Cloud Assessment Framework

Cloud assessment focuses on application readiness, defining the cloud development strategy & roadmap, selection of cloud types and platforms and a wide range of security aspects to develop optimized cloud solutions.

Key benefits of cloud computing

- Adaptable - Allows for adaptable programs and applications that are customizable, while allowing owners control over the core code.
- Multitenant - Cloud software provides the opportunity to provide personalized applications and portals to a number of customers or tenants.
- Reliable - Because it is hosted by a third party, businesses and other users have greater assurance of reliability, and when there are problems, easy access to customer support.
- Scalable - With the Internet of Things, it is essential that software functions across every device and integrates with other applications. Cloud applications can provide this.
- Secure - Cloud computing can also guarantee a more secure environment, thanks to increased resources for security and centralization of data.

General Design Principles **The well-architected framework identifies a set of general design principles to facilitate good design in the cloud**		
Stop guessing your capacity needs: Use as much or as little capacity as you need and scale up and down automatically	**Test systems at production scale:** Only pay for the test environment when its running. you can simulate your live environment for a fraction of the cost of testing on premises	**Automate to make architectural experimentation easier:** Automation helps to create and replicate your systems at low cost and avoid the expense of manual effort.
Allow for evolutionary architectures: Automation allows systems to evolve over time so that businesses can take advantage of the innovations as a standard practice	**Drive architectures using data:** Your cloud infrastructure as code, so you can use your collected date to inform your architecture choices and improvements over times	**Improve through game days:** Test how your architecture and processes perform by regularly scheduling game days to simulate events in production

Cloud Deployment Model

- Public Cloud - Allows systems and services to be easily accessible to the general public. Public cloud may be less secure because of its openness.
- Private Cloud - Allows systems and services to be accessible within an organization. It is more secured because of its private nature.
- Hybrid Cloud - The hybrid cloud is a mixture of public and private cloud, in which the critical activities are performed using private cloud while the non-critical activities are performed using public cloud.
- Community Cloud – The community cloud allows systems and services to be accessible by a group of organizations.

Cloud delivery services are a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction.

One of the cloud's biggest benefits is automation. When your organization utilizes cloud computing services correctly, you remove layers of management. You won't be responsible for the physical data centers, operating systems and hardware.

By removing these layers, you can cut costs and minimize the time spent on repetitive, prone-to-error IT tasks. Instead of maintaining hardware, middleware and software, you can focus on innovation and scale your applications on demand. More enterprises are turning to cloud to reinvent their applications and take advantage of new deployment strategies.

Cloud Service Delivery Models

IaaS – Infrastructure as a Service is a form of cloud computing that provides virtualized computing components (Virtual servers with CPU, memory, storage, network access, etc.) over the Internet. IaaS consumers do not manage or control the physical cloud infrastructure but has control over operating systems, storage, and deployed applications. Companies that lack an owned data center can turn to IaaS for a quick, cheap infrastructure that can be expanded or terminated as their business requirements change. Traditional companies that need compute power to run variable workloads on tight budget are perfect uses cases of IaaS adoption as they will only pay for the services they use.

Popular IaaS offerings include Amazon EC2, Google Cloud Engine and Microsoft Azure IaaS

Open source IaaS offerings include OpenStack and Apache's CloudStack

SaaS – Service as a Service is the most widely visible of all the cloud computing service models. In fact, many users might be using SaaS products without even realizing it. Popular products like Google's G Suite, Microsoft's Office 365, Zendesk, Slack and Salesforce are all SaaS offerings used by thousands of businesses every day. Some providers also offer their products under a SaaS model, such as SugarCRM or Acquia (Cloud-based Drupal sites).

Cloud Quality Engineering - Jmeter

Cloud DevOps – Logs and monitoring – Nagios, Splunk, Logstash

PaaS – Platform as a Service delivers development/operating environments as a service. It includes set of tools and services designed to make coding and deploying the applications quickly and efficiently. A PaaS provider hosts the hardware and software on its own infrastructure. As a result, PaaS frees users from having to install and manage in-house hardware and software to develop or run a new application.

Development companies and/or factories that want to implement agile methodologies are the most suited for PaaS. PaaS providers publish many services that can be consumed inside applications. Those services will be always available and up-to-date.

Cloud consumers not manage or control the underlying cloud infrastructure including network, servers, operating systems, or storage, but has control over the deployed applications and possibly configuration settings for the application-hosting environment.

Prime examples include Amazon AWS, Salesforce Platform, Azure from Microsoft and Google App Engine.

Open Source PaaS platforms, OpenShift Origin, OpenPaaS and Cloud Foundry are best options.

Configuration Mgmt. – Ansible, Terraform

STaaS – Storage as a Service is a cloud services model in which a company leases or rents its storage infrastructure to another company or individuals to store either files or objects. Small companies and individuals often find this to be a convenient methodology for managing backups, and providing cost savings in personnel, hardware and physical space. In general, STaaS operates through a web-based API that is remotely implemented through its interaction with the client application's in-house cloud storage infrastructure for input/output (I/O) and read/write (R/W) operations. If the company ever loses its local data, the network administrator could contact the STaaS provider and request a copy of the data.

When it comes to end-user-level cloud storage, Dropbox, Google Drive, Apple's iCloud and Microsoft OneDrive are among the leading end-user-level cloud storage providers.

For enterprise-level cloud storage, Amazon S3, Zadara, IBM's SoftLayer and Google Cloud Storage are some of the more popular providers. ownCloud and Cozy Cloud are powerful Open Source cloud STaaS solutions.

DaaS – Data as a Service computing model (a more advanced, fine-grained form of STaaS), data (as opposed to files) is readily accessible through a Cloud-based platform. Data (either from databases or object containers) is supplied "on-demand" via cloud platforms (as opposed to the traditional, on-premise models in which the data remains in the customer's hands) and the vendor provides the tools that make it easier to access and explore.

Based on Web Services standards and service-oriented architecture (SOA), DaaS provides a dynamic infrastructure for delivering information on demand to users, regardless of their geographical location or organizational separation – and, in the process, presents solution providers with a number of significant opportunities.

DaaS eliminates redundancy and reduces associated expenditures by accommodating vital data in a single location, allowing data use and/or modification by multiple users via a single update point. Typical business applications include customer relationship management (CRM), enterprise resource planning (ERP), e-commerce and supply chain systems and, more recently, Big Data analytics.

Some of the best-known enterprise-level providers are Oracle's Data Cloud , Amazon DynamoDB, Microsoft SQL Database (formerly known as SQL Azure) and Google Cloud's Datastore.

For open source projects, Apache Cassandra and CockroachDB or CouchDB

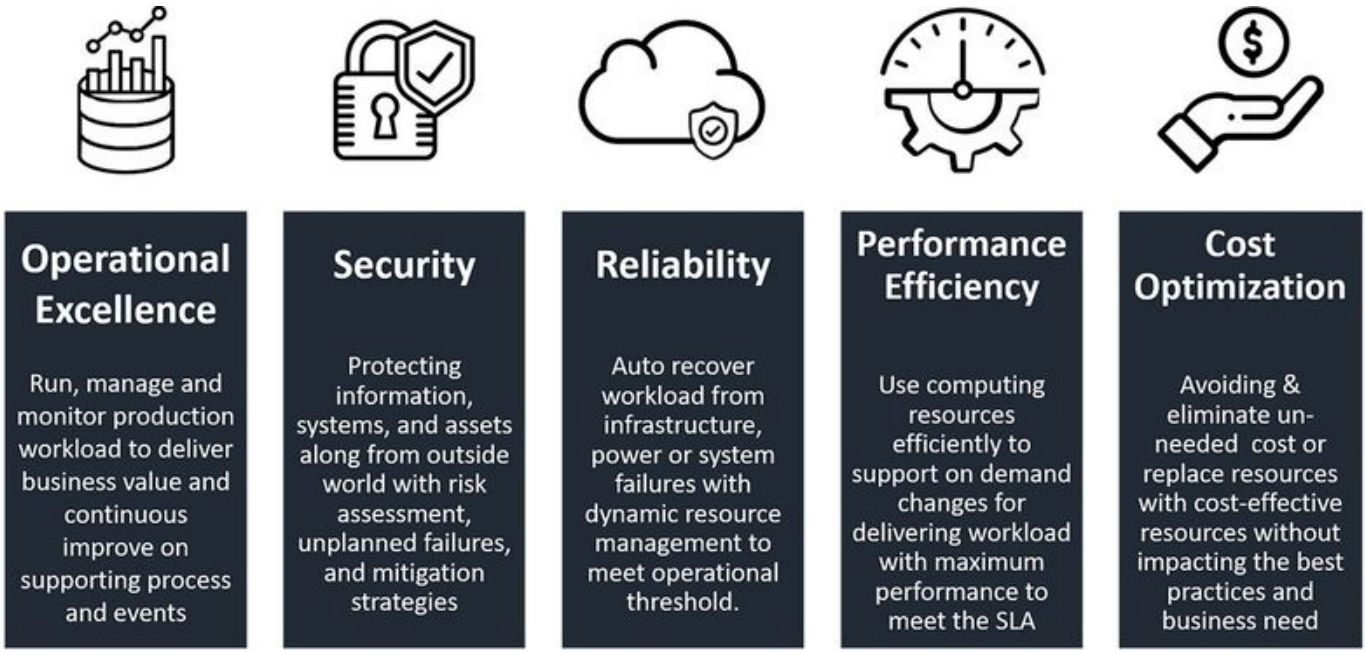
CaaS – Container as a Service is a cloud service model that allows users to manage and deploy containers, applications and clusters through container-based virtualization. With CaaS, this can be achieved using on-premises data centers or over the cloud. (i.e. Kubernetes, Amazon EKS, Azure Kubernetes Service)

FaaS – Function as a Service, which provide a platform allowing customers to develop, run, and manage application functionalities without the complexity of building and maintaining the infrastructure typically associated with developing and launching a complete application. Building an application following this model is one way of achieving a "serverless" architecture, and is typically used when building micro-services applications.

FaaS is an extremely recent development in the cloud service delivery model (IBM Cloud Functions, AWS Lambda, Google Cloud Functions and Microsoft Azure Functions, Open source side of FaaS, there is IBM/Apache's OpenWhisk and Oracle Cloud Fn, both of which are available for public use.

With cloud services, you don't need to make large upfront investments in hardware and spend a lot of time on the heavy lifting of managing that hardware. Instead, you can provision exactly the right type and size of computing resources you need to power your newest bright idea or operate your IT department. You can access as many resources as you need, almost instantly, and only pay for what you use.

Five key pillars of cloud infrastructure



Operational Excellence Design Principles	Security Design Principles	Reliability Design Principles	Performance Efficiency Design Principles	Cost Optimization Design Principles
• Perform operations as code • Refine operations procedures frequency • Annotate documentation • Anticipate failure • Make frequent, small, reversible changes • Learn from all operation failures	• Implement a strong identity foundation • Annotate security best practices • Enable traceability • Protest data in transit and at rest • Apply security at all layers • Prepare for security events	• Test recovery procedures • Stop guessing capacity • Automatically recover from failure • Manage change in automation • Scale horizontally to increase aggregate system availability	• Democratize advanced technologies • Experiment more often • Go global in minutes • Mechanical sympathy • User Serverless architecture	• Adopt a consumption model • Analyze and attribute expenditure • Measure overall efficiency • Use managed services to reduce cost of ownership • Stop spending money on data center operations

Cloud infrastructure

1. Compute - Cloud computing is the on-demand delivery of compute power, database storage, applications, and other IT resources through a cloud services platform via the internet with pay-as-you-go pricing.
2. Storage - Cloud storage is a remote platform that uses a highly virtualized, multi-tenant infrastructure to provide enterprises with scalable storage resources that can be provisioned dynamically as required by the organization. This service is offered by a wide array of cloud storage providers (i.e. AWS, GCP, Microsoft Azure)
3. Networking & Content Delivery - Cloud networking is a type of infrastructure where network capabilities and resources are available on demand through a third-party service provider that hosts them on a cloud platform. A content delivery network (CDN) is a system of distributed servers (network) that deliver pages and other Web content to a user, based on the geographic locations of the user, the origin of the webpage and the content delivery server.
4. Database - A cloud database is a database that typically runs on a cloud computing platform, and access to the database is provided as-a-service. Database services take care of scalability and high availability of the database. Database services make the underlying software-stack transparent to the user. Both SQL and No-SQL types available in different cloud providers.
5. Security, Identity and Access Management - Cloud security is the protection of data, applications, and infrastructures involved in cloud computing. High-level security concerns—like unauthorized data exposure and leaks, weak access controls, susceptibility to attacks, and availability disruptions—affect traditional IT and cloud systems. Identity and Access Management (IAM) is the security discipline that enables the right individuals to access the right resources at the right times for the right reasons. Cloud compliance issues arise as soon as you make use of cloud storage or backup services. By moving data from your internal storage to someone else's you are forced to examine closely how that data will be kept so that you remain compliant with laws and industry regulations. So, when it comes to cloud compliance what data should you move to the cloud and what should be kept in-house, what questions do you need to ask your cloud provider and what terms should be written into SLAs to maintain compliance.

Incident Response -

- Given an Cloud provider abuse notice, evaluate the suspected compromised instance or exposed access keys.
- Verify that the Incident Response plan includes relevant cloud services.

- Evaluate the configuration of automated alerting, and execute possible remediation of security-related incidents and emerging issues.

Logging and Monitoring -

- Design and implement security monitoring and alerting.
- Troubleshoot security monitoring and alerting.
- Design and implement a logging solution.
- Troubleshoot logging solutions.

Infrastructure Security -

- identity and Access Management
- Data Protection
- Troubleshoot a secure network infrastructure.
- Design and implement host-based security.

Identity and Access Management -

- Design and implement a scalable authorization and authentication system to access cloud resources.
- Troubleshoot an authorization and authentication system to access cloud resources.

Data Protection

- Design and implement key management and use.
- Troubleshoot key management.
- Design and implement a data encryption solution for data at rest and data in transit.

6. Operations & Monitoring - Cloud operations consist of the process of operating or running a cloud infrastructure and environment. It is supplemented by management to ensure that all of the processes and resources are managed properly to keep cloud operations running smoothly. Cloud monitoring is the process of reviewing, monitoring and managing the operational workflow and processes within a cloud-based IT asset or infrastructure. Intelligence to Fault Detection and Application Monitoring is key in cloud infrastructure. Amazon CloudWatch enables you to report on the overall health of your application and resources and to create application monitoring policies defining the data that must be collected, synthesized and evaluated to generate smart events

7. Cost - Cost considerations depend upon an organization's actual goals and requirements. If high resiliency or uptime are top priorities, for example, it makes financial sense to move to the cloud. Understanding things like CPU, IOP, and memory usage are necessary if you want to both forecast cloud cost and keep an eye on growing costs. Cloud cost analysis can be difficult because cloud providers offer different pricing models, unique discounting options, and frequent price cuts. For the major cloud providers — AWS, Microsoft Azure, Google Cloud, and IBM Cloud — it required routine to analyze the latest price reductions and discounts which providers have the lowest-cost options for cloud compute instances and for which use cases

8. Elasticity & Scalability - In cloud computing, elasticity is defined as "the degree to which a system is able to adapt to workload changes by provisioning and de-provisioning resources in an autonomic manner, such that at each point in time the available resources match the current demand as closely as possible". The main benefit of scalable architecture is performance and the ability to handle bursts of traffic or heavy loads with little or no notice. A scalable system can help keep your application or online business running during peak times and not end up losing you money or damaging your reputation.

9. Pay as you go Model - Pay-as-you-go cloud computing (PAYG cloud computing) is a payment method for cloud computing that charges based on usage. The practice is similar to that of utility bills, using only resources that are needed. One major benefit of the pay-as-you-go method is that there are no wasted resources, since users only pay for services procured, rather than provisioning for a certain amount of resources that may or may not be used. With traditional enterprise design, users architect data storage to handle the maximum workload. But with the public cloud, the pay-as-you-go method allows you to be charged only for what you store. Most cloud providers help you reduce Total Cost of Ownership (TCO) by reducing the need to invest in large capital expenditures and providing a pay-as-you-go model that empowers you to invest in the capacity you need and use it only when the business requires it. Cloud provider's TCO calculators allow you to estimate the cost savings when using cloud services and provide a detailed set of reports that can be used in executive presentations. The calculators also give you the option to modify assumptions that best meet your business needs.

Six application migration cloud strategies

1. Rehosting—Otherwise known as "lift-and-shift."
2. Replatforming—Sometimes call this "lift-tinker-and-shift."
3. Repurchasing—Moving to a different product.
4. Refactoring / Re-architecting—Re-imagining how the application is architected and developed, typically using cloud-native features.
5. Retire—Get rid of.
6. Retain—Usually this means "revisit" or do nothing (for now).

Infrastructure as Code

Infrastructure as code (IaC) is the process of managing and provisioning computer data centers through machine-readable definition files, rather than physical hardware configuration or interactive configuration tools. The IT infrastructure managed by this comprises both physical equipment

such as bare-metal servers as well as virtual machines and associated configuration resources. The definitions may be in a version control system. It can use either scripts or declarative definitions, rather than manual processes, but the term is more often used to promote declarative approaches.

IaC can be a key attribute of enabling best practices in DevOps & Cloud management – Developers become more involved in defining configuration and Ops teams get involved earlier in the development process. Tools that utilize IaC bring visibility to the state and configuration of servers and ultimately provide the visibility to users within the enterprise, aiming to bring teams together to maximize their efforts. Automation in general aims to take the confusion and error-prone aspect of manual processes and make it more efficient, and productive. Allowing for better software and applications to be created with flexibility, less downtime, and an overall cost effective way for the company. IaC is intended to reduce the complexity that kills efficiency out of manual configuration. Automation and collaboration are considered central points in DevOps; Infrastructure automation tools are often included as components of a DevOps toolchain.

Tools and Release Management

Build Tools - Each cloud provider has fully managed continuous integration service that compiles source code, runs tests, and produces software packages that are ready to deploy. With cloud build tool, you don't need to provision, manage, and scale your own build servers. It scales continuously and processes multiple builds concurrently, so your builds are not left waiting in a queue. You can get started quickly by using prepackaged build environments, or you can create custom build environments that use your own build tools. With cloud build tool, you are charged by the minute for the compute resources you use.

Orchestration Tools - Cloud formation templates, Docker containers (Kubernates,EKS)

Logging and Monitoring Tools - Cloud Watch, Splunk, Kibana, Athena

Major Cloud Infrastructure Providers

1. **Amazon Web Services**
2. **GCP**
3. **Microsoft Azure**

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