

Cloud

Computing



**Caltech** | Center for Technology & Management Education

**Post Graduate Program  
in Cloud Computing**

Cloud

Computing



**Caltech** | Center for Technology & Management Education

**PG CC - Microsoft Azure Architect  
Design: AZ:304**



## Design for Cost Optimization

# Learning Objectives

By the end of this lesson, you will be able to:

- Recommend a solution for cost management
- Recommend a solution for cost reporting
- Recommend solutions to minimize costs

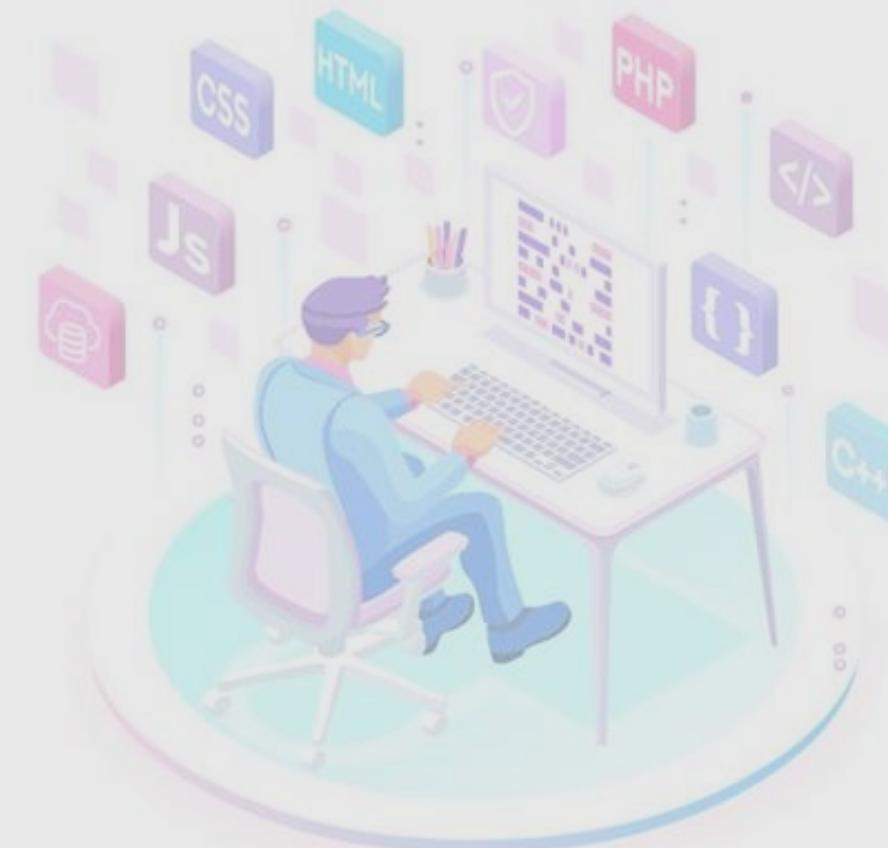


# A Day in the Life of an Azure Architect

You are working as an Director – Cloud Engineering in an organization. You are responsible for identifying and managing costs for your organization. As a part of monthly review meeting, you have been asked to report on the services with the highest cost.

- You have noticed that, though the cost of computes are low but there is significant cost getting incurred on the networking due to the large amount of egress data from the VMs. You need to recommend a solution to analyze the cost by services.
- Also, to minimize the cost you're looking for a solution that will inform you when expenditure, based on usage or cost, hits or exceeds the amount indicated in the budget's alert condition.

To achieve all of the above, along with some additional features, we would be learning a few concepts in this lesson that will help you find a solution for the above scenario.



## Recommend a Solution for Cost Management and Cost Reporting

# Azure Cost Management

Today's businesses are operating in a complex cloud environment:



Running millions of  
cloud resources

Microsoft Azure



Google Cloud Platform



Running on multi-cloud  
environments



Running across business  
units and projects

# Azure Cost Management

Microsoft's Azure cost management and billing is a set of tools that allows the user to evaluate, manage, and optimize the costs of the workloads.



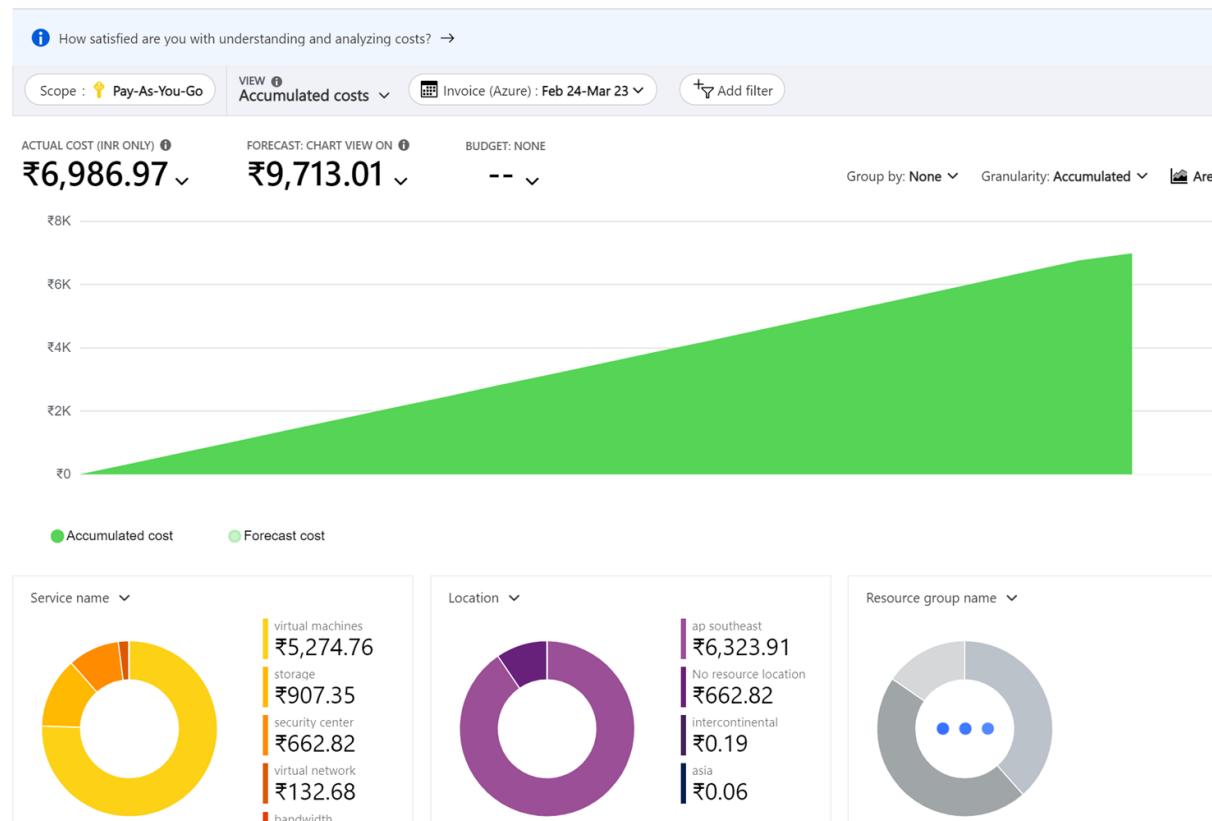
- Users only pay for what they use.
- They are charged for the services based on usage.

Without effective analysis and monitoring, the expenses of your workloads can skyrocket due to the simplicity with which more resources can be deployed.

# Azure Cost Management

Cost management displays organizational cost and usage patterns.

It shows usage-based costs consumed by Azure services and third-party marketplace offerings.



- Conduct cost analysis
- Create a budget
- Review recommendations
- Export the data

# Optimize with Azure Cost Management

Cost management is an organizational issue that should be addressed before investing in cloud computing resources.

To successfully implement cost management and optimize costs, your organization must:



- Ensure you have the right tools for success
- Be accountable for the expenses
- Develop a strategy to optimize spending

# Optimize with Azure Cost Management

To successfully manage costs, three main groups must be aligned.

Finance

Managers

App teams



- People are in charge of approving budget requests across the company based on cloud spending projections.
- To ensure responsibility, they pay the corresponding bill and assign charges to other teams.

# Optimize with Azure Cost Management

Finance

Managers

App teams



- Organizational decision-makers need to understand cloud expenditure to get the greatest returns.

# Optimize with Azure Cost Management

Finance

Managers

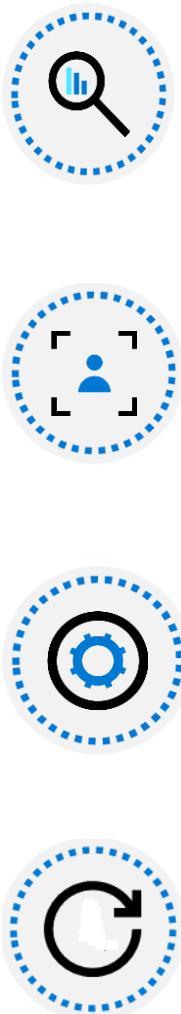
App teams



- Engineers who manage cloud resources daily, design services to satisfy the demands of the enterprise.
- These teams require flexibility to deliver the maximum value within their budget constraints.

# Cost Design Principles

Key principles for cost management are:



- Visibility
- Accountability
- Optimization
- Iteration



# Visibility

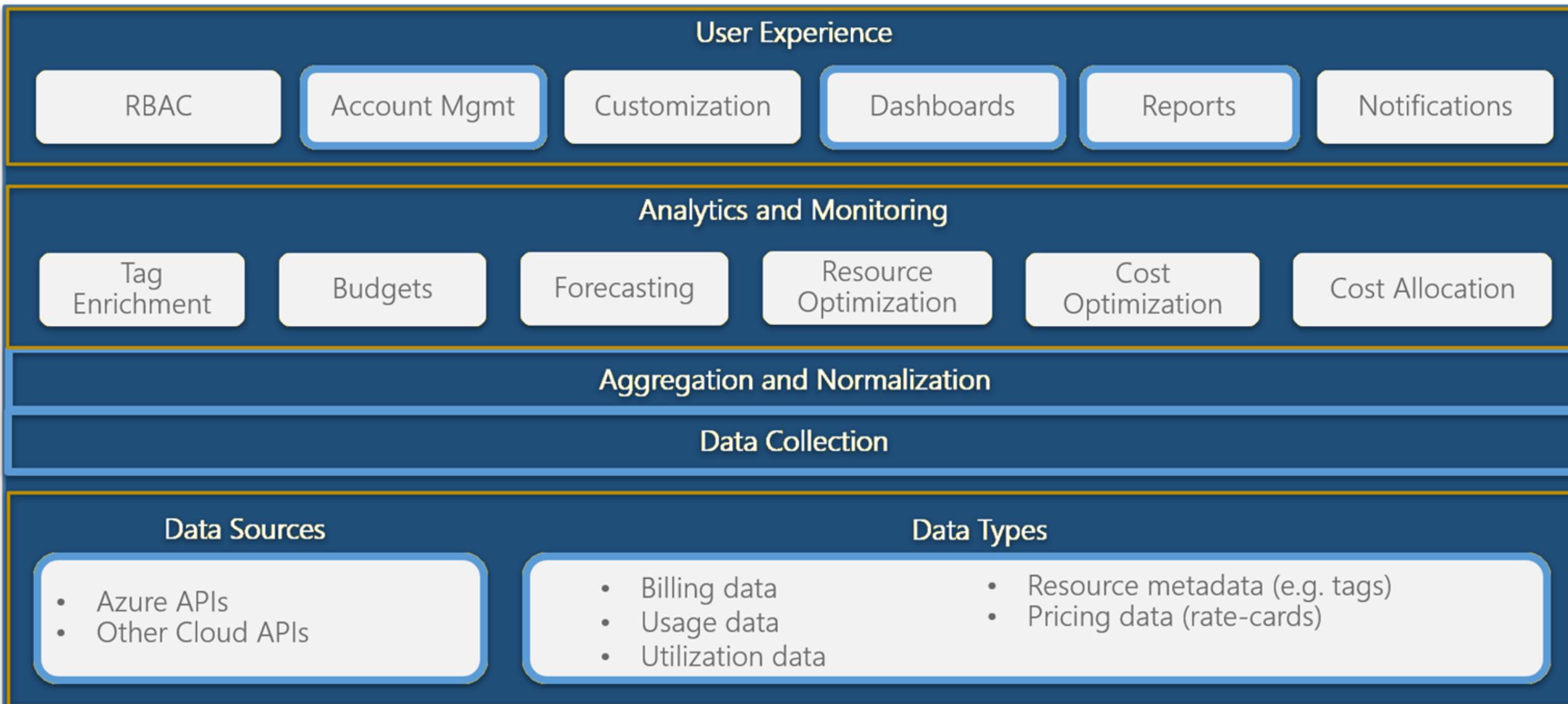
Cost management, when properly structured, assists organizations in informing people about the Azure costs for which they are responsible, as well as the money they spend.



- Azure provides features that allow users to see where their money is going.
- Users should utilize these tools to their best.

# Visibility

The tools provided by Azure can assist users in identifying underutilized resources, eliminating waste, and maximizing cost-cutting potential.



# Accountability

Accountability can be implemented by:

- Extending visibility to stakeholders
- Making them cost-aware
- Making them accountable
- Setting clear budgets
- Setting alerts (be notified of any anomalies)
- Challenging them to get better



# Optimization

Optimization means taking measures to cut costs.



Make the most of it based on the information acquired through cost visibility and planning.

## Optimization is not a one-time effort

- Cloud is a constantly changing place
- New projects, new applications, and changing loads

# Optimization

Optimization can be of two types:



## Resource optimization

- Correct families and sizes
- Correct resource or service types

## Cost optimization

- When to buy more or less reserved instances

# Design with Cost in Mind

The common questions for cost analysis include:

- Cost estimation for the current month
- Anomaly investigation
- Invoice reconciliation
- Internal chargeback

The screenshot shows the Microsoft Azure Cost Management + Billing interface. The left sidebar includes sections for Overview, None selected, Access control, and the currently selected 'Diagnose and solve problems'. The main content area is titled 'Common problems' and lists several troubleshooting links under categories like Cost management, Partners, Support + troubleshooting, and Cost management.

- Cost management**
  - What costs are included in Cost Management?**  
Learn about what costs are included in Azure Cost Management.  
[Troubleshoot](#)
  - How do I analyze unexpected costs that I have received?**  
Learn about techniques you can use to better understand unexpected costs.  
[Troubleshoot](#)
  - Why can't I see costs, after I transferred my subscription to a new ...**  
Learn about how transfer scenarios affect the cost data seen in cost management.  
[Troubleshoot](#)
  - Optimizing cloud investments in Azure Cost Management**  
In this video, you will get an overview of advisor recommendation in Azure Cost Management and how to leverage it to ...  
[Troubleshoot](#)
  - How to assign access with Azure Cost Management**  
In this video, you will learn how to assign access with Azure Cost Management and provide access to your team.  
[Troubleshoot](#)
  - How to review tag policies with Azure Cost Management**  
In this video, you will learn how to review tagging policies which allow you to manage your cloud costs with Azure Co...  
[Troubleshoot](#)
- Partners**
  - How do I use Cost Management as a partner?**  
Learn about how to setup and use Cost Management as a partner  
[Troubleshoot](#)
- Support + troubleshooting**
  - New support request**



## Recommend a Solution to Minimize Costs

# Plan and Estimate Azure Cost

Azure provides tools to assist users in the assessment process.

Before deploying cloud resources, the following items must be assessed:

The Azure offer  
that best meets  
user needs



The resources  
users plan to use

The estimation of  
their cost

# View Cost Breakdown by Azure Service

1

Review invoiced charges in Cost Analysis



# View Cost Breakdown by Azure Service

2

View cost breakdown by Azure Resource

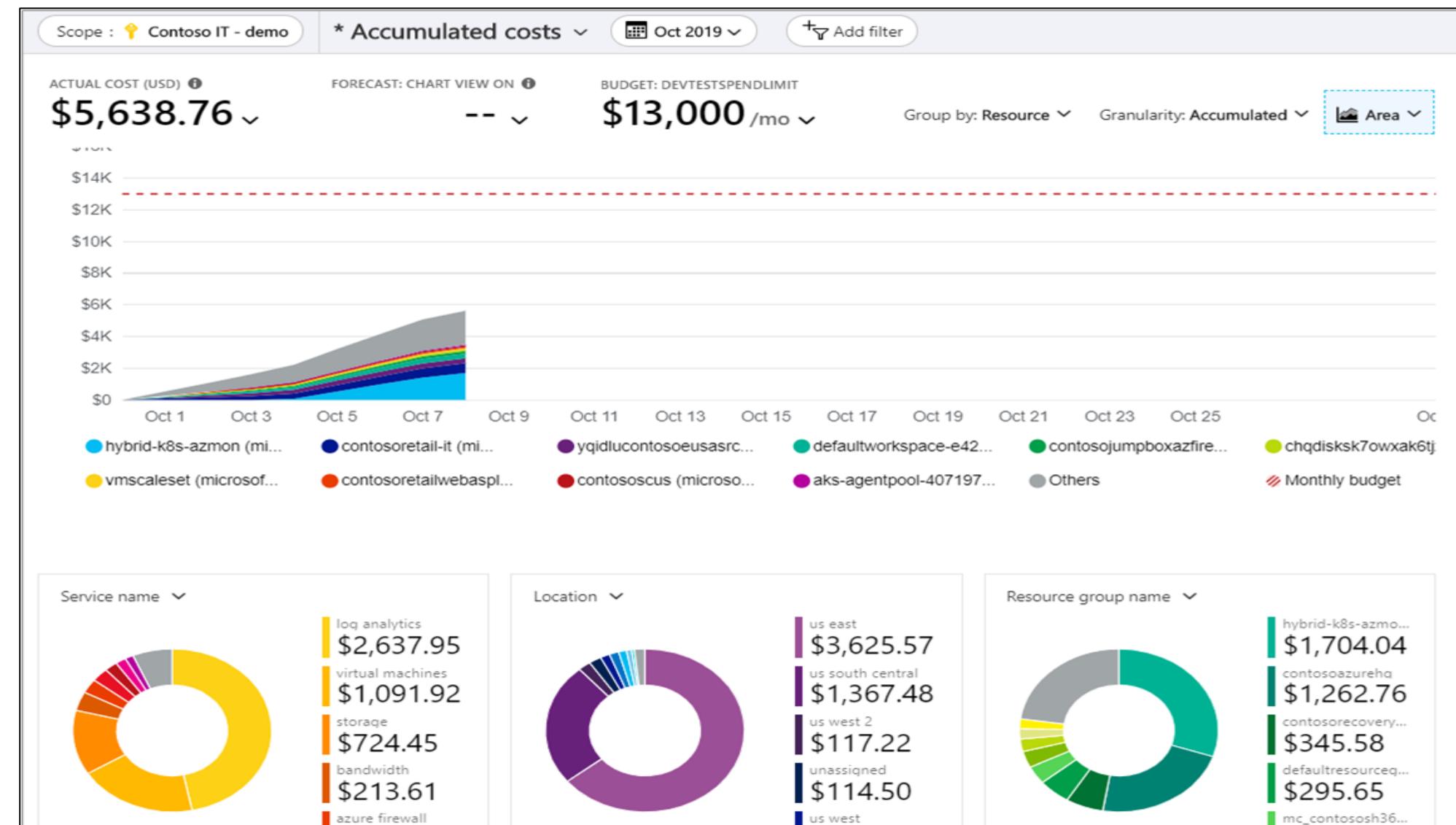
The screenshot shows the Azure Cost Management & Billing portal. At the top, there's a scope filter set to "Contoso IT - demo", a date range from "Oct 2019" to "Oct 2019", and a "Add filter" button. Below that, the "ACTUAL COST (USD)" is displayed as "\$5,638.76". To the right, the "BUDGET: DEVTESTSPENDLIMIT" is shown as "\$13,000/mo". The "Cost by resource" button is highlighted with a red box. A dropdown menu is open, showing options: Home, Built-in views, Accumulated costs, Cost by resource (which is selected and highlighted with a red box), Daily costs, Cost by service, and Invoice details. The main area shows a table with columns: Resource, Resource group n..., Tags, and Cost. The table lists several resources with their details and costs:

Resource	Resource group n...	Tags	Cost		
hybrid-k8s-azmon	Log Analytics workspace	us east	hybrid-k8s-azmon-rg	businessowner: compos...	\$1,704.04
contosoretail-it	Log Analytics workspace	us east	contosoazurehq	businessowner: compos...	\$615.93
yqidlucontosoeusasrcache	Storage account	us south central	contosorecoveryvaulteus	environment:prod	\$311.29
defaultworkspace-e4272...	Log Analytics workspace	us east	defaultresourcegroup-eus	businessowner: compos...	\$295.65
contosojumpboxazfirewall	Firewall	us south central	contosojumpboxfirewall	Not applicable	\$160.15
chqdisksk7owxak6tjx7u	Storage account	us south central	contosoazurehq	displayname:vmstorage	\$107.51
vmscaleset	Virtual machine scale set	us east	contosochefautomatevms	x-application:rhel-harde...	\$78.71

# View Cost Breakdown by Azure Service

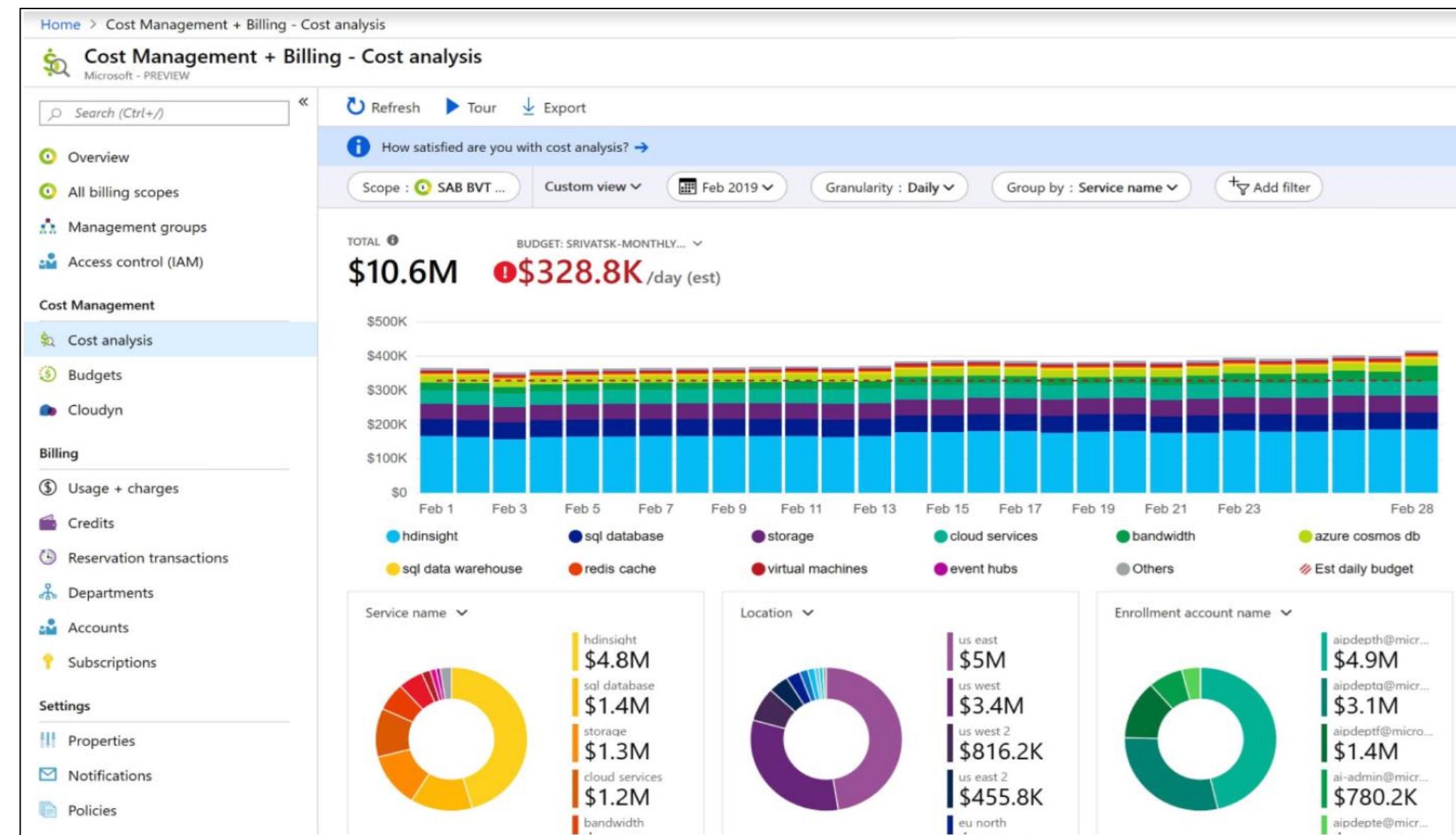
3

View cost breakdown by selected dimensions



# View Costs by Day or Month

Monthly or Daily: Cost Management + Billing > Cost Management > Cost Analysis



# View Reservation Charges

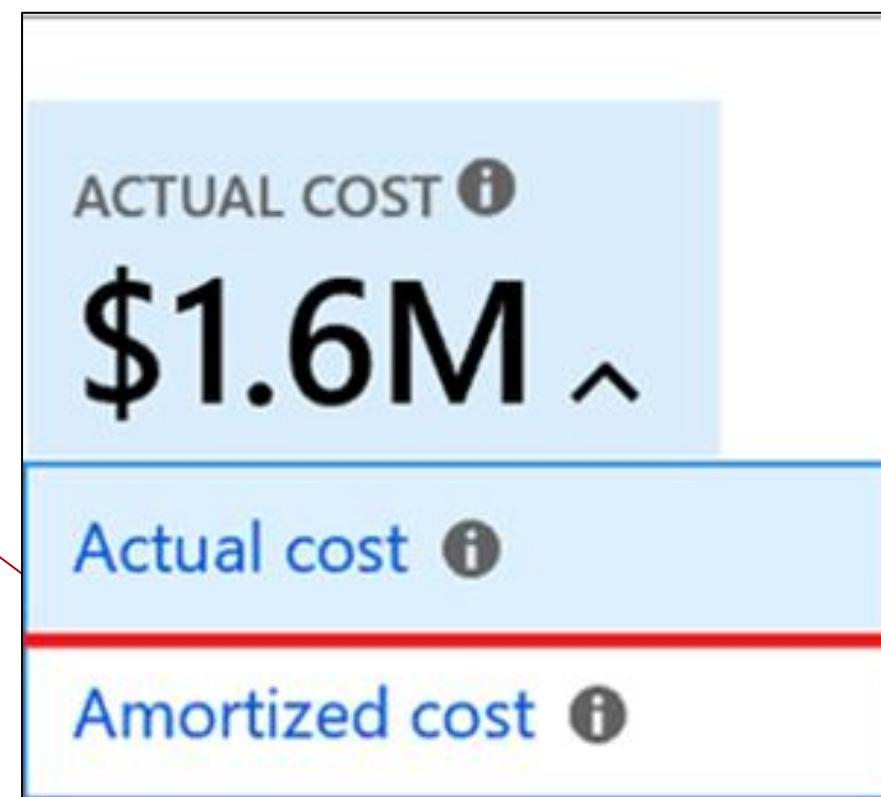
The reservation charges are shown as an actual cost or an amortized cost.

Actual Cost

The purchase as it appears on the bill

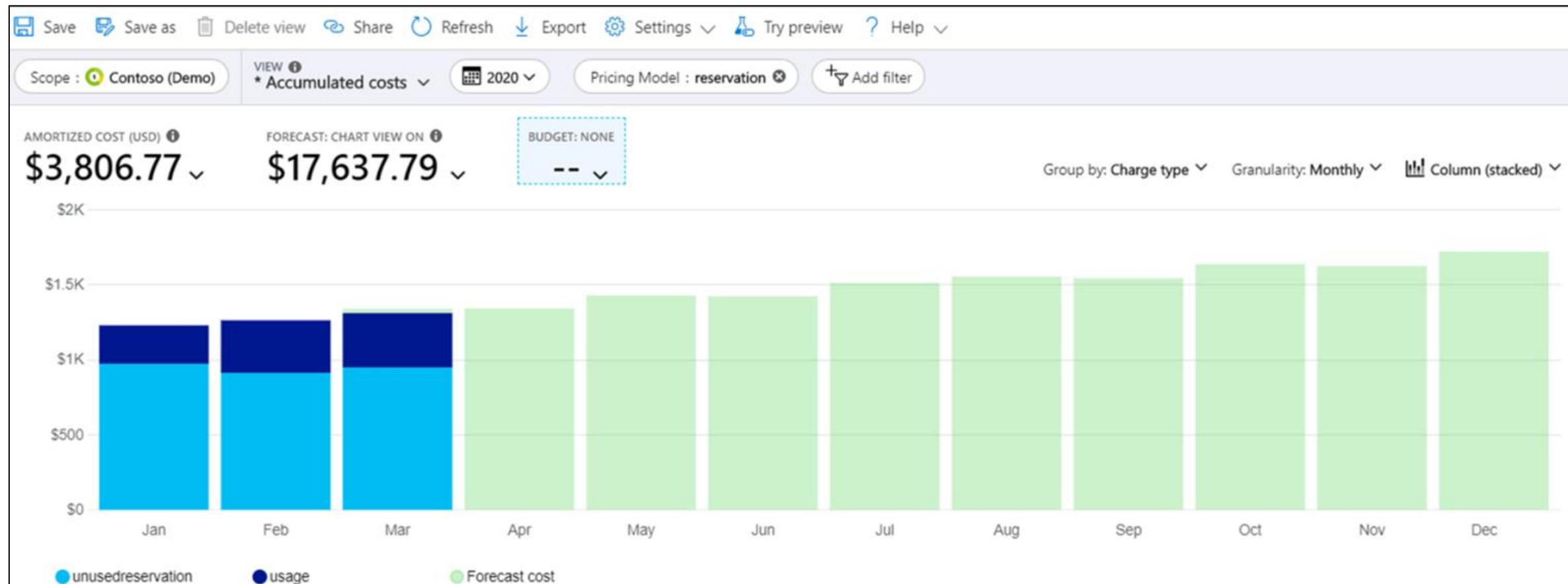
Amortized Cost

Amortized cost over the duration of the reservation term



# View Reservation Charges

After purchasing a reservation, it is important to track utilization.



# View Cost for a Specific Tag

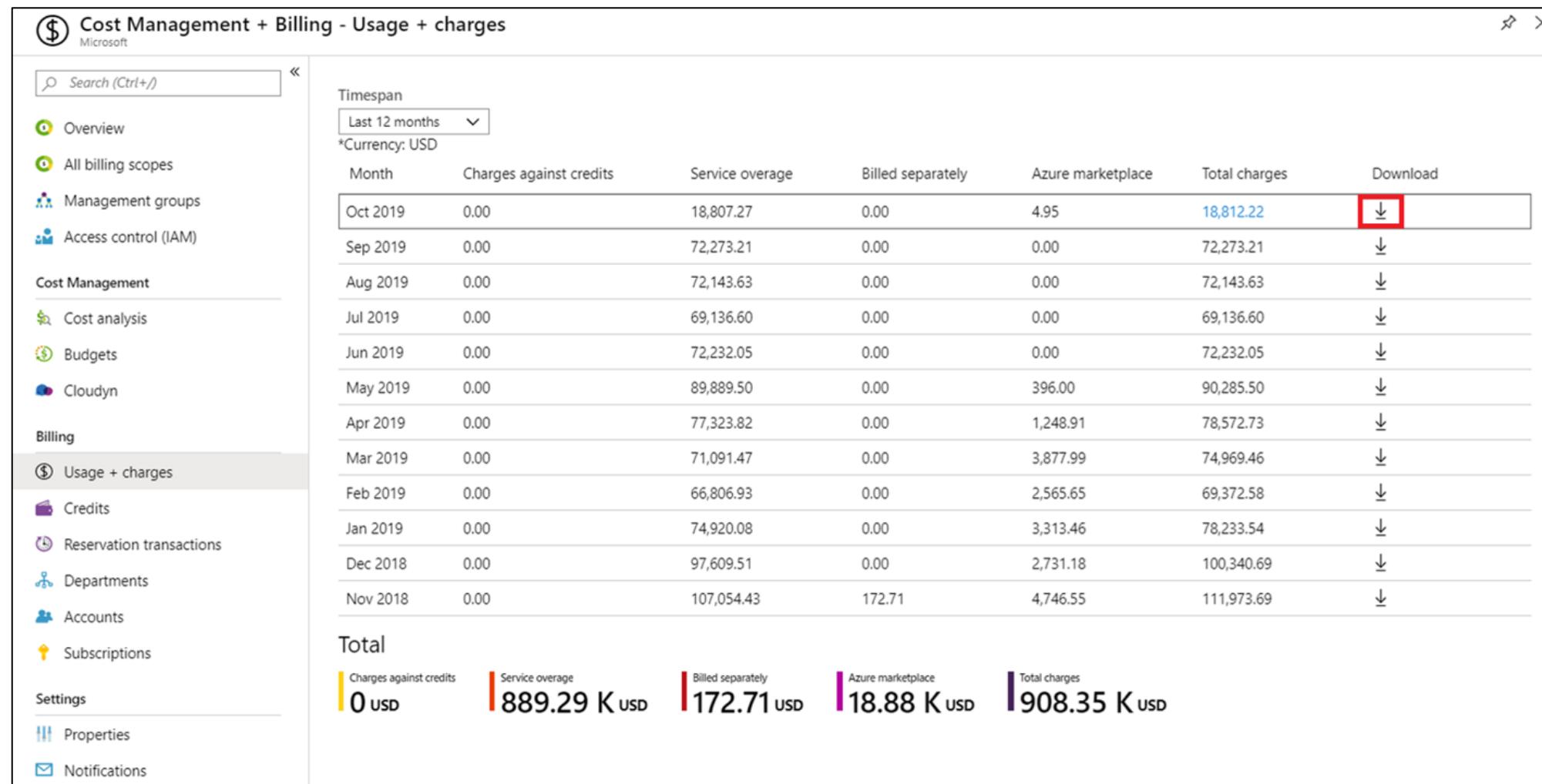
Tag support is for usage, reported after the tag has been applied to the resource.

The screenshot shows the Azure Cost Management + Billing interface. At the top, it displays the scope as 'Contoso IT - demo', the accumulated cost as '\$5,638.76', and the budget as '\$13,000 /mo'. Below this, there's a 'Filter items' input field and a list of tags: 'TagValue', 'Untagged', 'prod', and 'test'. To the right, a 'Group by' dropdown menu is open, showing options like 'Publisher type', 'Reservation', 'Resource', etc., with 'Tag' highlighted and a red box drawn around it. A tooltip indicates that tag support is for usage reported after the tag has been applied to the resource.

- Cost Management + Billing > Cost Management > Cost Analysis
- Select Group by, for the tag

# Download Usage Details

In the Azure portal, navigate to Cost Management + Billing > Billing > Usage + charges



Month	Charges against credits	Service overage	Billed separately	Azure marketplace	Total charges	Download
Oct 2019	0.00	18,807.27	0.00	4.95	<b>18,812.22</b>	
Sep 2019	0.00	72,273.21	0.00	0.00	72,273.21	
Aug 2019	0.00	72,143.63	0.00	0.00	72,143.63	
Jul 2019	0.00	69,136.60	0.00	0.00	69,136.60	
Jun 2019	0.00	72,232.05	0.00	0.00	72,232.05	
May 2019	0.00	89,889.50	0.00	396.00	90,285.50	
Apr 2019	0.00	77,323.82	0.00	1,248.91	78,572.73	
Mar 2019	0.00	71,091.47	0.00	3,877.99	74,969.46	
Feb 2019	0.00	66,806.93	0.00	2,565.65	69,372.58	
Jan 2019	0.00	74,920.08	0.00	3,313.46	78,233.54	
Dec 2018	0.00	97,609.51	0.00	2,731.18	100,340.69	
Nov 2018	0.00	107,054.43	172.71	4,746.55	111,973.69	

**Total**

Charges against credits	Service overage	Billed separately	Azure marketplace	Total charges
<b>0 USD</b>	<b>889.29 K USD</b>	<b>172.71 USD</b>	<b>18.88 K USD</b>	<b>908.35 K USD</b>

Select the line item to download from and click the download symbol

# View Monthly EA Cost Breakdown

Follow the steps to view the monthly EA cost breakdown:

Timespan						
Last 12 months						
*Currency: USD						
Month	Charges against credits	Service usage	Billed separately	Azure marketplace	Total charges	Download
Oct 2019	0.00	18,807.27	0.00	4.95	<b>18,812.22</b>	⬇️
Sep 2019	0.00	72,273.21	0.00	0.00	72,273.21	⬇️
Aug 2019	0.00	72,143.63	0.00	0.00	72,143.63	⬇️
Jul 2019	0.00	69,136.60	0.00	0.00	69,136.60	⬇️
Jun 2019	0.00	72,232.05	0.00	0.00	72,232.05	⬇️
May 2019	0.00	89,889.50	0.00	396.00	90,285.50	⬇️
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Jan 2019	0.00	74,920.08	0.00	3,313.46	78,233.54	⬇️
Dec 2018	0.00	97,609.51	0.00	2,731.18	100,340.69	⬇️
Nov 2018	0.00	107,054.43	172.71	4,746.55	111,973.69	⬇️
Total						
Charges against credits	0 USD	Service usage	172.71 USD	Billed separately	18.88 K USD	Azure marketplace
						Total charges
						<b>908.35 K USD</b>

- Navigate to Cost Management + Billing > Overview
- Click Breakdown

# View Monthly EA Cost Breakdown

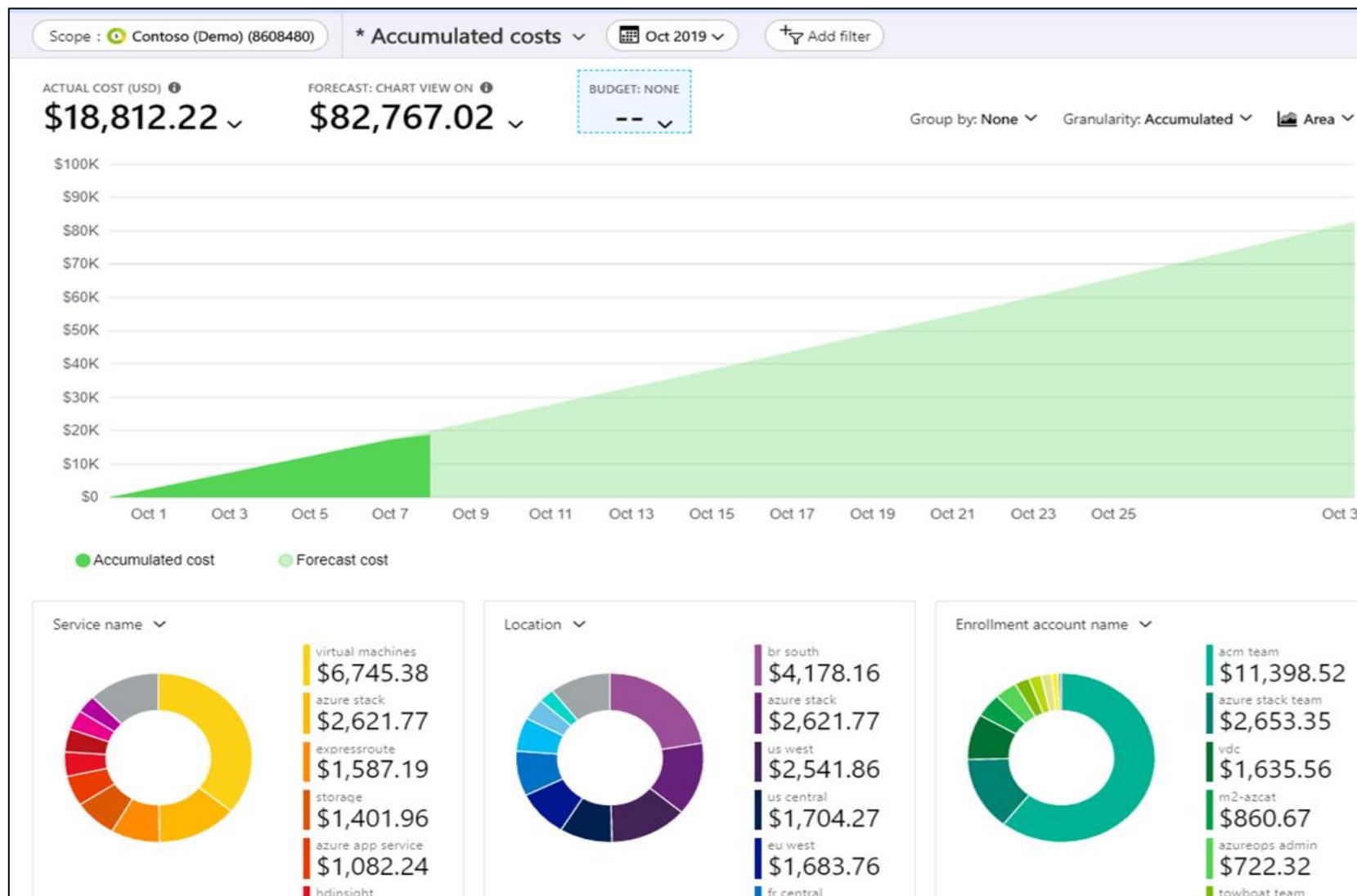
Follow the steps to view enrollment monthly cost by term:



- Navigate to Cost Management + Billing > Cost Management > Cost analysis
- Select your enrollment and set the enrollment term

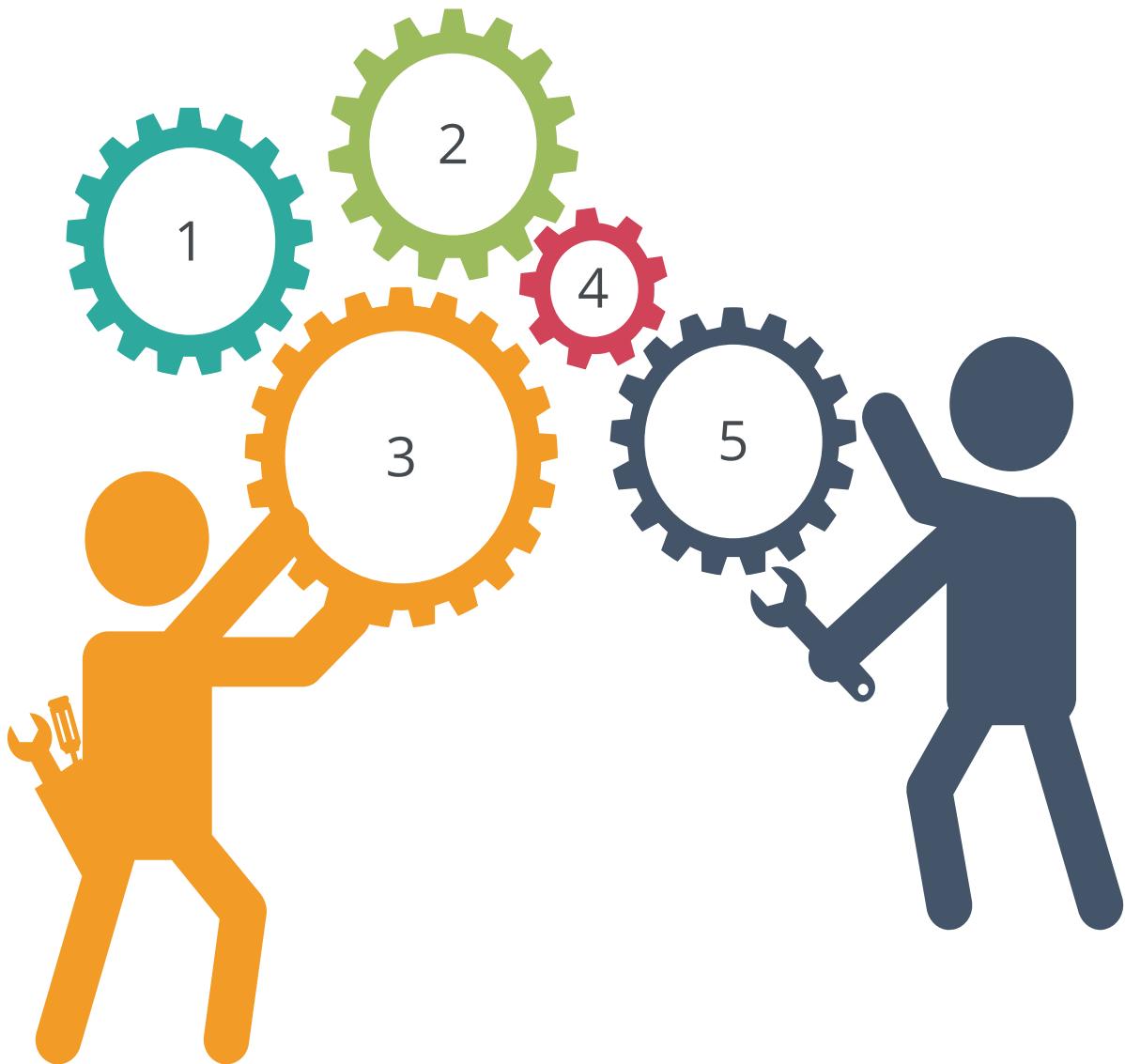
# View Monthly EA Cost Breakdown

Follow the steps to view EA enrollment accumulated costs:



- Navigate to Cost Management + Billing > Cost Management > Cost Analysis
- Select the enrollment and then view the current accumulated costs

# Checklist: Design for Cost



## Cost model

Capture clear requirements

Estimate the initial cost

Define policies for the cost constraints defined by the organization

Identify shared assets

Plan a governance strategy

# Checklist: Design for Cost

## Architecture



Use proof-of-concept deployments

Compare consumption-based pricing with pre-provisioned cost

Choose managed services when possible

Choose a subscription that is appropriate for the workload

Check the cost of resources in various Azure geographic regions

Choose the right resources to handle the performance

# Checklist: Optimize Cost

Use the following checklist to optimize cost:

- ✓ Review underutilized resources
- ✓ Continuously act on the cost reviews
- ✓ Use reserved instances on long running workloads
- ✓ Use discount prices
- ✓ Have a scale-in and scale-out policy
- ✓ Reevaluate design choices
- ✓ Choose the right storage tier
- ✓ Choose the right data store
- ✓ Choose Spot VMs for low priority workloads
- ✓ Optimize data transfer
- ✓ Reduce load on servers
- ✓ Use managed services

# Cost Trade-Offs

Consider these trade-offs between cost optimization and other aspects of design, such as security, scalability, resilience, and operability.

## Cost versus reliability

The cost of high-availability components may exceed the acceptable downtime. If it exceeds the cost of downtime, users can save by using Azure platform-managed replication and recover data from the backup storage.

## Cost versus performance efficiency

Factors impacting performance:

- Fixed or consumption-based provisioning
- Azure regions
- Caching
- Batch or real-time processing

# Cost Trade-Offs

An optimal design is not synonymous with a low-cost design. Low cost may incur additional risk.

## Cost versus security

Increasing the security of the workload will increase costs.

## Cost versus operation excellence

Investing in system monitoring and automation might increase the cost initially, but over time, it will reduce cost.

# Provision with Optimization

Best Practices for Optimizing Spending:



Cut out waste



Azure Advisor



Select Proper VM Sizes



Use Purchase Discounts



# Assisted Practice

## Generate Report on Spend

Duration: 10 Min.

### Problem Statement:

As an Azure Architect, you've been asked to provide your company with an Azure cost solution that can track cloud spending and make recommendations.

# Assisted Practice: Guidelines



Steps to generate a report on spend are:

1. Go to the Azure portal
2. Search for and select Cost Management + Billing
3. Generate report on spend

# Unassisted Practice

Billing Alerts

Min.

Duration: 10

## Problem Statement:

As an Azure Architect, you've been asked to provide your organization with an Azure cost solution that will inform you when expenditure, based on usage or cost, hits or exceeds the amount indicated in the budget's alert condition.

# Unassisted Practice: Guidelines



Steps to view billing alerts are:

1. Go to the Azure portal
2. Search for and select a subscription
3. View cost alerts

## Key Takeaways

- Cost management and billing is a set of tools that allows the user to evaluate, manage, and optimize the costs of the workloads.
- To successfully manage costs, finance, manager, and App teams must be aligned.
- Azure provides tools that users can use before deploying cloud resources, to assist users in the assessment process.
- After purchasing a reservation, it is important to track utilization.





Thank you