

What is the Well-Architected Framework and why does it matter?

AWS CLOUD CONCEPTS

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What is the Well-Architected Framework?

- Result of **AWS experts' experience** with many customers and partners
- Consistent approach to evaluate:
 - IT architectures on AWS
 - Organization around architectures
- Implement designs that **maximize the value of the cloud** and scale over time
 - Structured around 6 pillars:
 - Operational excellence
 - Security
 - Reliability
 - Performance efficiency
 - Cost optimization
 - Sustainability

What is a workload

- **Component:**
 - **Code** (e.g. python code for Lambda), **configuration** (e.g. template file for CloudFormation) and **AWS resources** (e.g. RDS database)
 - Executes certain tasks to satisfy a specific requirement
 - Independent unit, decoupled from other components
- **Workload:**
 - Set of components
 - Deliver business value
 - Ex: Python on Lambda and RDS database, both deployed through a CloudFormation template file, to **process clients' orders faster**
 - Level of detail where communication between technology and business leaders happen

Operational excellence



- Run workloads effectively
- Gain insights into their operations
- Continuously improve processes to deliver business value

¹ People vector created by pch.vector (<https://www.freepik.com/vectors/people>)

Security

- Leverage cloud technologies to protect:
 - data
 - systems
 - assets
- Improve companies' security posture



¹ Business vector created by jcomp (<https://www.freepik.com/vectors/business>)

Reliability

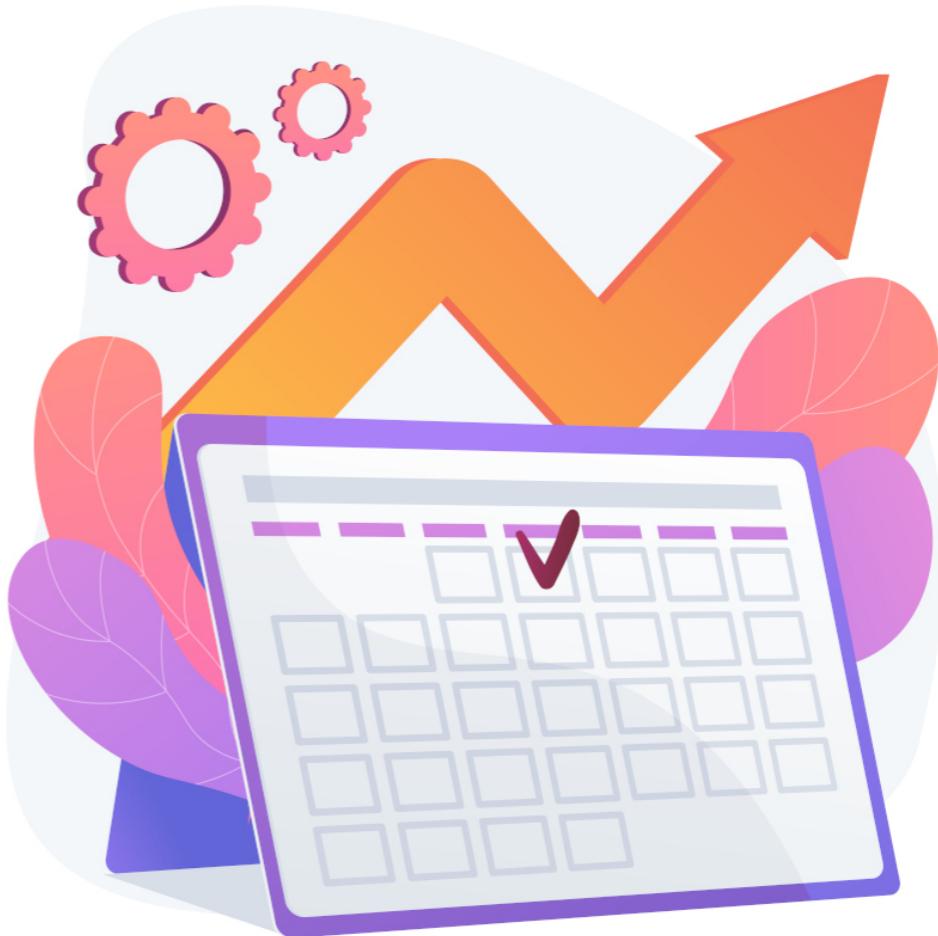


- Ability of workloads to correctly perform tasks when intended
- Administrators and developers ability to:
 - Operate workloads
 - Perform functional testing
 - Throughout the whole workload lifecycle

¹ Hand vector created by macrovector (<https://www.freepik.com/vectors/hand>)

Performance efficiency

- Efficient usage of resources to meet system requirements
- Maintaining efficiency as:
 - Demand changes
 - Technology evolves



¹ Calendar vector created by vectorjuice (<https://www.freepik.com/vectors/calendar>)

Cost optimization



- Cost-aware workloads
- Continuous ROI improvement:
 - Cost minimization while achieving business objectives

¹ Business vector created by studiogstock (<https://www.freepik.com/vectors/business>)

Sustainability

- Understanding and quantifying the **environmental impact** of workload
 - Energy consumption
 - Carbon emissions
- Implementing design principles and best practices to **reduce this impact**



¹ Green vector created by freepik (<https://www.freepik.com/vectors/green>)

The benefits of the Well-Architected Framework

- Accelerate the build and deploy process
- Better risk management:
 - Mitigate risks before problems arise
 - Quickly fix issues when they happen
- Cloud-native applications:
 - On the cloud since development
 - Faster deployment and scaling
- Properly assess technology evolution impact
- Constantly evolving framework:
 - Continuous improvement mindset

Pillar structure

- Areas of focus
 - Best practices
 - Design patterns
 - AWS resources and services
-
- **Note:** Some best practices can serve several pillars

Let's practice!

AWS CLOUD CONCEPTS

Operational excellence and sustainability

AWS CLOUD CONCEPTS



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Operational excellence focus areas

- Organization
- Prepare
- Operate
- Evolve

Organization



- **Clear objectives and priorities** based on:
 - Internal and external customers' needs
 - Leadership team's requirements
 - Compliance requirements
 - Threat landscape
- **Shared understanding** of business goals between teams
- Good understanding of each **team's role**
- Encourage teams to **experiment**, take risks and **escalate** concerns

¹ Infographic vector created by pikisuperstar (<https://www.freepik.com/vectors/infographic>)

Prepare

- Design your workloads to emit information about their internal state
- Facilitate changes into production:
 - Version control
 - Test and validation automation
- Plan for recovery after unsuccessful change
- Processes to assess when a workload is production-ready



¹ Education vector created by vectorjuice (<https://www.freepik.com/vectors/education>)

Operate



- Define clear KPIs and metrics related to:
 - Workload health (e.g. error rate, response time)
 - Operations health (e.g. successful vs. failed deployments)
- Regularly collect and analyze them
- Set alerts when KPIs are at risk or when anomalies arise
- Have a process for each alert
- Automate responses to events

¹ Abstract vector created by vectorjuice (<https://www.freepik.com/vectors/abstract>)

Evolve

- Constantly **analyze** operations
- **Learn** from failures:
 - Post-incident analysis
- Document and share learning experiences
 - Feedback loops
- Proactively allocate time to continuously **improve and adapt** your processes



¹ Business vector created by jcomp (<https://www.freepik.com/vectors/business>)

Some AWS resources for operational excellence

- AWS Compliance
- AWS Trusted Advisor
- AWS Organizations
- AWS Control Tower
- AWS Service Catalog
- AWS Partner Network (APN)
- AWS Systems Manager
- Amazon CloudWatch
- Amazon EventBridge
- AWS X-Ray
- AWS CloudFormation
- AWS CodeBuild
- AWS CodePipeline
- AWS CodeDeploy
- AWS Config
- AWS Personal Health Dashboard

Design principles for operational excellence

1. Perform **operations as code**
2. Make **small, frequent, reversible** changes
3. **Refine** operations procedures **frequently**
4. **Anticipate** failure
5. **Learn from all operational failures**

Sustainability focus areas

- Region selection
- User behavior patterns
- Software and architecture patterns
- Data patterns
- Hardware patterns
- Development and deployment process

Region selection



- Include sustainability factors in your choice of regions:
 - Some regions are near **renewable energy** projects
 - Some regions publish lower **carbon intensity** reports than others
- Check the following link:
<https://sustainability.aboutamazon.com/all-the-globe>

¹ Business vector created by macrovector_official (<https://www.freepik.com/vectors/business>)

User behavior patterns

- Minimize unused infrastructure by adapting to user load
- Incorporate **sustainability goals** in your **Service-Level Agreements (SLAs)**
- Reduce the distance network traffic must travel by **adapting geographic placement** to user locations



¹ Mobile website vector created by vectorjuice (<https://www.freepik.com/vectors/mobile-website>)

Software and architecture patterns

- **Code optimization** to lower time and resource usage
- Remove or refactor idle or low usage components and workloads
- Use technologies and software patterns that minimize data processing and storage requirements



¹ Business vector created by vectorjuice (<https://www.freepik.com/vectors/business>)

Data patterns

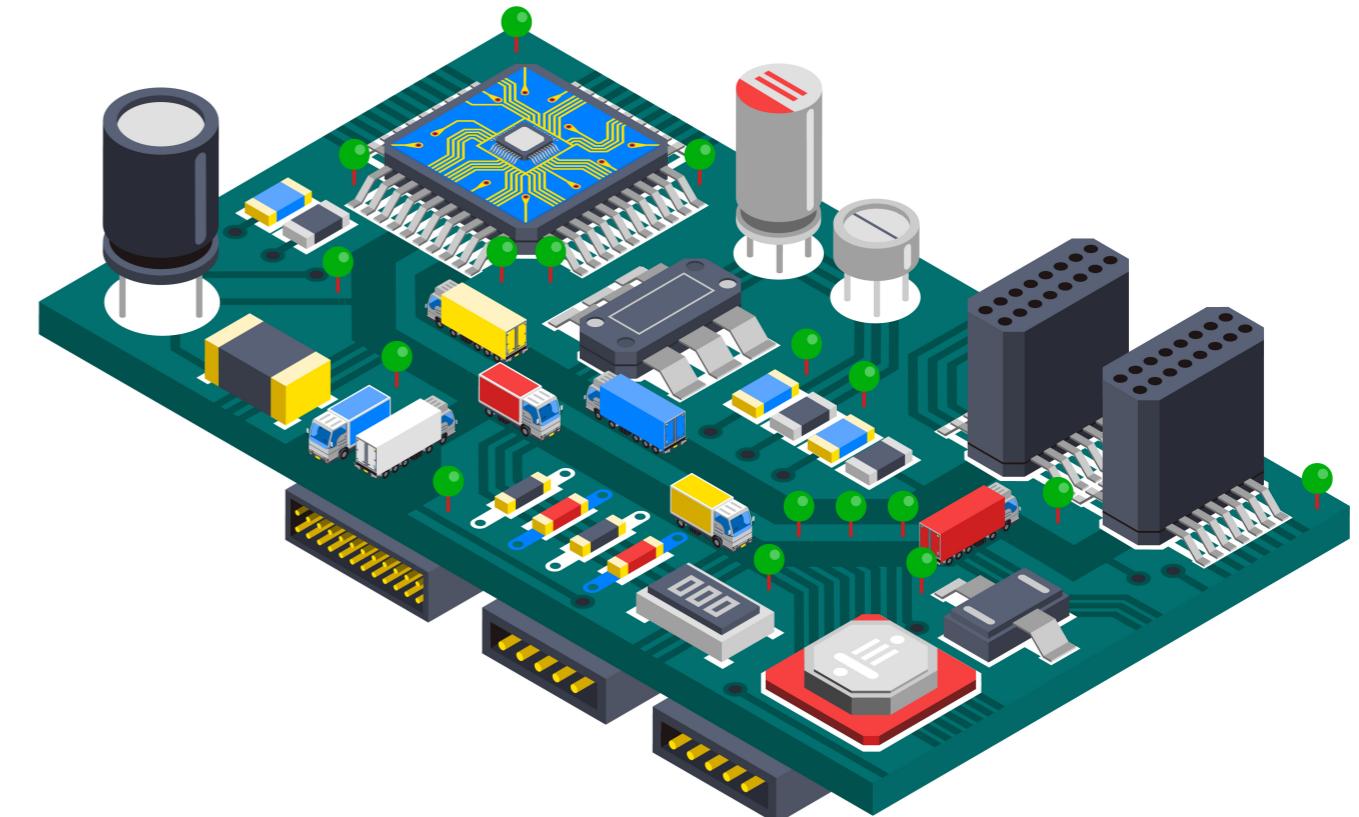


- Limit redundant and delete unnecessary data
- Minimize data traffic across networks
- Back up only when difficult/impossible to recreate data

¹ Data vector created by storyset (<https://www.freepik.com/vectors/data>)

Hardware patterns

- Use the most **energy-efficient instances**
 - Keep up to date regarding new instances improvements
- Only use GPUs for the necessary time
- Use **managed services**:
 - Shifts sustainability optimization responsibility to AWS
 - Distributes sustainability impact across all hardware users



¹ Abstract vector created by macrovector (<https://www.freepik.com/vectors/abstract>)

Development and deployment process



- Evaluate the sustainability impact before performing new deployments
- Provision build environment resources only when needed
- Test new features using managed device farms

¹ Abstract vector created by vectorjuice (<https://www.freepik.com/vectors/abstract>)

Some AWS resources for sustainability

- Amazon around the globe
- Renewable energy methodology
- Amazon CloudWatch
- Amazon CloudFront
- AWS Systems Manager Fleet Manager
- Amazon CodeGuru Profiler
- AWS Device Farm
- Amazon Athena Compression Support
- AWS Compute Optimizer

Design principles for sustainability

- Understand your **impact**
- Establish **sustainability goals**
- Maximize utilization
- Anticipate and adopt new, more **efficient hardware and software offerings**
- Use **managed services**
- Reduce the **downstream impact** of your cloud workloads

Let's practice!

AWS CLOUD CONCEPTS

Security and reliability

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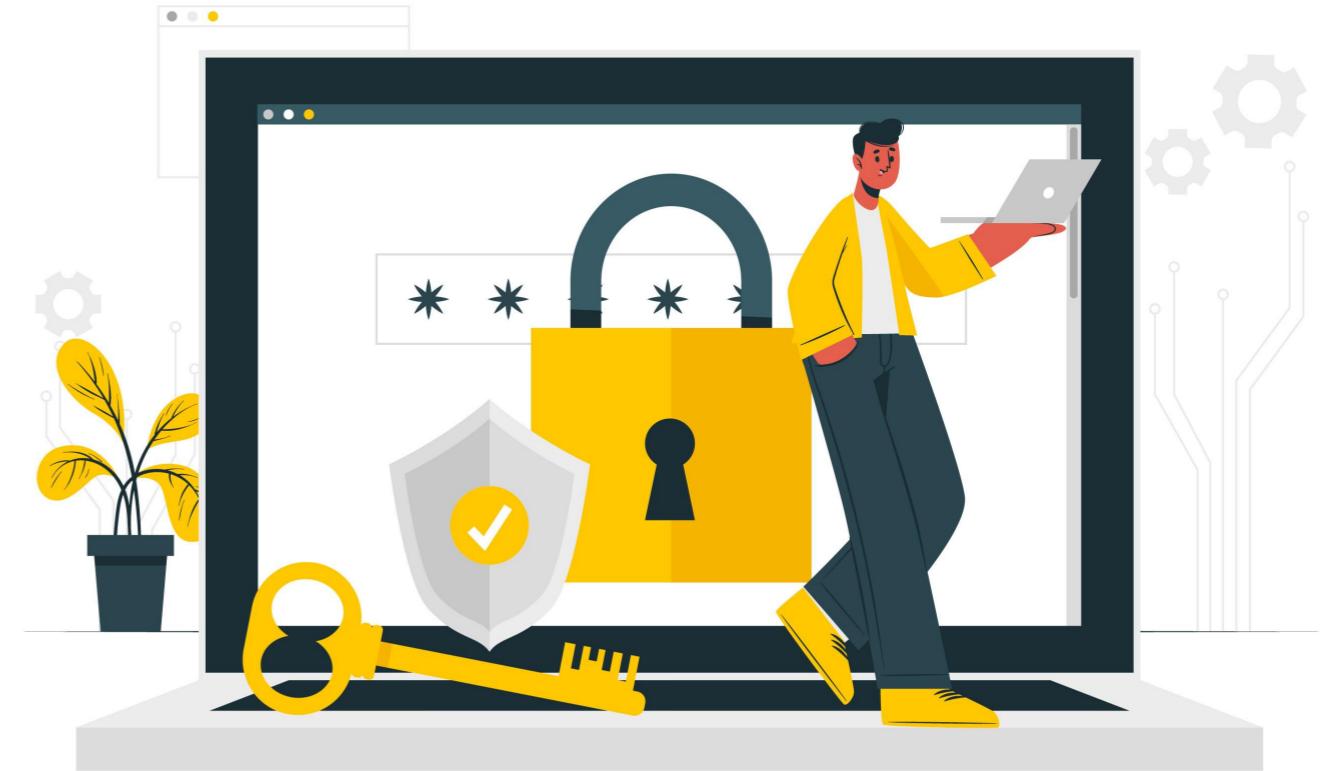
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Security focus areas

- Foundations
- Identity and access management
- Detection
- Infrastructure protection
- Data protection
- Incident response

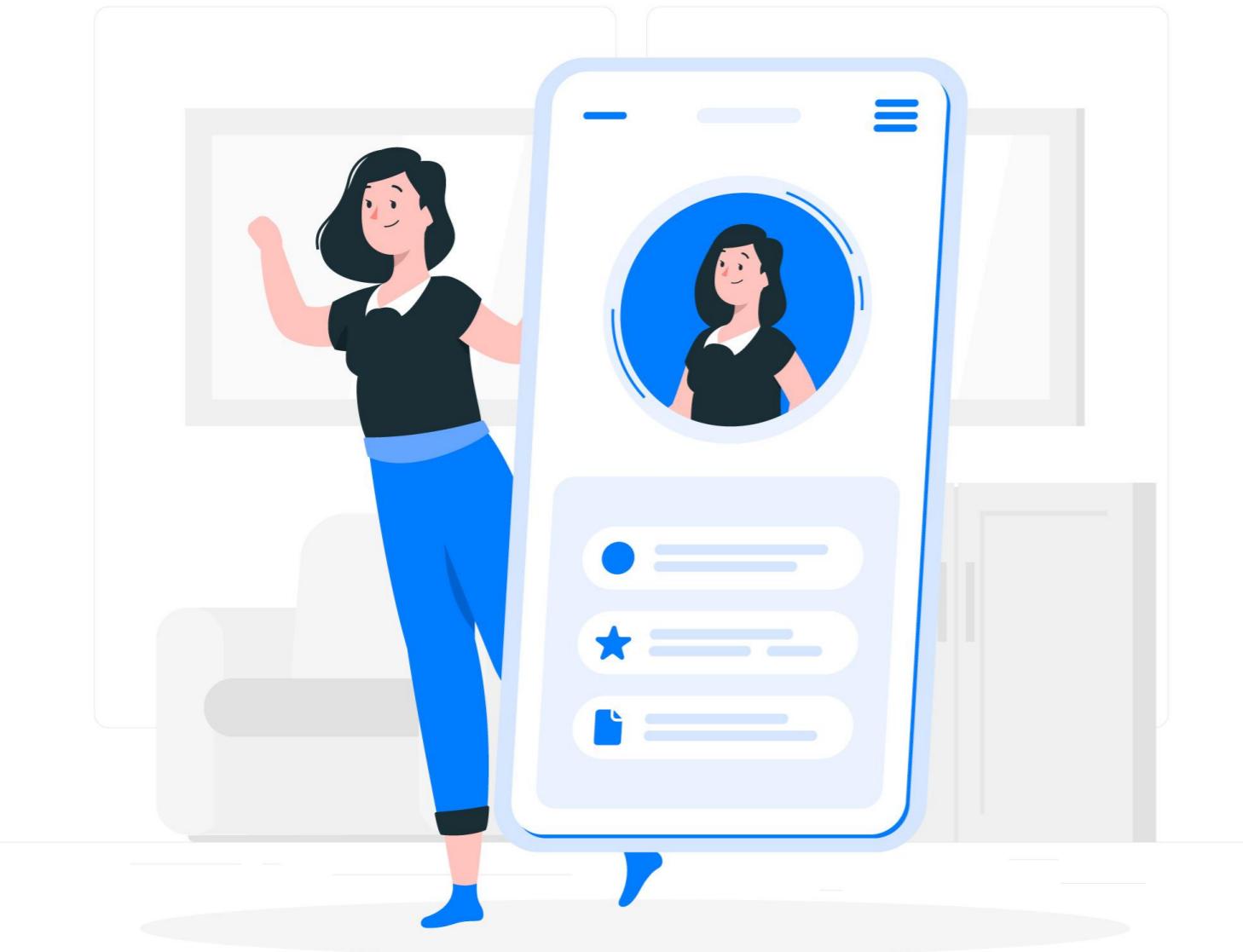
Foundations

- AWS secures the cloud, you secure your application
- Keep contact information accurate: AWS can reach out to you quickly in case of abuse or compromise
- Stay up to date on security matters
- Automate security processes
- Separate accounts for workloads but centralize environment management using AWS Organizations



¹ Technology vector created by stories (<https://www.freepik.com/vectors/technology>)

Identity and access management



- Centralized identity management
- Carefully grant permissions to human and machine identities in a fine-grained fashion
- Strong sign-in for identities with high privileges

¹ Social media vector created by stories (<https://www.freepik.com/vectors/social-media>)

Detection

- Continuous logging and analysis for malicious activity detection
- Actionable security events
- Automated response to event



¹ Business vector created by vectorjuice (<https://www.freepik.com/vectors/business>)

Infrastructure protection



- Several network layers:
 - Ex: using subnets with no direct access to the Internet
- Frequent scans and patches for code vulnerabilities, software integrity validations
- Managed services

¹ Clouds vector created by vectorjuice (<https://www.freepik.com/vectors/clouds>)

Data protection

- Data categorization based on criticality and sensitivity
- For both data at rest and in transit:
 - Encryption
 - Key management
 - Certificate management
 - Access control enforcement



¹ People vector created by pch.vector (<https://www.freepik.com/vectors/people>)

Incident response



- Clear objectives and documented plans for security incident responses
- Pre-deployed and ready to use investigation tools
- Incident simulation through game days
- Containment and recovery automation

¹ Technology vector created by vectorjuice (<https://www.freepik.com/vectors/technology>)

Some AWS resources for security

- AWS Artifact
- AWS Organizations
- AWS IAM
- AWS Secrets Manager
- AWS Resource Access Manager
- AWS CloudTrail
- AWS GuardDuty
- AWS EventBridge
- AWS Transit Gateway
- AWS WAF
- AWS CodeGuru
- AWS Signer
- AWS KMS
- AWS Macie
- AWS Certificate Manager
- AWS VPN
- AWS Trusted Advisor
- AWS Detective
- AWS Security Hub

Security design principles

1. Implement a **strong identity** foundation
2. Enable **traceability**
3. Apply security at **all layers**
4. **Automate** security best practices
5. **Protect** data in transit and at rest
6. **Keep people away** from data
7. **Prepare** for security events

Reliability focus areas

- Foundations
- Workload architecture
- Change management
- Failure management

Foundations

- Knowing and monitoring service quotas and limitations
- Network topology planning:
 - High connectivity for public endpoints
 - Redundant connectivity between private networks



¹ Business vector created by freepik (<https://www.freepik.com/vectors/business>)

Workload architecture

- Distributed systems to **prevent failures**:
 - Microservices (single function building blocks)
 - API communication
- **Mitigating failures**:
 - Request throttling (slowing down request processing)
 - Request timeouts



¹ Business vector created by vectorjuice (<https://www.freepik.com/vectors/business>)

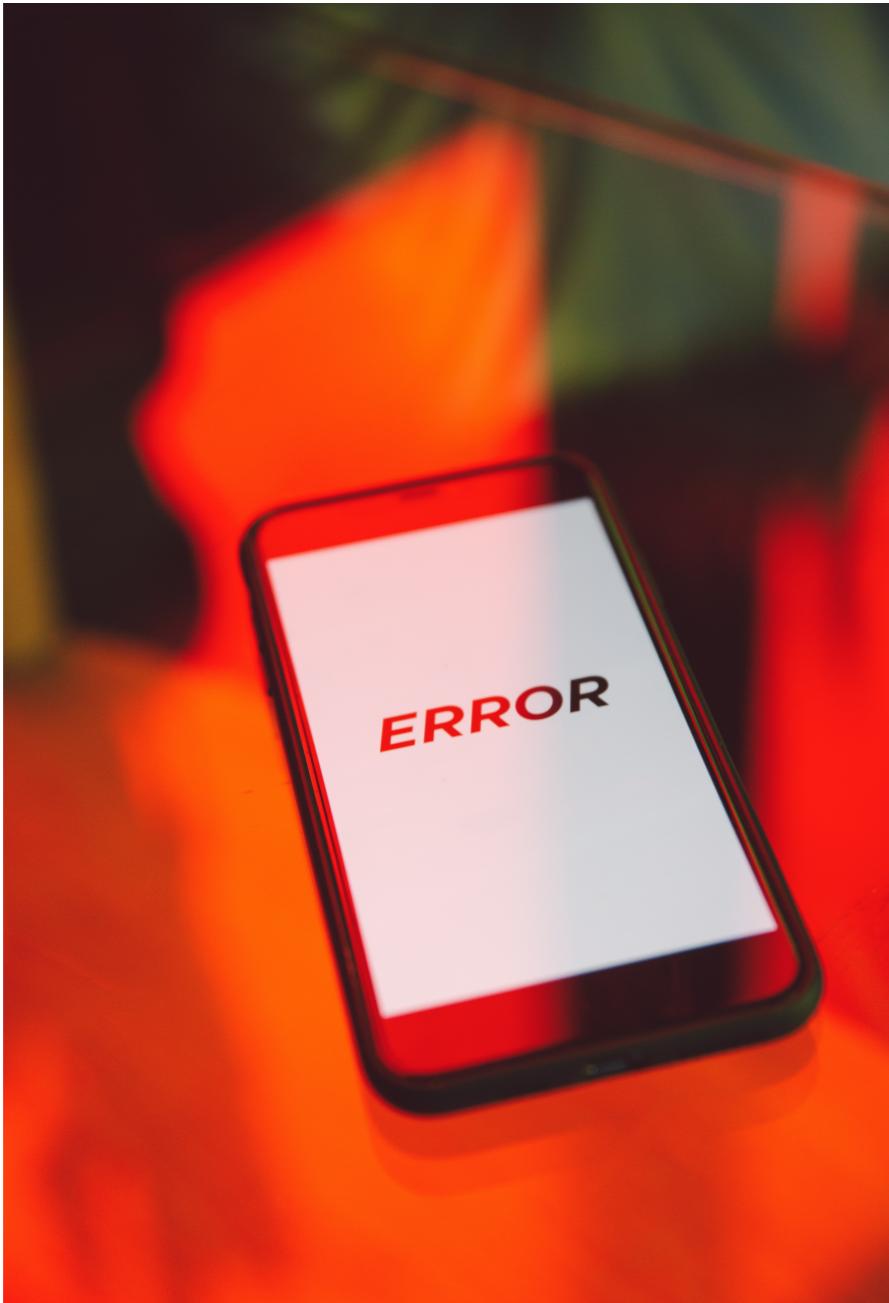
Change management

- Automatic adaptation to **change in demand**:
 - Automatic provisioning and scaling
- Processes for **change in implementation**:
 - Automatic testing
 - Automatic deployment



¹ <https://www.pexels.com/photo/shallow-focus-photo-of-change-4502492/>

Failure management



- Automatic data backup
- Multiple location deployment
- Automatic failure detection and failover
- Testing, simulation and game days:
 - Performance requirements
 - Resiliency
- Plan for disaster recovery

¹ <https://www.pexels.com/photo/black-smartphone-displaying-error-3747139/>

Some AWS resources for reliability

- AWS service by service documentation
- AWS Trusted Advisor
- AWS Direct Connect
- AWS X-Ray
- AWS API Gateway
- AWS Elastic Load Balancing (ELB)
- AWS CloudTrail
- AWS CloudWatch
- AWS Auto Scaling
- AWS CodeDeploy
- AWS CodePipeline
- AWS S3
- AWS KMS
- AWS CloudFormation
- AWS Route 53
- AWS Fault Injection Simulator
- AWS Backup

Reliability design principles

1. **Automatically recover** from failure
2. **Test** recovery procedures
3. **Scale horizontally** to increase aggregate workload availability
4. **Stop guessing** capacity
5. **Automate** change management

Let's practice!

AWS CLOUD CONCEPTS

Performance efficiency and cost optimization

AWS CLOUD CONCEPTS



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Performance efficiency best practices four areas

- Selection
- Review
- Monitoring
- Trade-offs

Selection

- Understand the available resources
- Evaluate the options and possible configurations, and their impact on performance
- Make decisions based on performance metrics
- Use guidance from AWS or partner



¹ Photo by Steve Johnson from Pexels

Review



- Have a consistent performance review process based on well defined metrics:
 - Ex: Deming's PDCA (Plan Do Check Act)
- Stay up to date and keep track of new resources:
 - Use the ones that improve performance

¹ Photo by Michael Burrows from Pexels

Monitoring

- Collect performance data and analyze it
- Use real-time processing and alarming
- Establish Key Performance Indicators (KPIs) and review them regularly



¹ Photo by fauxels from Pexels

Trade-offs



- Understand:
 - The areas where performance is most **critical**
 - The **levers** to trade-off in order to maximize performance on those areas
 - Consistency
 - Durability
 - Space
 - Latency
- **Measure** the impact of performance improvements

¹ Photo by cottonbro from Pexels

AWS resources for performance efficiency

- AWS Solutions Architects
- AWS Architecture Center
- AWS Partner Network (APN)
- AWS CloudWatch
- AWS X-Ray
- AWS Route 53
- AWS Direct Connect
- AWS Global Accelerator
- AWS Transit Gateway
- AWS CloudFront
- AWS Outposts
- AWS Local Zones
- AWS Wavelength
- AWS CloudWatch

Performance efficiency design principles

- Democratize advanced technologies
- Go global in minutes
- Use serverless architectures
- Experiment more often
- Consider mechanical sympathy

Cost optimization focus areas

- Practice cloud financial management
- Expenditure and usage awareness
- Cost-effective resources
- Manage demand and supplying resources
- Optimize over time

Practice cloud financial management

- Bridge the gap between finance and technology teams
- Build a cost-aware culture and processes
- Establish cloud budget and forecasts
- Quantify business value generated by cost optimization



¹ Photo by Karolina Grabowska from Pexels

Expenditure and usage awareness



- Define goals and set usage quotas
- Establish costs and usage reports
- Decommission unused resources

¹ Photo by cottonbro from Pexels

Cost effective resources

- Evaluate the cost of services
- Select the optimal configuration:
 - Type of resource
 - Size of resource
 - Number of resource
 - Pricing model



¹ Photo by Karolina Grabowska from Pexels

Manage demand and supplying resources



- Manage demand:
 - Throttling requests
 - Buffer-based
- Dynamic supply:
 - Demand-based
 - Time-based

¹ Photo by Anna Shvets from Pexels

Optimize over time

- Implement consistent cost review processes
- Stay up to date
- Implement new services



¹ Photo by Lorenzo from Pexels

AWS resources for cost optimization

- AWS Cost Explorer
- AWS Budgets
- AWS Organization
- AWS Control Tower
- AWS Cost & Usage Report (CUR)
- AWS IAM
- AWS Cost Management Blog
- AWS Auto Scaling
- AWS Simple Monthly Calculator
- AWS Pricing Calculator
- AWS Managed Services
- AWS License Manager
- AWS Compute Optimizer
- AWS CloudWatch

Cost optimization design principles

1. Implement cloud financial management
2. Adopt a consumption model
3. Measure overall efficiency
4. Stop spending money on undifferentiated heavy lifting
5. Analyze and attribute expenditure

Let's practice!

AWS CLOUD CONCEPTS

Wrap-up

AWS CLOUD CONCEPTS



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Congratulations



Chapter 1: Introduction to AWS



○ Regions
○ Coming Soon

A screenshot of the AWS Management Console homepage. The top navigation bar includes 'Services', 'Resource Groups', 'Indeed', and 'Support'. The main area features a search bar, a 'Build a solution' section with cards for launching a virtual machine, building a web app, connecting an IoT device, starting a development project, and registering a domain, along with a 'See more' link; a 'Learn to build' section with categories like Websites and Web Apps, Storage, Databases, DevOps, Machine Learning, and Big Data; and sections for 'Explore AWS' (Amazon Redshift, Run Serverless Containers with AWS Fargate, Scalable, Durable, Secure Backup & Restore with Amazon S3, AWS Marketplace), 'Have feedback?' (Submit feedback), and footer links for Feedback, English (US), Privacy Policy, and Terms of Use.

A terminal window titled 'James (aws)' showing the execution of an AWS CLI command. The command is '\$ aws dynamodb wizard new-table'. The user is prompted to enter the table name ('MyTable') and primary key ('pk'). It then asks if a sort key is needed and to select a read/write capacity mode. Finally, it asks to select server-side encryption settings, with 'DEFAULT' and 'KMS - AWS managed CMK' listed, and 'KMS - Customer managed CMK' highlighted as the selected option.

Chapter 2: AWS Cloud Value Framework

Cost Savings (TCO)

What is it?

Infrastructure cost savings/
avoidance from moving to the
cloud.

Staff Productivity

What is it?

Efficiency improvement
by function on a task-by-
task basis.

Operational Resilience

What is it?

Benefit of improved availability,
security, and compliance.

Business Agility

What is it?

Deploying new features/
applications faster and reducing
errors

Chapter 3: Overview of AWS core services

▼ All services

Compute

EC2

Elastic Container Service

Lambda

Elastic Beanstalk

ECR

Storage

S3

Glacier

Storage Gateway

Database

RDS

DynamoDB

ElastiCache

Amazon Redshift

Migration

Database Migration Service

Server Migration Service

Snowball

Networking & Content Delivery

VPC

API Gateway

Direct Connect

Developer Tools

CodeDeploy

Management Tools

CloudWatch

CloudFormation

CloudTrail

Config

Systems Manager

Trusted Advisor

Machine Learning

Amazon SageMaker

Amazon Polly

Rekognition

Amazon Translate

Analytics

EMR

Elasticsearch Service

Kinesis

Security, Identity & Compliance

IAM

GuardDuty

Inspector

Certificate Manager

CloudHSM

Directory Service

Application Integration

Step Functions

Simple Notification Service

Simple Queue Service

SWF

Internet of Things

IoT Core

IoT Device Management

Chapter 4: The Well-Architected Framework



¹ <https://aws.amazon.com/architecture/well-architected/>

Other resources

- AWS Well-Architected Tool
- AWS Well-Architected Labs
- AWS Knowledge Center
- AWS Discussion Forums
- AWS Support Center
- AWS Builder's Library
- AWS Blog
- Official AWS Podcast

What now?



Best of luck

AWS CLOUD CONCEPTS