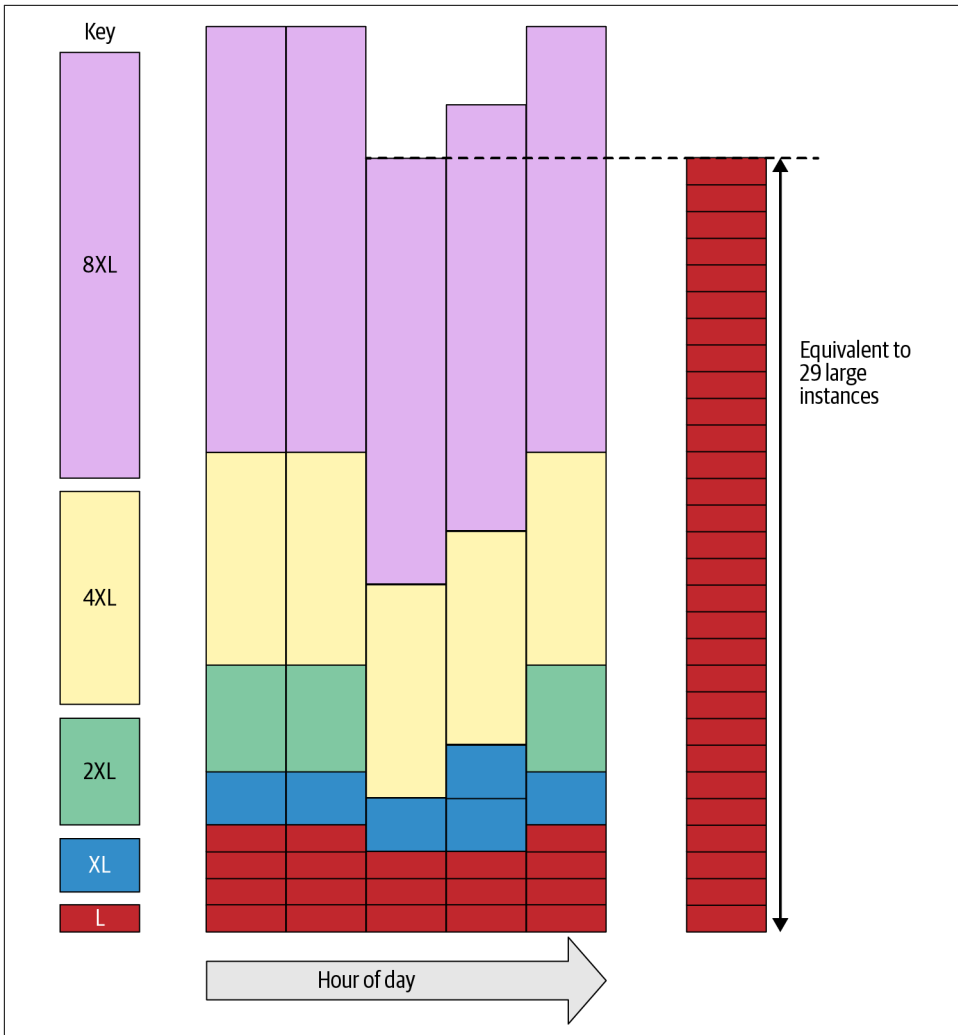


Figure 17-3. Conversion of AWS instance sizes to a normalized size with size flexibility

Table 17-2. Normalization factors for AWS reservations

Instance size	Normalization factor	Instance size	Normalization factor
nano	0.25	6xlarge	48
micro	0.5	8xlarge	64
small	1	9xlarge	72
medium	2	10xlarge	80
large	4	12xlarge	96
xlarge	8	16xlarge	128
2xlarge	16	18xlarge	144
3xlarge	24	24xlarge	192
4xlarge	32	32xlarge	256

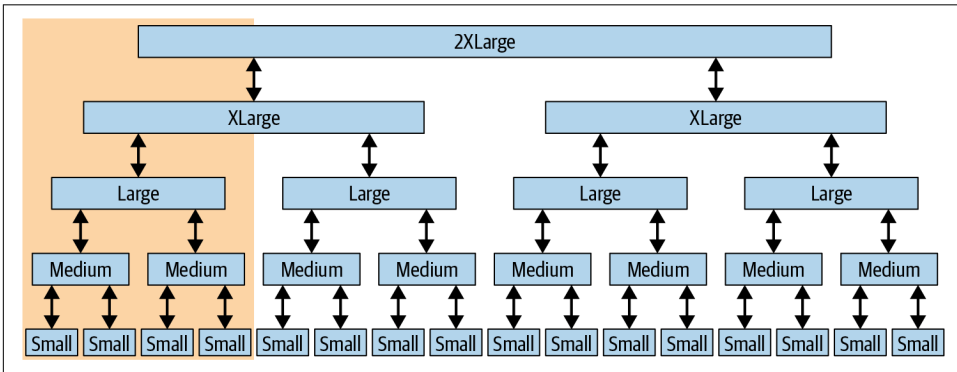


Figure 17-4. Application of reservations with ISF

Table 17-3. The ratio table for the DSv3-series instances

Size	Ratio units	Size	Ratio units
Standard_D2s_v3	1	Standard_D16s_v3	8
Standard_D4s_v3	2	Standard_D32s_v3	16
Standard_D8s_v3	4	Standard_D64s_v3	32

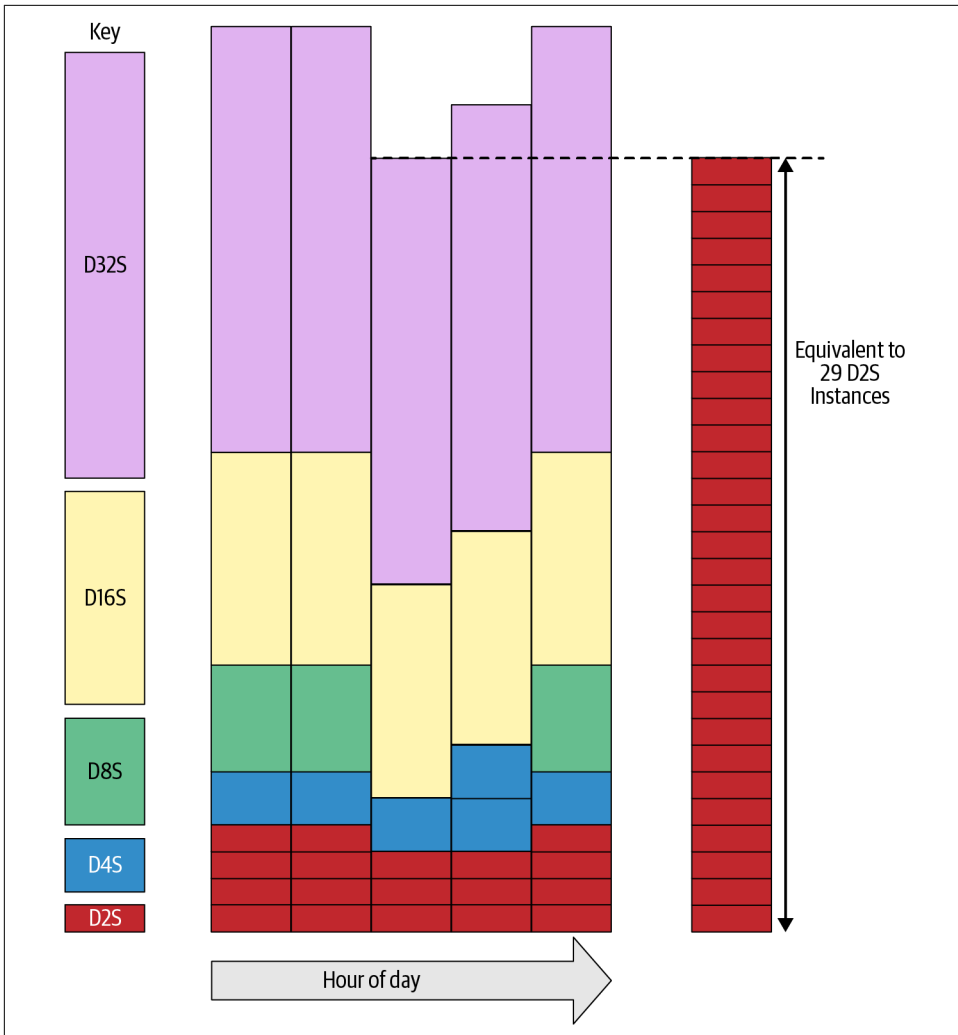


Figure 17-5. Conversion of Azure instance sizes to a normalized size with size flexibility

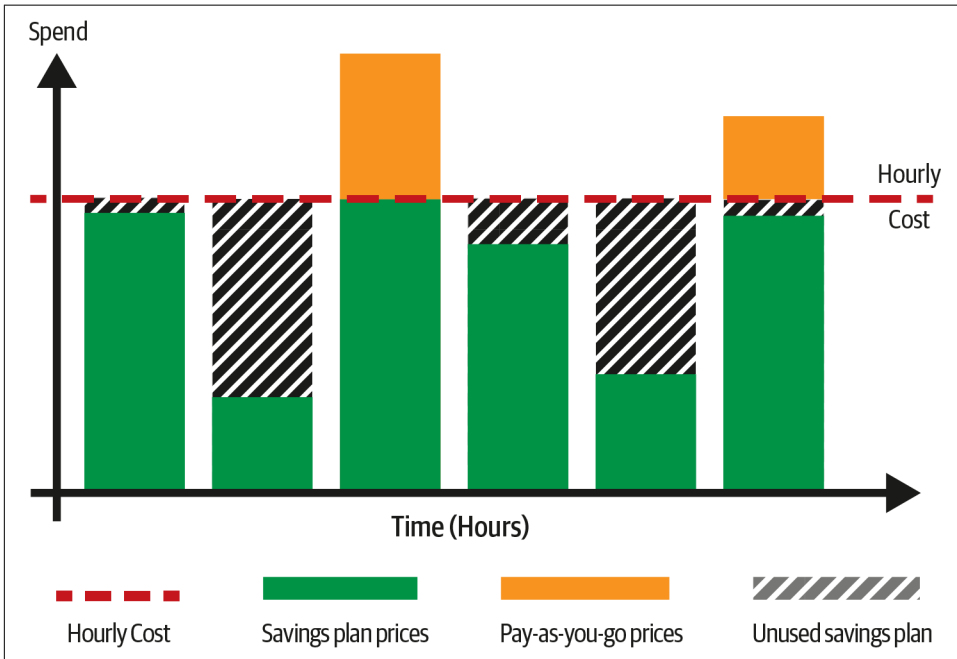


Figure 17-6. SPs showing under- and overutilization hours (source: *Azure documentation*)

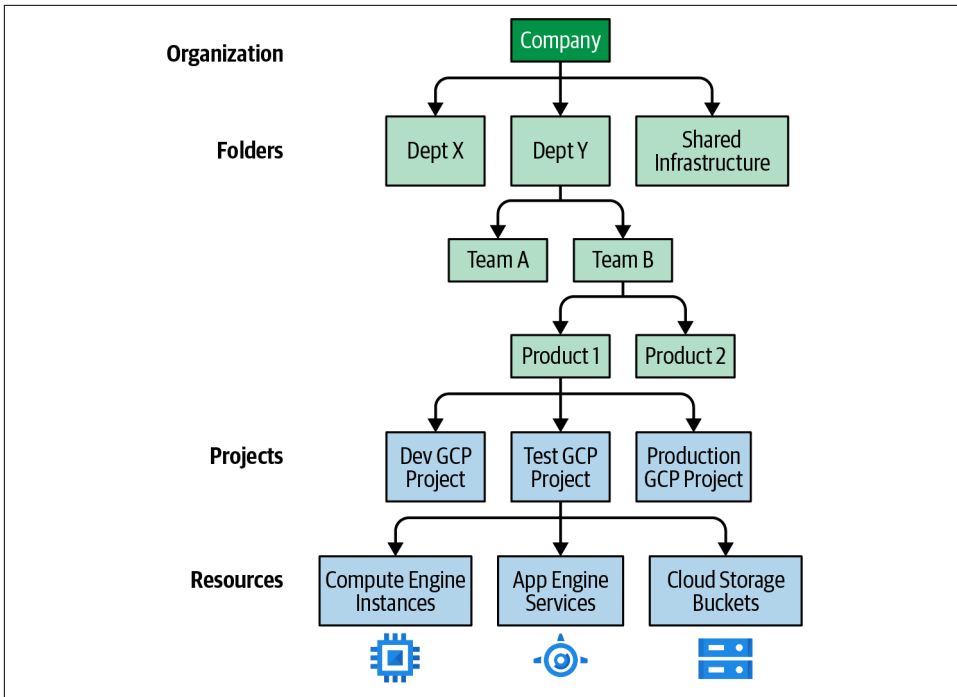


Figure 17-7. Google project and folder hierarchy

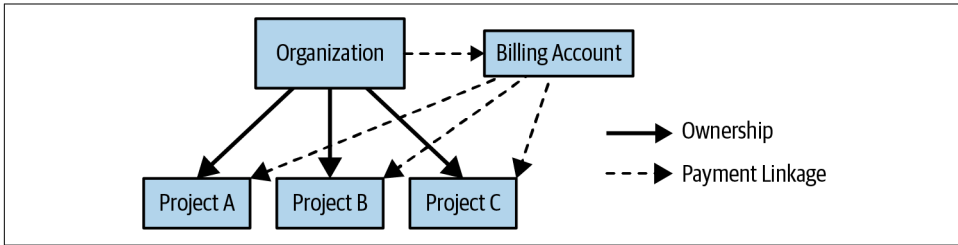


Figure 17-8. Google billing account and ownership

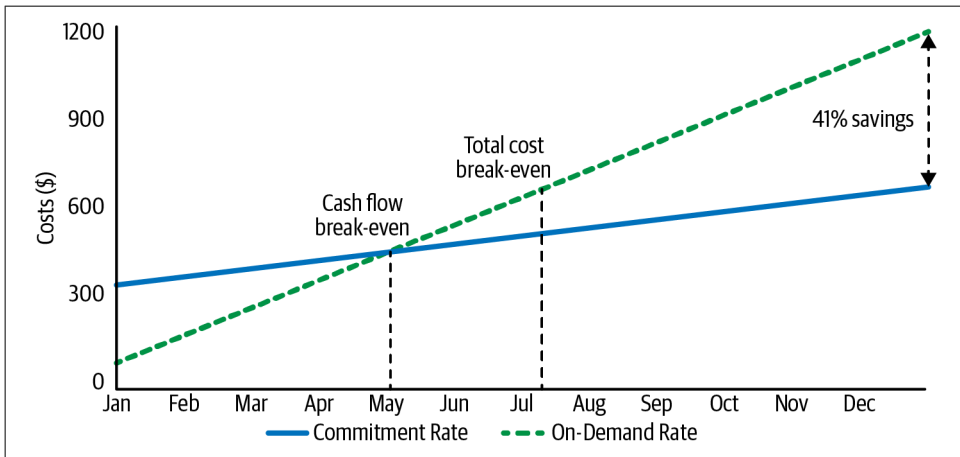


Figure 18-1. Commitment-based discount cash flow

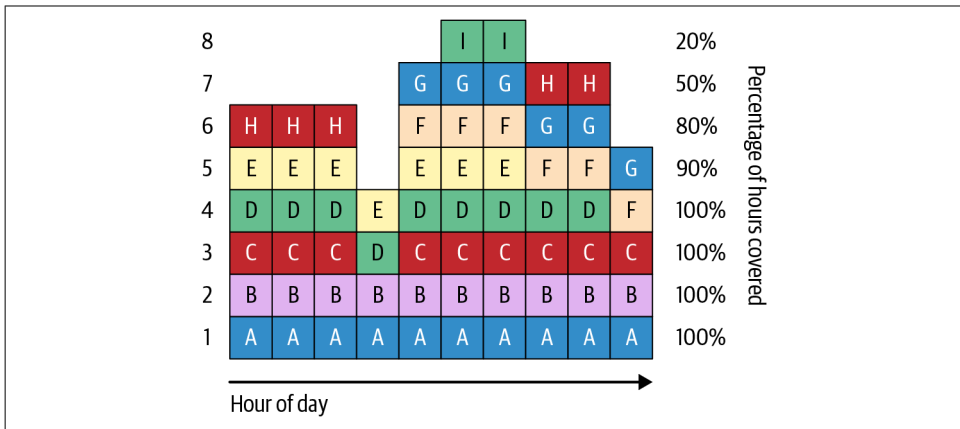


Figure 18-2. Commitment utilization

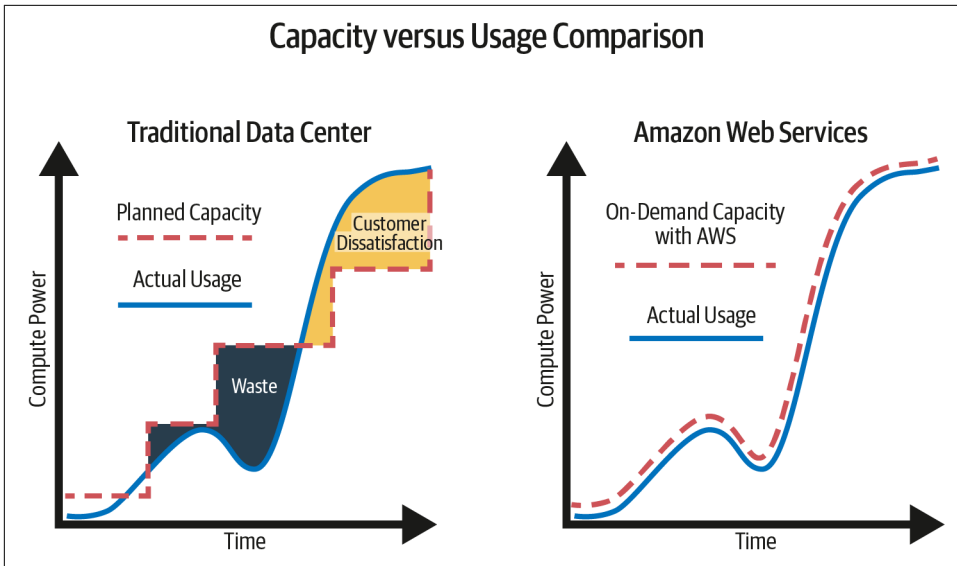


Figure 18-3. Diagram AWS used to host on their website

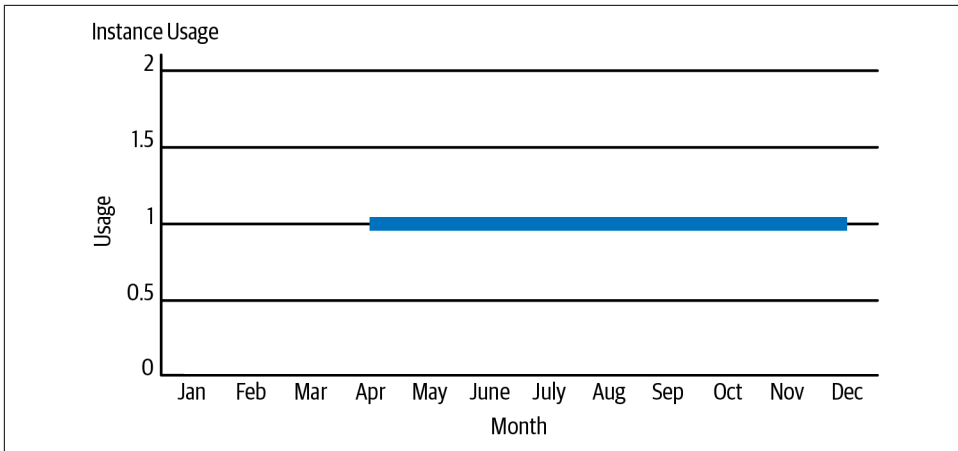


Figure 18-4. Resource usage starting in April and running for nine months

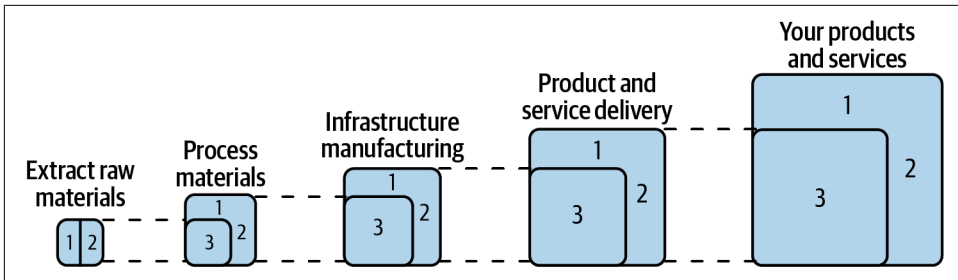


Figure 19-1. Visualization of how different scope emissions stack together and feed into scope 3 emissions as you move up the value chain

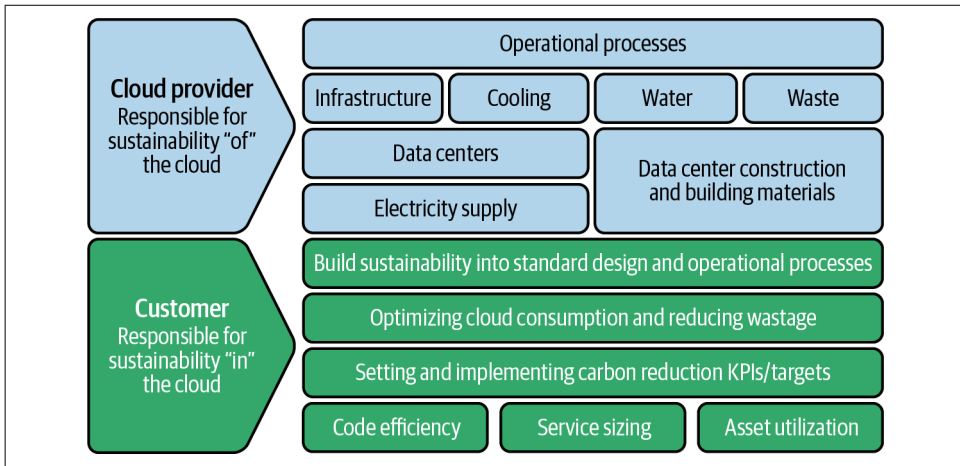


Figure 19-2. The cloud sustainability shared responsibility model (contributed by Mark Butcher)

Table 19-1. Comparison of the price and green energy used by a single e2-highcpu-32 instance within Google Cloud

Region	Location	% green energy	Price per month
us-central1	Iowa	97%	\$578
us-east1	South Carolina	25%	\$578
us-east4	Northern Virginia	64%	\$651
us-east5	Columbus	64%	\$578
us-south1	Dallas	40%	\$682
us-west1	Oregon	88%	\$578
us-west2	Los Angeles	53%	\$694
us-west3	Salt Lake City	31%	\$694
us-west4	Las Vegas	21%	\$651
Average		54%	\$631

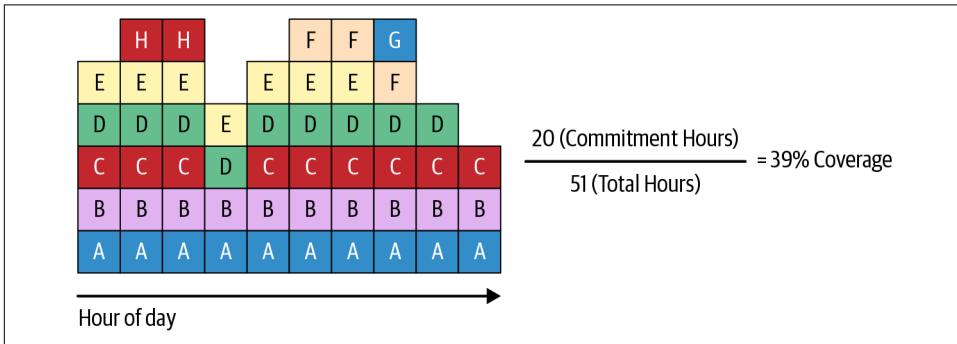


Figure 22-1. Commitment coverage calculated via raw hours

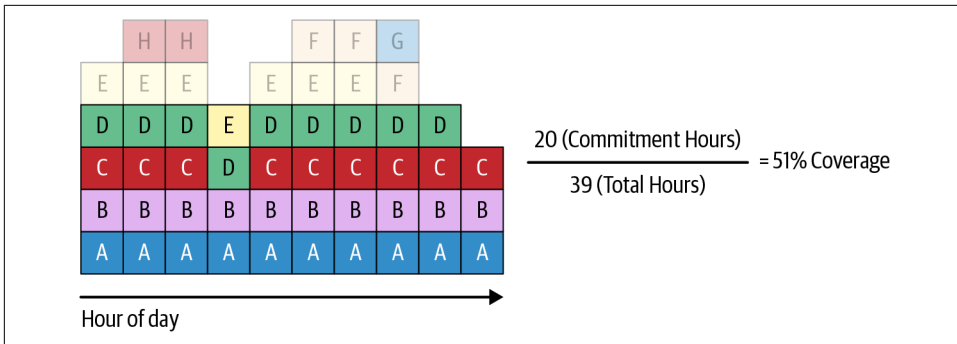


Figure 22-2. Commitment coverage calculated via coverable hours

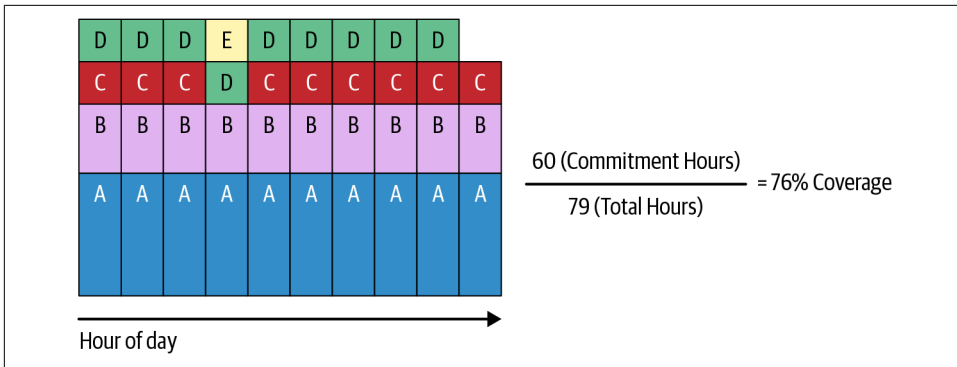


Figure 22-3. Commitment coverage calculated via weighted coverable hours

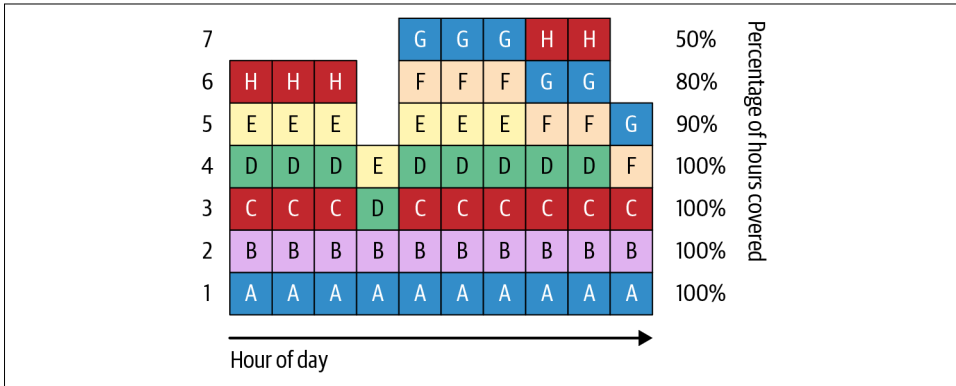


Figure 22-4. Commitment usage over time

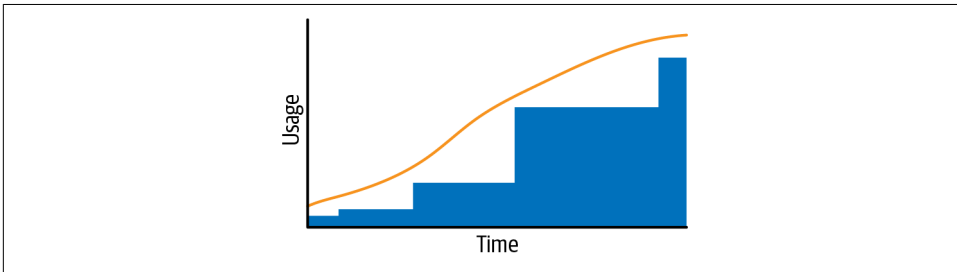


Figure 22-5. Commitment coverage when performed infrequently

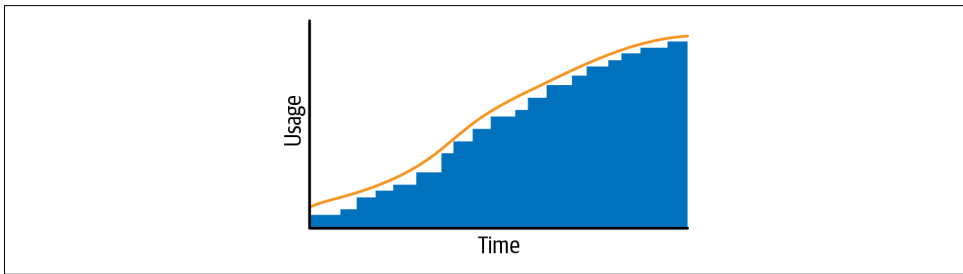


Figure 22-6. Commitment coverage when performed frequently

Table 22-1. Policy changes and automation processes put into place to manage multipart uploads

Phase	Lens	Process	Action
Inform	Knowledge	Awareness of impact for change	800+ AWS accounts and no lifecycle rule configured for S3 incomplete multipart uploads
Inform	Process	Who will make decisions	Spending 11K per month on incomplete multipart uploads, no single account is exceeding more than 1K
Optimize	Metrics	Baseline KPIs for success	FinOps submit policy to Cloud Governance board for review, vote to move to implement
Optimize	Adoption	How will implementation be communicated	Decision made for remediation after 14 days and ability to opt-out
Operate	Automation	Offload repetitive tasks to tooling	Cloud Custodian policy created by Cloud Management engineering team

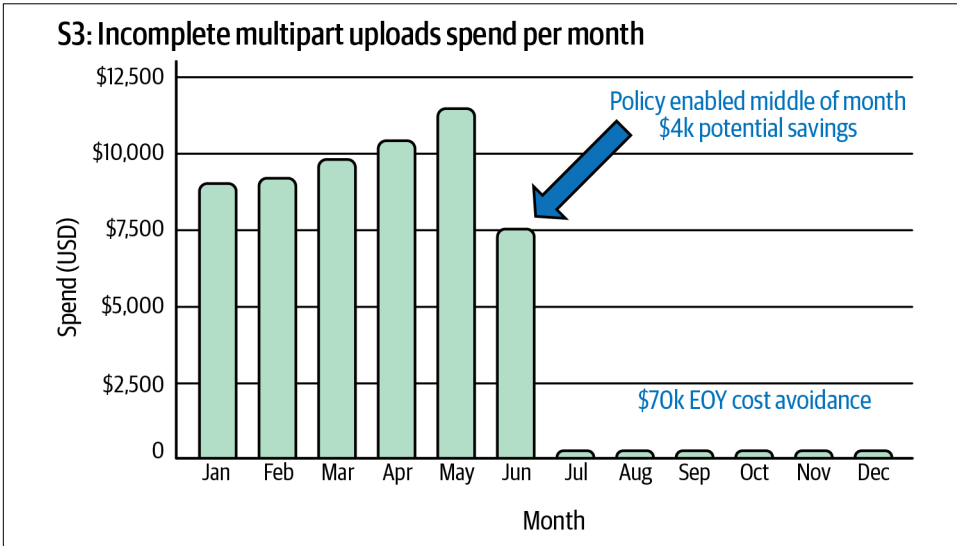


Figure 22-7. Spending decline after a multipart upload policy is put in place

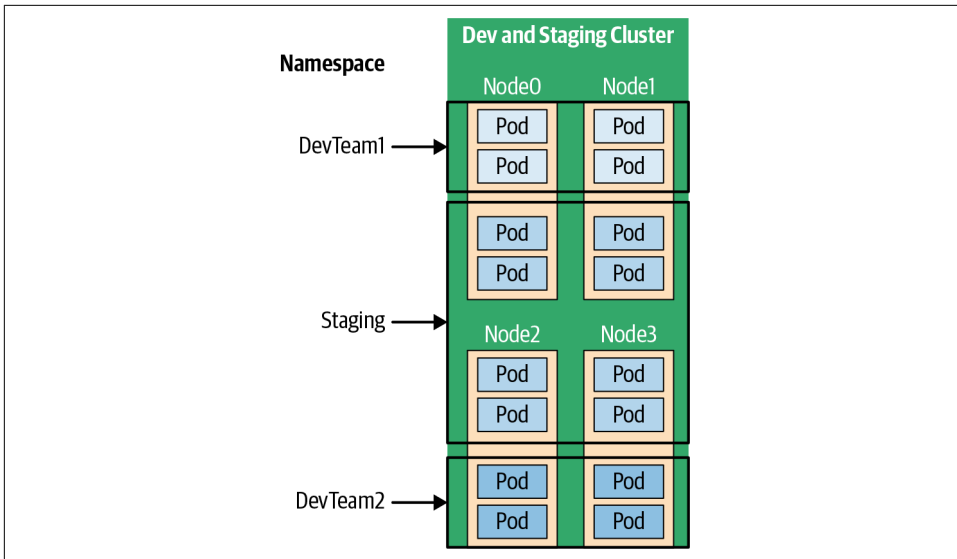


Figure 23-1. Basic view of a Kubernetes cluster

Table 23-1. Example container allocation on a server instance

ServerID	Container ID	Service label	vCPU	Mem (GB)	Time (mins)	Proportion
i-123456	1	A	1	2	60	25%
i-123456	2	A	1	2	60	25%
i-123456	3	B	0.5	1	60	12.5%
i-123456	4	C	1	2	15	6.25%

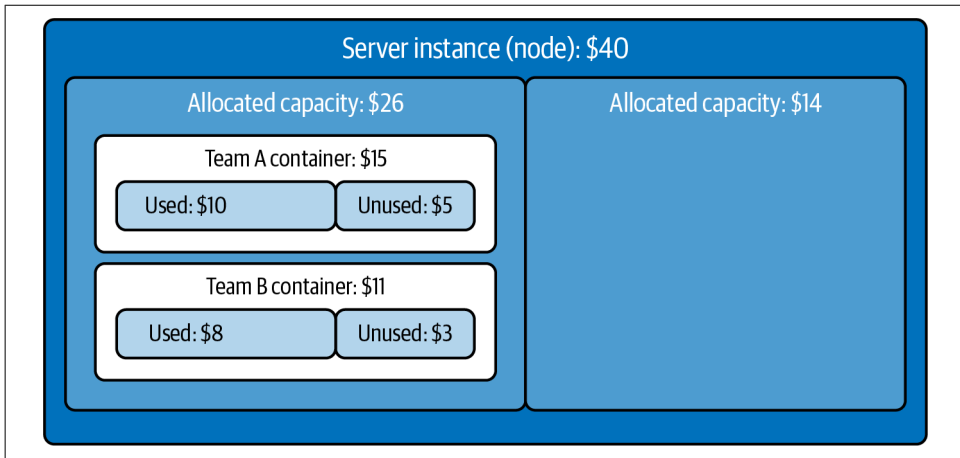


Figure 23-2. Unallocated capacity on a server instance/node

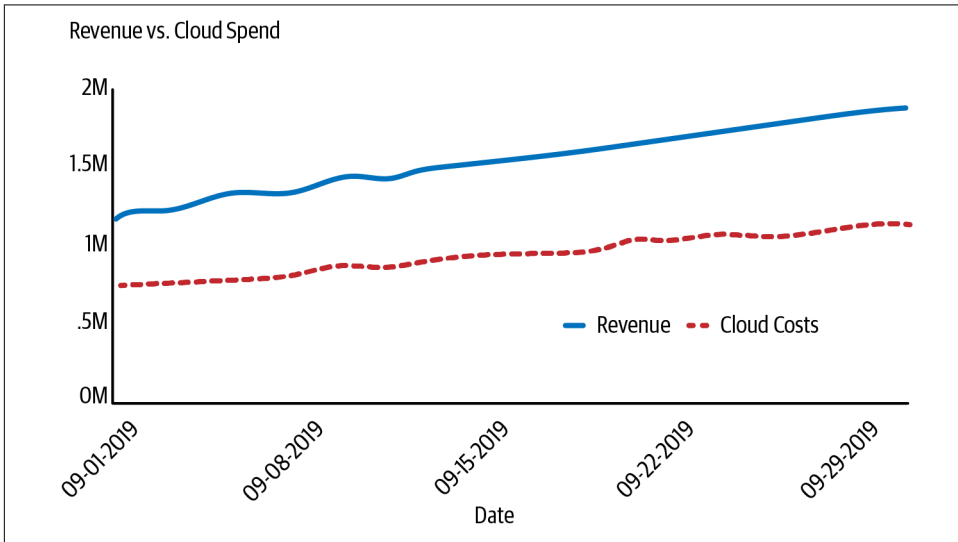


Figure 26-1. Company with stable revenue and cloud costs

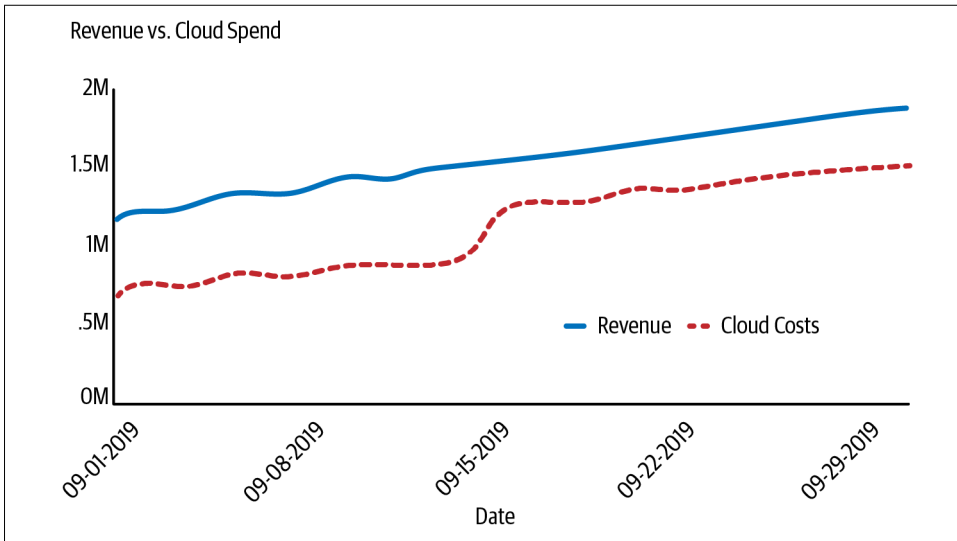


Figure 26-2. Company revenue and cloud costs during the introduction of a free-tier offering

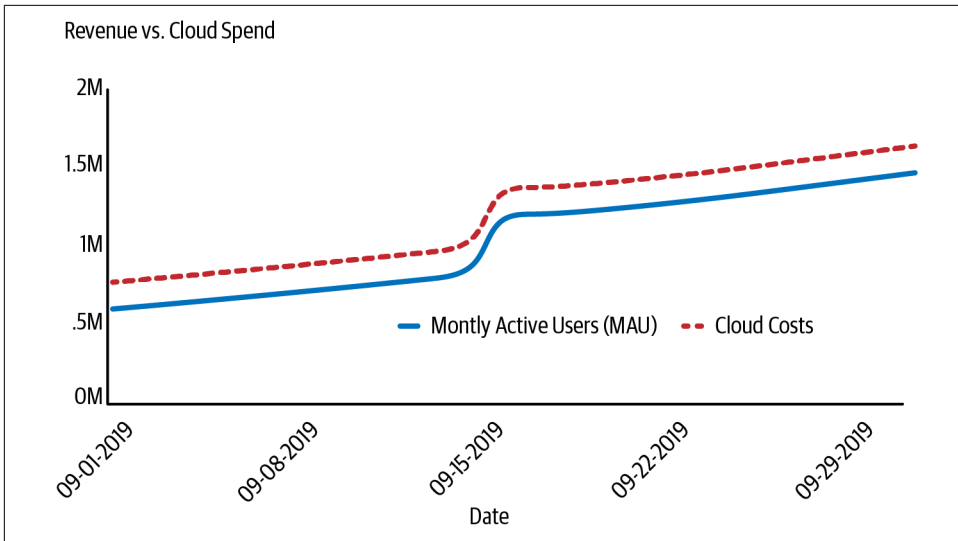


Figure 26-3. Monthly active users and company cloud costs during the introduction of a free-tier offering

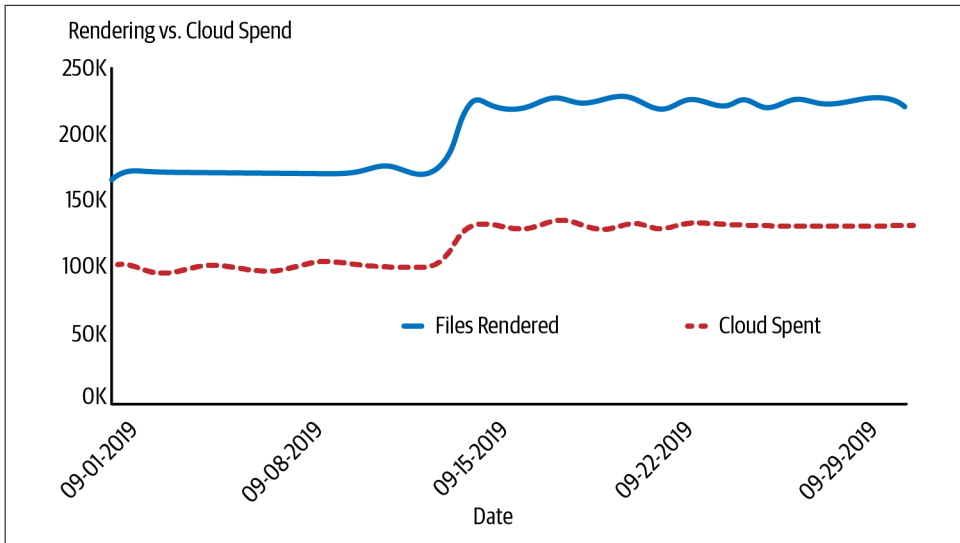


Figure 26-4. Files rendered over the costs, increased rendering

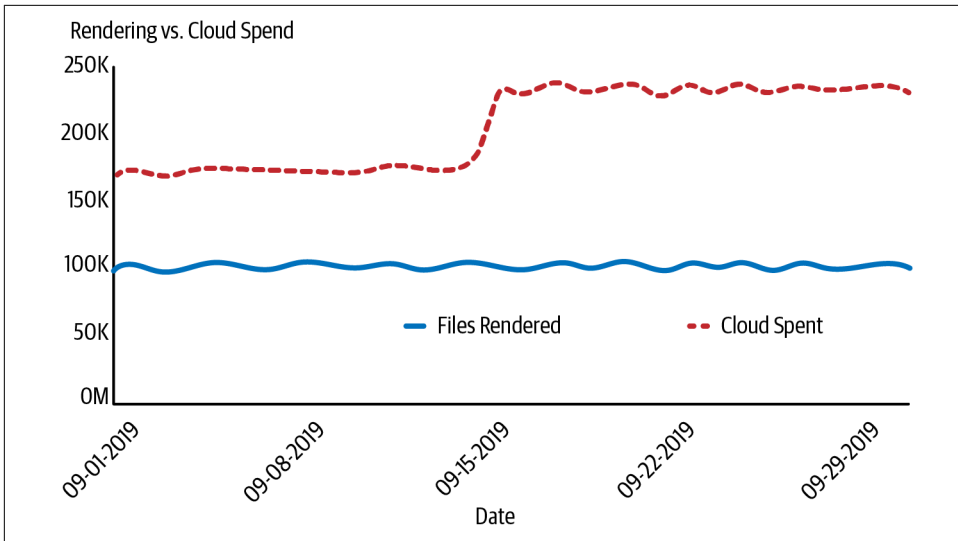


Figure 26-5. Files rendered over the costs, increased cost