

Curso de Especialização em Aprendizagem de Máquina em Inteligência Artificial

Disciplina: Computação em nuvem

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Aula 04 – 03 de Setembro de 2020



Debriefing – Entrega Parcial 2 – Requisitos Críticos

- **Erick Munekata:** desempenho, Disponibilidade, Escalabilidade, Confiabilidade (Tolerância a falhas e recuperabilidade), Segurança, Interoperabilidade.
- **Fernanda:** **segurança**, confiabilidade, desempenho e disponibilidade de recursos.
- **Marcos:** **segurança** e disponibilidade de recursos (Exemplo: PIX)
- **Paulo Braga:** **segurança**, desempenho e manutenibilidade
- **Paulo Sergio:** disponibilidade, desempenho e **segurança**
- **Tarcizio:** desempenho e **segurança**
- **Wal:** **segurança**, disponibilidade e desempenho

Objetivos da aula

Apresentar os principais conceitos e utilização de:

- *Multitenancy*
- *QoS para Cloud Computing*
- *Ciclo de vida de Cloud Computing*

Parte Prática:

- *Exemplos de Modelos de Ciclo de Vida de Cloud proposto por provedores de nuvem*

Atividade para a próxima aula (10/09/2020)

Multitenancy


- **Resource pooling** – One of the 5 Cloud Computing Essential attribute:
 - The provider's computing resources are pooled to serve multiple consumers using a **multi-tenant model**, with different physical and virtual resources dynamically assigned and reassigned according to consumer demand.
 - There is a sense of location independence in that the customer generally has no control or knowledge over the exact location of the provided resources but may be able to specify location at a higher level of abstraction (e.g., country, state, or datacenter).
 - Examples of resources include storage, processing, memory, and network bandwidth.

Fonte: Peter M. Mell and Timothy Grance. 2011. SP 800-145. the NIST Definition of Cloud Computing. Technical Report. NIST, Gaithersburg, MD, United States.

Tenant ?

tenant

noun [C]

UK  /'ten.ənt/ US  /'ten.ənt/



Cambridge
Dictionary



C2

a person who pays rent for the use of land or a building

— Exemplos

- *Tenants are complaining that vital repairs are not being done.*
- *They formed a tenants association.*
- *He was cruel to his tenants.*
- *Tenants had to give part of their harvest to the landowners.*

Fonte: <https://dictionary.cambridge.org/pt/dicionario/ingles/tenant>.

Exemplo: Criação de um tenant no Azure

Quickstart: Create a new tenant in Azure Active Directory

09/09/2018 • 2 minutos para ler • 

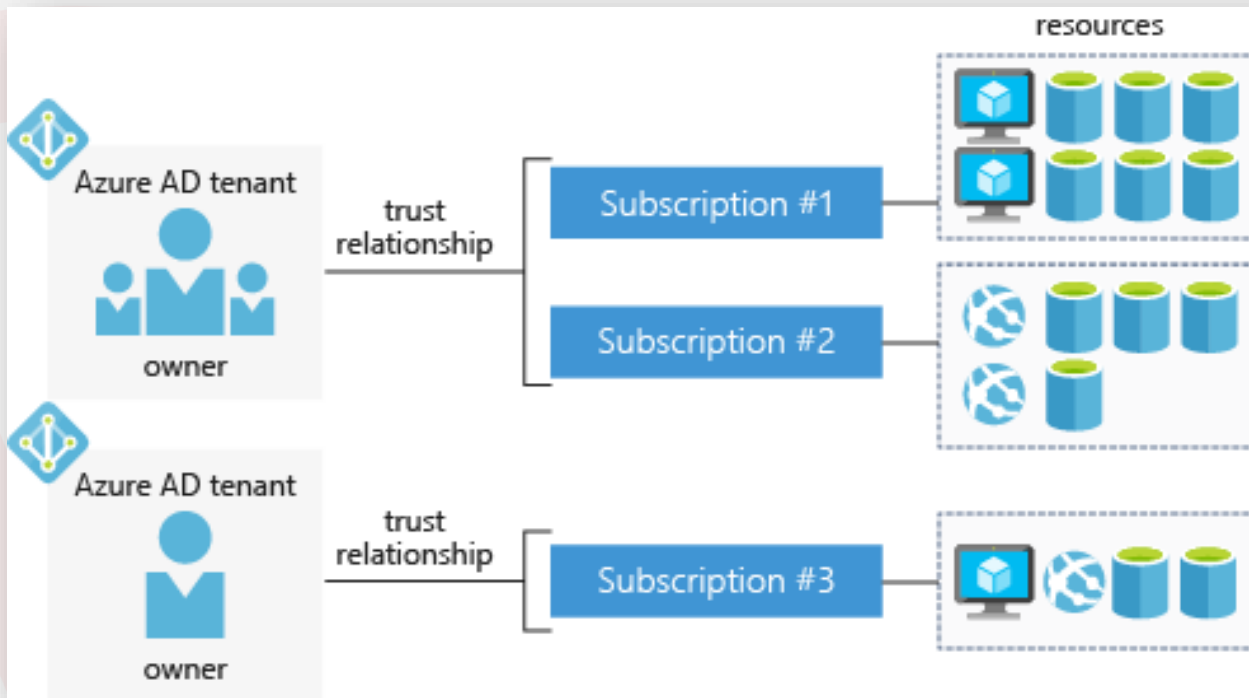
You can do all of your administrative tasks using the Azure Active Directory (Azure AD) portal, including creating a new tenant for your organization.

In this quickstart, you'll learn how to get to the Azure portal and Azure Active Directory, and you'll learn how to create a basic tenant for your organization.

If you don't have an Azure subscription, create a [free account](#) before you begin.

Fonte: <https://docs.microsoft.com/pt-br/azure/active-directory/fundamentals/active-directory-access-create-new-tenant>

Exemplo: Criação de um tenant no Azure



Fonte: <https://daryusman.files.wordpress.com/2019/01/4-azure-ad-tenant.png>

Exemplo: Criação de um tenant no Azure

Create a new tenant for your organization

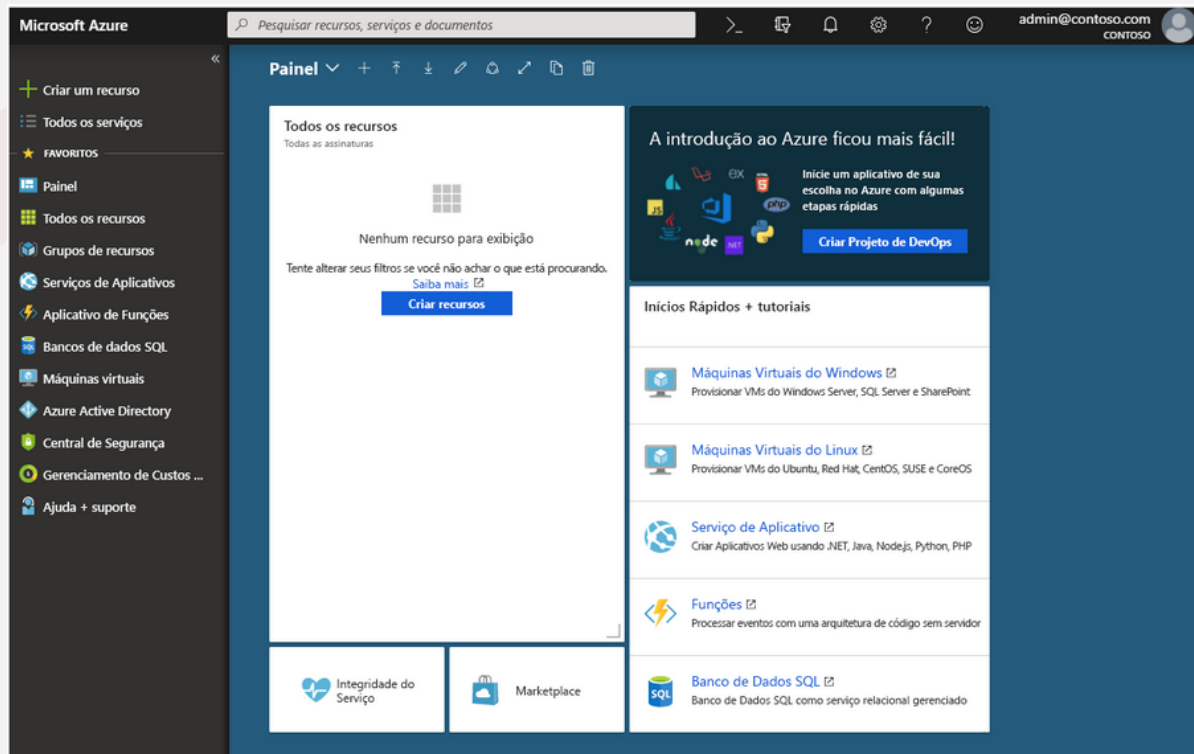
After you sign in to the Azure portal, you can create a new tenant for your organization. Your new tenant represents your organization and helps you to manage a specific instance of Microsoft cloud services for your internal and external users.

To create a new tenant

1. Sign in to your organization's [Azure portal](#) using a Global administrator account.
2. From the Azure portal menu, select **Create a resource**.

Fonte: <https://docs.microsoft.com/pt-br/azure/active-directory/fundamentals/active-directory-access-create-new-tenant>

Exemplo: Criação de um tenant no Azure



Fonte: <https://docs.microsoft.com/pt-br/azure/active-directory/fundamentals/active-directory-access-create-new-tenant>

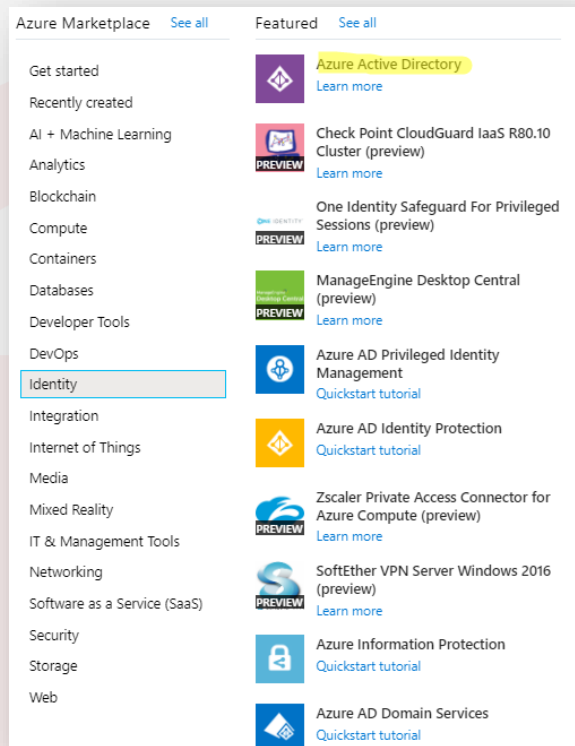
Exemplo: Criação de um tenant no Azure

3. Select **Identity**, and then select **Azure Active Directory**.

The **Create directory** page appears.

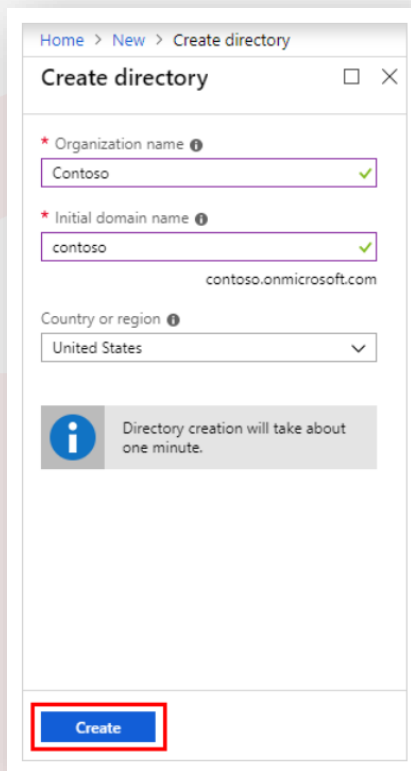
Fonte: <https://docs.microsoft.com/pt-br/azure/active-directory/fundamentals/active-directory-access-create-new-tenant>

Exemplo: Criação de um tenant no Azure



Fonte: <https://docs.microsoft.com/pt-br/azure/active-directory/fundamentals/active-directory-access-create-new-tenant>

Exemplo: Criação de um tenant no Azure



Home > New > Create directory

Create directory

* Organization name ⓘ
Contoso ✓

* Initial domain name ⓘ
contoso ✓
contoso.onmicrosoft.com

Country or region ⓘ
United States ▼

i Directory creation will take about one minute.

Create

Fonte: <https://docs.microsoft.com/pt-br/azure/active-directory/fundamentals/active-directory-access-create-new-tenant>

Exemplo: Criação de um tenant no Azure

4. On the **Create directory** page, enter the following information:

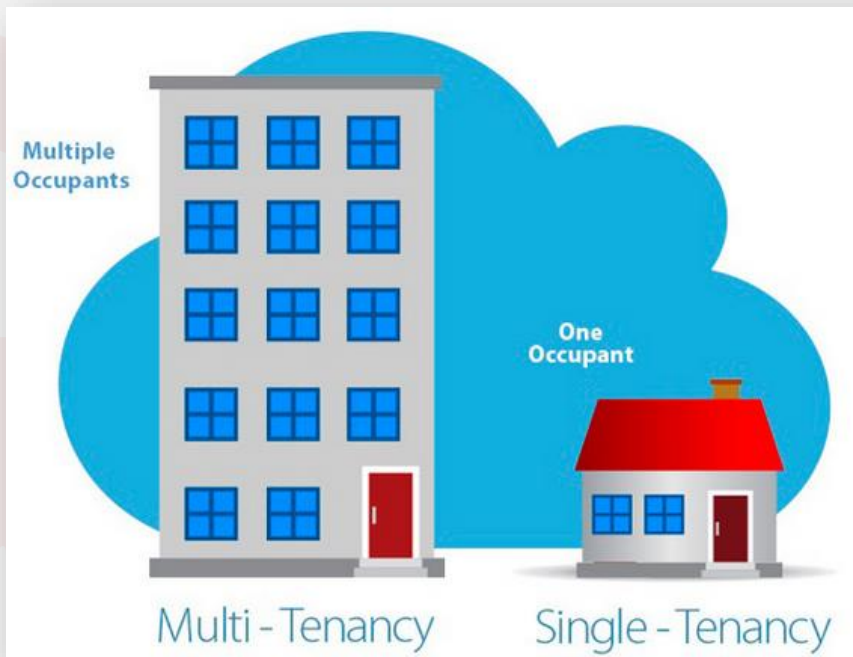
- Type *Contoso* into the **Organization name** box.
- Type *Contoso* into the **Initial domain name** box.
- Leave the *United States* option in the **Country or region** box.

5. Select **Create**.

Your new tenant is created with the domain **contoso.onmicrosoft.com**.

Fonte: <https://docs.microsoft.com/pt-br/azure/active-directory/fundamentals/active-directory-access-create-new-tenant>

Hospedagem do tenant na nuvem



Fonte: Extraído de <https://blog.vision33.com/hs-fs/hubfs/Cloud-ERP-Single-Tenant-VS-Multi-Tenant.jpg?width=1227&name=Cloud-ERP-Single-Tenant-VS-Multi-Tenant.jpg>

Metáfora com aluguel – Single Tenancy

Situação 1: Single Tenancy

- Suponha que 3 pessoas queiram alugar casas, elas optam por alugar casas separadas:
 - **Custo:** Como a pessoa tem que alugar a casa inteira, certamente custará mais.
 - **Utilização de Recursos:** A casa pode ser muito grande para o indivíduo usar completamente.
 - **Manutenção:** Toda casa precisa de uma manutenção e o custo deve ser suportado pelo indivíduo.

Fonte: https://medium.com/@vaibhavsingh_56357/multitenant-applications-what-is-it-part-1-10af84cf64e6

Metáfora com aluguel – Multi-tenancy

Situação 2: Multi-tenancy

- Agora, supondo que as 3 pessoas alugassem a mesma casa e ocupassem diferentes andares do mesmo prédio:
 - **Custos:** alugar um andar de um prédio seria muito mais barato do que alugar um prédio inteiro.
 - **Utilização de recursos:** como o espaço alugado é menor, é mais provável que o espaço atenda melhor às necessidades do usuário. Isso leva a uma melhor utilização do espaço.
 - **Manutenção:** Como a manutenção deve ser feita para o mesmo edifício, o custo e a complexidade da manutenção diminuirão.

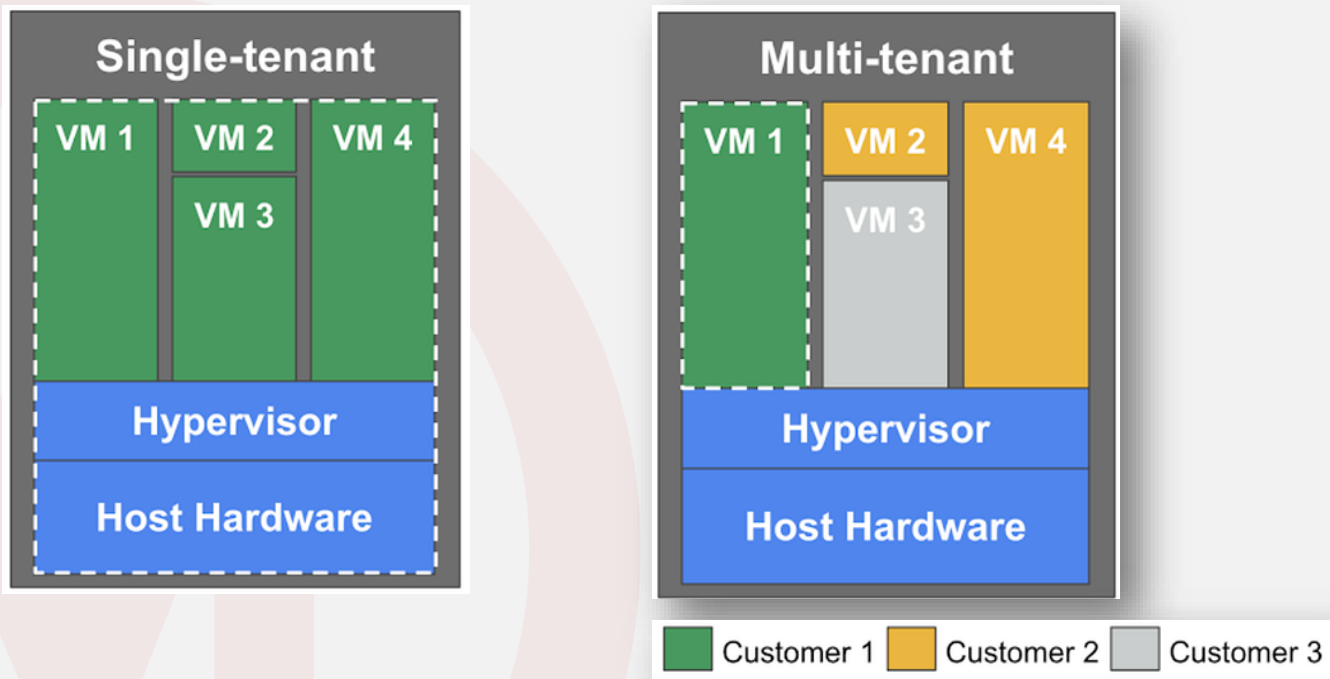
Fonte: https://medium.com/@vaibhavsingh_56357/multitenant-applications-what-is-it-part-1-10af84cf64e6

Casa vs. Prédio

- *Multi-tenant clouds can be compared to the structure of an apartment building.*
- *Each resident has access to their own apartment within the agreement of the entire building and only authorized individuals can enter the specific units.*
- *However, the entire building shares resources such as water, electricity and common areas.*

Fonte: <https://searchcloudcomputing.techtarget.com/definition/multi-tenant-cloud>

Single-tenant vs. Multi-tenant



Fonte: https://medium.com/@vaibhavsingh_56357/multitenant-applications-what-is-it-part-1-10af84cf64e6

Single-Tenancy

- *In a single-tenant cloud, only one customer is hosted on a server and is granted access to it.*
- *Single-tenant clouds give customers more control over the management of data, storage, security and performance.*

Fonte: <https://searchcloudcomputing.techtarget.com/definition/multi-tenant-cloud>

Multi-Tenancy

- A multi-tenant cloud is a cloud computing architecture that allows customers to share computing resources in a public or *private cloud (???)*.
- Each tenant's data is isolated and remains invisible to other tenants.
- In a multi-tenant cloud system, users have individualized space for storing their projects and data.

Fonte: <https://searchcloudcomputing.techtarget.com/definition/multi-tenant-cloud>

Multi-Tenancy

- *Within the cloud infrastructure, each tenant's data is inaccessible to all other tenants, and can only be reached with the cloud provider's permissions.*
- *In a **private cloud**, the customers, or tenants, may be different individuals or groups within a single company,*
- *While in a **public cloud**, entirely different organizations may safely share their server space.*
- *Most public cloud providers use the multi-tenancy model. It allows them to run servers with single instances, which is less expensive and helps to streamline updates*

Fonte: <https://searchcloudcomputing.techtarget.com/definition/multi-tenant-cloud>

Multi-Tenancy



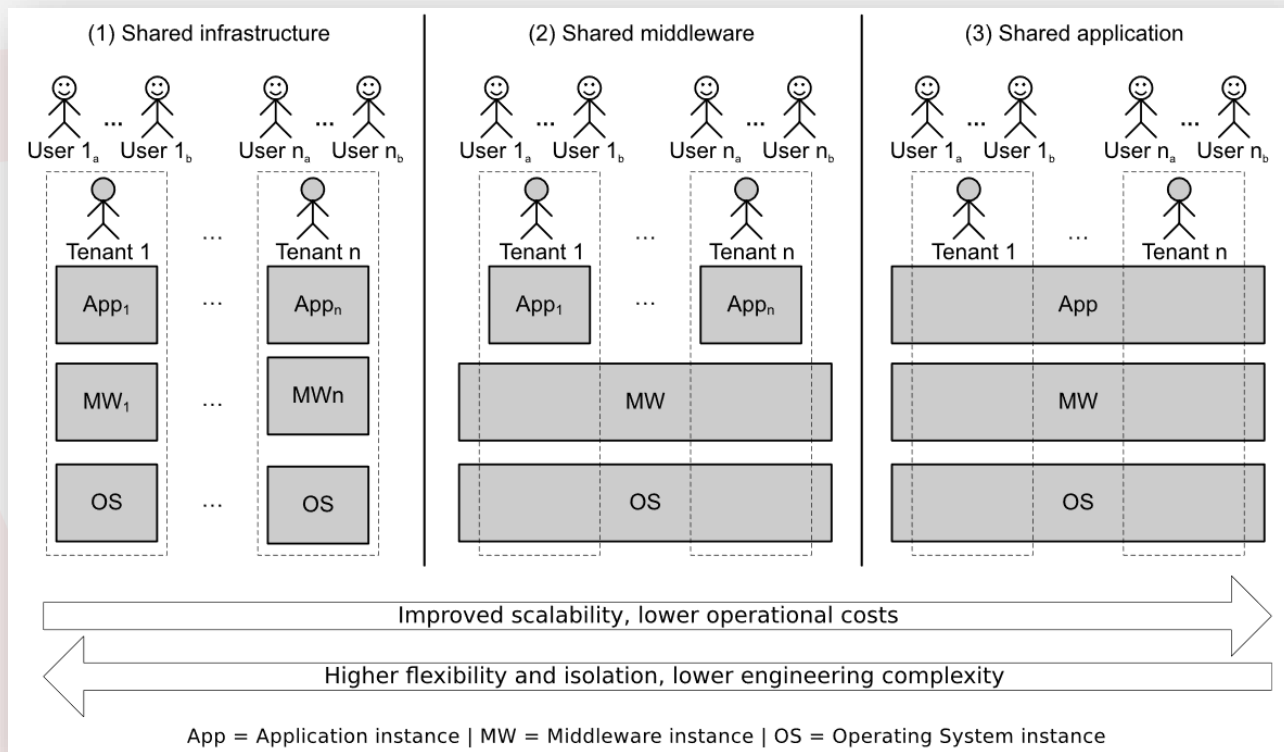
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Discussão em sala: Exemplos de uso massivo de Multi-tenancy ?

Multi-Tenancy is a requirement for a SaaS vendor to be successful.

Marc Benioff, CEO, Salesforce.com

Multi-tenancy and economy of scale



Fonte: [Application-level multi-tenancy: the promise and pitfalls of shared-everything architectures](#)

Trade-offs | Single-tenant

Advantages:

- *Increased privacy as all applications that belong to a user are housed in one instance.*
- *Better control over upgrades. Upgrades can be performed at your own discretion.*
- *Single tenant systems are easier to back up and restore since each client database has its own separate back up.*

Disadvantages:

- *With the single-tenant hosting model, the user must bear the costs of the entire system alone.*
- *In general, it is more expensive than a multi-tenant hosting solution.*

Fonte: <https://blog.vision33.com/cloud-erp-single-tenant-vs-multi-tenant>

Trade-offs | Multi-tenant

Advantages:

- *The solution costs are generally lower than single-tenant solutions.*
- *With resource pooling, there are considerable savings in hardware and power.*
- *Multi-tenancy has seamless forced upgrades as upgrades don't require any level of per-user intervention when other users are upgraded simultaneously.*

Disadvantages:

- *Since multiple tenants run their applications off the same code and database, individual users have less ability to customize the applications to their specific needs.*
- *Updates could be deployed to your business without your authorization as you are relying on the same code base as the other users.*

Fonte: <https://blog.vision33.com/cloud-erp-single-tenant-vs-multi-tenant>

Multi-tenant – Desafios de Engenharia

Increased engineering complexity:

The engineering of multi-tenant application software is more complex than traditional single-tenant applications that consist of a dedicated deployment of application, middleware and OS for each tenant.

Different and varying tenant-specific requirements.

Each tenant has its business specific needs. However, because of the typical one-size-fits-all approach, the multi-tenant application only satisfies the requirements that are common to all tenants.

More complex application-level security.

In a shared-everything architecture, application-level security such as application-specific access control becomes more complex. SaaS providers need to guarantee strict tenant separation.

Fonte: [Application-level multi-tenancy: the promise and pitfalls of shared-everything architectures](#)



Quality of Service (QoS)

Quality

Quality defined as the degree to which a set of inherent characteristics meet requirement.

Characteristics defined by ISO as well-known feature that means the other features are not included in the definition of the quality.

Inherent characteristics are the necessary part of the system and cannot be separated from the system.

Fonte: RAMADAN, Hashem H.; KASHYAP, D. Quality of Service (QoS) in Cloud Computing. *International Journal of Computer Science and Information Technologies*, v. 8, n. 3, p. 318-320, 2017.

Quality Case

E-commerce requirements elicitation

- *Provide search capability*
- *Pay products using credit cards*
- *Support up to 10.000 products in a category*
- *Support up to 100 sales/minute in special dates (Black Friday, Christmas, etc.)*

Business goals drives architectural decisions

- *Pay products using credit cards*
- *The system should support up to 100 sales/minute in special dates*
- *Architectural decisions related to:*
 - *Functional Requirements (FR)*
 - *Nonfunctional requirements (NFR)*

Defining Requirements - FR

Functional Requirement: *what the system must do, and how it must behave or react to a stimulus*

- *Add a product to cart*
- *Pay the products using credit card*
- *Browse related products*

Related to functionality quality attribute

Defining Requirements - NFR

Non-Functional Requirement: *qualification of functional requirements that drives overall quality of the resulting system.*

- *Support 1000 simultaneous users*
- *Return results a search in less than 2 seconds in 95% of time during business hours*

Related to others quality attributes (-ities: scalability, security, etc.)*

NFR supports FR and software overall quality

Functional suitability

Security

Usability

Maintainability

Performance

Scalability

Software Quality Attributes – ISO 25010

ISO/IEC (2011) - Systems and Software Quality Requirements and Evaluation (SQuaRE)

Functional
suitability

Performance
efficiency

Compatibility

Usability

Reliability

Security

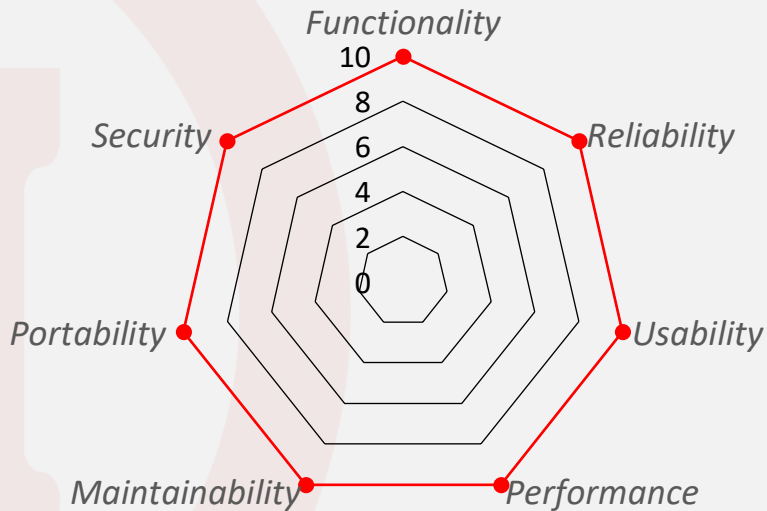
Maintainability

Portability

Software Quality Requirements Trade-Offs

- *Quality requirements: we can not get them all!*
- *Balance the trade-offs between them*

Utopic Software Architecture:



There is no free lunch!

	Availability	Efficiency	Flexibility	Integrity	Interoperability	Maintainability	Portability	Reliability	Reusability	Robustness	Testability	Usability
Availability								+		+		
Efficiency			-		-	-	-	-		-	-	-
Flexibility		-		-		+	+	+		+		
Integrity		-			-				-		-	-
Interoperability		-	+	-			+					
Maintainability	+	-	+					+			+	
Portability		-	+		+	-			+		+	-
Reliability	+	-	+			+				+	+	+
Reusability		-	+	-				-			+	
Robustness	+	-						+				+
Testability	+	-	+			+		+				+
Usability		-								+	-	

Fonte: Evaluating Application Architecture, Quantitatively. The Architecture Journal, 2010

QoS para Cloud Computing

- *Recent years seen the tremendous shift of enterprise applications to the cloud.*
- *Quality-of-Service (QoS) in cloud computing is defined in terms of allocating resources to the application that guaranties a service level along dimensions such as performance, availability and reliability.*

Fonte:

RAMADAN, Hashem H.; KASHYAP, D. *Quality of Service (QoS) in Cloud Computing. International Journal of Computer Science and Information Technologies*, v. 8, n. 3, p. 318-320, 2017.

SINGH, Juhí; AGGARWAL, S.; MISHRA, Jayant. *A Review: Towards Quality of Service in Cloud Computing. Int J Sci Res*, v. 6, n. 1, p. 31-9, 2017.

QoS Characteristics in Cloud Computing

- *Quality of Service parameters as performance, reliability, cost, response time, security etc. builds an important characteristics in Cloud Computing*
- *Cloud computing is an operation model that integrates many technological advancements of the last decade such as virtualization, web services, and SLA management for enterprise applications*

Fonte: SINGH, Juhi; AGGARWAL, S.; MISHRA, Jayant. A Review: Towards Quality of Service in Cloud Computing. Int J Sci Res, v. 6, n. 1, p. 31-9, 2017.

QoS Characteristics in Cloud Computing

Accountability

- *This group of QoS attributes is used to measure various Cloud provider specific characteristics.*
- *This is important to build trust of a customer on any Cloud provider.*
- *No organization will want to deploy its applications and store their critical data in a place where there is no accountability of security exposures and compliance.*
- *Functions critical to accountability: auditability, compliance, data ownership, provider ethicality, sustainability etc.*

Fonte: SINGH, Juhi; AGGARWAL, S.; MISHRA, Jayant. A Review: Towards Quality of Service in Cloud Computing. *Int J Sci Res*, v. 6, n. 1, p. 31-9, 2017.

QoS Characteristics in Cloud Computing

Agility

- *One of the most important advantage of Cloud computing is that it adds to the agility of an organization.*
- *The organization can expand and change quickly without much expenditure.*
- *Agility is measured as a rate of change metric, showing how quickly new capabilities are integrated into IT as needed by the business.*
- *When considering a Cloud service's agility, organizations want to understand whether the service is elastic, portable, adaptable and flexible*

Fonte: SINGH, Juhi; AGGARWAL, S.; MISHRA, Jayant. A Review: Towards Quality of Service in Cloud Computing. Int J Sci Res, v. 6, n. 1, p. 31-9, 2017.

QoS Characteristics in Cloud Computing

Cost

- *One question that arises in the mind of organizations before switching to Cloud computing is that whether it is cost-effective or not.*
- *Therefore, cost is clearly one of the vital attributes for IT and the business.*
- *Cost tends to be the single most quantifiable metric today, but it is important to express cost in the characteristics which are relevant to a business organization.*

Fonte: SINGH, Juhi; AGGARWAL, S.; MISHRA, Jayant. A Review: Towards Quality of Service in Cloud Computing. *Int J Sci Res*, v. 6, n. 1, p. 31-9, 2017.

QoS Characteristics in Cloud Computing

Performance

- *There are many different solutions offered by Cloud providers addressing the IT needs of different organizations.*
- *Each solution has different performance in terms of functionality, service response time, accuracy, stability, interoperability, suitability etc.*
- *The organizations need to understand through these properties how well their applications will perform on the different Clouds and whether these deployments meet their expectations*

Fonte: SINGH, Juhi; AGGARWAL, S.; MISHRA, Jayant. A Review: Towards Quality of Service in Cloud Computing. *Int J Sci Res*, v. 6, n. 1, p. 31-9, 2017.

QoS Characteristics in Cloud Computing

Assurance

- *This characteristic indicates the likelihood of a Cloud service that it will perform as expected or promised in the SLA.*
- *Every organization looks to expand their business and provide better services to their customers.*
- *Therefore availability, reliability, resiliency and service stability become an important factor for them before they decide switching to Cloud services*

Fonte: SINGH, Juhi; AGGARWAL, S.; MISHRA, Jayant. A Review: Towards Quality of Service in Cloud Computing. *Int J Sci Res*, v. 6, n. 1, p. 31-9, 2017.

QoS Characteristics in Cloud Computing

Security and Privacy

- *Data protection and privacy are very important concerns of nearly every organization.*
- *Hosting data in other organizations control is always a critical issue which require stringent security policies employed by Cloud providers*
- *For instance, Financial organizations generally require high compliance regulations involving data integrity and privacy.*
- *Security and Privacy is also multi-dimensional in nature and include many attributes such as privacy, confidentiality, data loss and integrity.*

Fonte: SINGH, Juhi; AGGARWAL, S.; MISHRA, Jayant. A Review: Towards Quality of Service in Cloud Computing. *Int J Sci Res*, v. 6, n. 1, p. 31-9, 2017.

SLAs ?

- *Definição e detalhamento dos SLAs dos principais provedores de Cloud Computing:*
 - AWS: <https://aws.amazon.com/pt/legal/service-level-agreements/>
 - Azure: <https://azure.microsoft.com/pt-br/support/legal/sla/>
 - Google Cloud: <https://cloud.google.com/terms/sla/>

Exemplo: Azure - SLA para Máquinas virtuais

SLA para Máquinas virtuais

Última atualização: março de 2018

- Para todas as Máquinas Virtuais com duas ou mais instâncias implantadas em duas ou mais Zonas de Disponibilidade na mesma região, garantimos que você terá Conectividade de Máquinas Virtuais, no mínimo, a uma instância, pelo menos, 99,99% do tempo.
- Para todas as Máquinas Virtuais com duas ou mais instâncias implantadas no mesmo Grupo de Disponibilidade, garantimos que você terá Conectividade de Máquinas Virtuais, no mínimo, a uma instância, pelo menos, 99,95% do tempo.
- Para qualquer Máquina Virtual de Única Instância que usa o armazenamento premium para todos os Discos de Sistema Operacional e Discos de Dados, garantimos que você terá Conectividade de Máquinas Virtuais pelo menos 99,9% do tempo.

Fonte: https://azure.microsoft.com/pt-br/support/legal/sla/virtual-machines/v1_8/

Exemplo: Azure - SLA para Máquinas virtuais

Cálculo do Tempo de Atividade Mensal e Níveis de Serviço para Máquinas Virtuais em Zonas de Disponibilidade

“**Máximo de Minutos Disponíveis**” é o total de minutos acumulados durante um mês de cobrança com duas ou mais instâncias implantadas em duas ou mais Zonas de Disponibilidade na mesma região. Máximo de Minutos Disponíveis é medido a partir do momento em que pelo menos duas Máquinas Virtuais em duas Zonas de Disponibilidade na mesma região foram inicializadas em decorrência de uma ação iniciada pelo Cliente até o momento em que o Cliente iniciou uma ação que resultou na parada ou exclusão das Máquinas Virtuais.

“**Tempo de Inatividade**” é o total de minutos acumulados que fazem parte do Máximo de Minutos Disponíveis sem Conectividade de Máquina Virtual na região.

A “**Porcentagem de Tempo de Atividade Mensal**” para Máquinas Virtuais em Zonas de Disponibilidade é calculada como o Máximo de Minutos Disponíveis menos o Tempo de Inatividade, dividido pelo Máximo de Minutos Disponíveis em um mês de cobrança para uma determinada assinatura do Microsoft Azure. A Porcentagem de Tempo de Atividade Mensal é representada pela seguinte fórmula:

$$\% \text{ de Tempo de Atividade Mensal} = (\text{Máximo de Minutos Disponíveis} - \text{Tempo de Inatividade}) / \text{Máximo de Minutos Disponíveis} \times 100$$

Fonte: https://azure.microsoft.com/pt-br/support/legal/sla/virtual-machines/v1_8/

Exemplo: Azure - SLA para Máquinas virtuais

PORCENTAGEM DE TEMPO DE ATIVIDADE MENSAL	CRÉDITO DE SERVIÇO
< 99,99%	10%
< 99%	25%
< 95%	100%

Fonte: https://azure.microsoft.com/pt-br/support/legal/sla/virtual-machines/v1_8/



Cloud Computing Life Cycle

Managing Cloud Computing

- *There are many **challenges** to successfully delivering cloud-based services; including security, data ownership, interoperability, service maturity and return on investment.*
- *These challenges need to be understood and managed before attempting to take advantage of what the cloud has to offer.*

Fonte: Conway, Gerard, and Edward Curry. "Managing Cloud Computing-A Life Cycle Approach." CLOSER. 2012.

Cloud Computing – Business Drivers

- A major driver of cloud computing is the **pressure on IT departments to deliver more and enhanced services with reduced budgets**, while responding to ever-increasing and ever-changing business requirements.
- Cloud computing is also seen as a way to **free up IT resources to concentrate on core activities**, by outsourcing non-core activities such as management of e-mail systems.
- **Foster innovation**

Fonte: Conway, Gerard, and Edward Curry. "Managing Cloud Computing-A Life Cycle Approach." CLOSER. 2012.

Cloud Computing – Life Cycle



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Discussão em sala:

- *Ciclo de vida de aplicações on-prem vs. Ciclo de vida de aplicações na nuvem ?*
- *Similaridades e diferenças ?*

Cloud Computing – Life cycle key challenges

Security: *With cloud computing, you are heavily dependent on the service provider for security.*

- *Cloud service providers can claim to provide complete security for access, compliance, data segregation, backup, recovery, etc.*

Fonte: Conway, Gerard, and Edward Curry. "Managing Cloud Computing-A Life Cycle Approach." CLOSER. 2012.

Cloud Computing – Life cycle key challenges

Data Ownership

- *What happens to your data when it leaves your organization to reside in the cloud?*
- *Companies who move to the cloud probably will not completely lose track of their data, but they are likely to lose some level of ownership and, in particular, control.*
- *It is important to understand who can access the data and for what purpose.*
- **GDPR** is coming...

Fonte: Conway, Gerard, and Edward Curry. "Managing Cloud Computing-A Life Cycle Approach." CLOSER. 2012.

Cloud Computing – Life cycle key challenges

Lock-in and Interoperability

- *Today each service offering provides its own unique way for the cloud to interact with applications, data and clients.*
- *It can be very difficult to use **multiple vendors** and to seamlessly **integrate legacy** and cloud services.*
- *Necessary to have plan to **integrate your cloud services or to move to another cloud supplier in the future.***

Fonte: Conway, Gerard, and Edward Curry. "Managing Cloud Computing-A Life Cycle Approach." CLOSER. 2012.

Cloud Computing – Life cycle key challenges

Enterprise Support and Service Maturity

- *Cloud computing services may not provide the levels of reliability, manageability, and support required by large enterprises.*
- *Is the cloud supplier mature enough for your needs ?*

Fonte: Conway, Gerard, and Edward Curry. "Managing Cloud Computing-A Life Cycle Approach." CLOSER. 2012.

Cloud Computing – Life cycle key challenges

Loss of Data

- *Data stored in the cloud can be replicated across multiple machines and backed up.*
- *However, not all cloud services have the same redundancy for disaster recovery.*
- *Does the cloud supplier have an appropriate **disaster recovery strategy**?*

Fonte: Conway, Gerard, and Edward Curry. "Managing Cloud Computing-A Life Cycle Approach." CLOSER. 2012.

Cloud Computing – Life cycle key challenges

Return on Investment

- *The expectation is that external cloud computing can reduce costs.*
- *However, the **cost advantages** for large enterprises may not be as clear as for SMEs.*
- *Currently, many large enterprises can gain the benefits of significant economies of scale in their own internal IT operations.*
- *What is the real TCO of the cloud service ?*

Fonte: Conway, Gerard, and Edward Curry. "Managing Cloud Computing-A Life Cycle Approach." CLOSER. 2012.

Cloud Computing – Life cycle key challenges

Requirement for online connectivity

- *Cloud computing is impossible if you cannot connect to the Internet.*
- *A dead Internet connection means it is not possible to work, and in areas where Internet connections are few or inherently unreliable, this could be a problem.*
- *What network redundancy exists between you and the cloud supplier ?*

Fonte: Conway, Gerard, and Edward Curry. "Managing Cloud Computing-A Life Cycle Approach." CLOSER. 2012.

Cloud Computing – Life cycle *key challenges*

- In order to overcome these challenges, organizations need a systematic means of reviewing their business needs and *weighing up the potential gains and opportunities against the risks*, so that the transition to cloud computing is *strategically planned and understood*.



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Fonte: Conway, Gerard, and Edward Curry. "Managing Cloud Computing-A Life Cycle Approach." CLOSER. 2012.

Cloud Computing – Why does a life cycle work ?

- *The cloud life cycle applies proven and documented project management principles that are known by most IT and business managers.*
- *It breaks down the project into discrete manageable stages that allows the company to **gather the correct information to decide before moving to the next stage***

Fonte: Conway, Gerard, and Edward Curry. "Managing Cloud Computing-A Life Cycle Approach." CLOSER. 2012.

Cloud Computing – Why does a life cycle work ?

- *The life cycle ensures appropriate pre-planning so that the correct partners are chosen and that the impacts on the business are properly understood, managed, and controlled.*
- *For example it allows a company to identify the correct services to move to the cloud and to create plans for the impact on **staff directly and indirectly impacted**.*

Fonte: Conway, Gerard, and Edward Curry. "Managing Cloud Computing-A Life Cycle Approach." CLOSER. 2012.

Cloud Life Cycle proposed by Hiran, Kant et al.



Fonte: Conway, Gerard, and Edward Curry. "Managing Cloud Computing-A Life Cycle Approach." CLOSER. 2012.

HIRAN, Kamal Kant et al. *Cloud Computing: Master the Concepts, Architecture and Applications with Real-world examples and Case studies*. Bpb Publications, 2019.

Cloud Life Cycle – 4 phases

I. Architect

- *The first phase starts with the investigation and planning of the cloud project.*

II. Engage:

- *The second phase selects a service provider that can deliver the required cloud service.*

III. Operate:

- *The third phase is the implementation and the day-to-day management of the cloud service.*

IV. Refresh:

- *The fourth phase is the ongoing review of cloud services*

Fonte: Conway, Gerard, and Edward Curry. "Managing Cloud Computing-A Life Cycle Approach." CLOSER. 2012.

Cloud Life Cycle – 9 Steps

Phase I - Architect

- Step 1 - Investigate
- Step 2 – Identify
- Step 3 – Implementation Strategy
- Step 4 – Business Design

Phase II - Engage

- Step 5 – Select
- Step 6 – Negotiate

Phase III - Operate

- Step 7 – Operational Roll-out
- Step 8 – Manage the Supply Chain

Phase IV - Refresh

- Step 9 – Review

Fonte: Conway, Gerard, and Edward Curry. "Managing Cloud Computing-A Life Cycle Approach." CLOSER. 2012.

Phase I: Architect → Step 1 - Investigate

Step 1: Investigate

*This step provides an **understanding** of what an organization wants to achieve by moving to the cloud, and what goals and expectations are to be met.*

*This will be based on an analysis of the appropriate industrial segment, **with insights from experts and experiences from peer organizations**, together with knowledge of potential suppliers.*

Fonte: Conway, Gerard, and Edward Curry. "Managing Cloud Computing-A Life Cycle Approach." CLOSER. 2012.

Phase I: Architect → Step 1 - Investigate

Activities	Outputs
<ul style="list-style-type: none">• Determine the organization's IT objectives and its alignment with the business.• Determine what role cloud computing will play within the IT strategy.• Gather intelligence on cloud service offerings.• Validate with cloud subject matter experts.	<ul style="list-style-type: none">• IT strategy for cloud computing.• Strategic intent of moving to the cloud and how it progresses the business objectives.• Intelligence document on cloud service offerings and providers.• Documented understanding of what will be achieved by comparing the strategic requirements with the available services and providers.

Fonte: Conway, Gerard, and Edward Curry. "Managing Cloud Computing-A Life Cycle Approach." CLOSER. 2012.

Phase I: Architect → Step 2 – Identify

Step 2: Identify

Objectively *assess* what areas of the *business are appropriate to outsource to the cloud* and what impact this will have on the current delivery model.

This will require an understanding of the current state, so that it can be compared to the desired future state.

Impact on the service, people, cost, infrastructure, stakeholders and how the impact will be managed should be considered.

Fonte: Conway, Gerard, and Edward Curry. "Managing Cloud Computing-A Life Cycle Approach." CLOSER. 2012.

Phase I: Architect → Step 2 – Identify

Activities	Outputs
<ul style="list-style-type: none">• Determine what services will be outsourced to the cloud, and consider impacts on the service, people, cost, infrastructure, and stakeholders.• Decide what type of cloud outsourcing model will be used, and why it is suitable.• Document the current and future states of the IT infrastructure.	<ul style="list-style-type: none">• A List of services to be outsourced to the cloud, with documented understanding on impacts to service, people, cost, infrastructure, and stakeholders.• A Cloud outsourcing model, with documented justification.• Documented current and future states of the IT structure.

Fonte: Conway, Gerard, and Edward Curry. "Managing Cloud Computing-A Life Cycle Approach." CLOSER. 2012.

Phase I: Architect → Step 3 – Implementation Strategy

Step 3: Implementation Strategy

Define at *strategic level* how the cloud services that are to be outsourced will be rolled out.

This will document how key decisions will be made later on, by defining strategies on:

- Staffing
- Communication
- Program roll-out
- Organizational rules
- Risk assessment.

Fonte: Conway, Gerard, and Edward Curry. "Managing Cloud Computing-A Life Cycle Approach." CLOSER. 2012.

Phase I: Architect → Step 3 – Implementation Strategy

Activities	Outputs
<ul style="list-style-type: none">• Determine the roll-out approach and how the program will be managed.• Detail how the program will be staffed and reported.• Decide how cloud suppliers will be engaged, selected and managed.• Determine how risks will be assessed and managed, including data recovery and in-sourcing.	<ul style="list-style-type: none">• A program roll-out strategy.• A Communication strategy.• A strategy to manage staff impacted by the migration to cloud.• A Cloud risk management strategy.• A Cloud supplier management strategy.

Fonte: Conway, Gerard, and Edward Curry. "Managing Cloud Computing-A Life Cycle Approach." CLOSER. 2012.

Phase I: Architect → Step 4 – Business Design

Step 4: Business Design

Design *what is to be outsourced* to the cloud and what the future state will look like.

This will detail the new service, how it will be managed, *how it interfaces to the existing / remaining systems*, and how it will be monitored and reported.

To provide requirements with enough detail to have a meaningful conversation with suppliers so that they can be objectively compared, based on *cost and quality of service*.

Fonte: Conway, Gerard, and Edward Curry. "Managing Cloud Computing-A Life Cycle Approach." CLOSER. 2012.

Phase I: Architect → Step 4 – Business Design

Activities	Outputs
<ul style="list-style-type: none">• Detail the service offering you wish to tender for.• Clearly define negotiable / non-negotiable issues around contracts, service-level agreements (SLA), and pricing model	<ul style="list-style-type: none">• Detailed and clear tender documents for cloud suppliers.

Fonte: Conway, Gerard, and Edward Curry. "Managing Cloud Computing-A Life Cycle Approach." CLOSER. 2012.

Phase II: Engage → Step 5 – Select

Based on the *requirements and the other criteria* defined by the Architect phase this step will select the best supplier based on:

- Value
- Sustainability
- Quality.

Organizations that compromised by accepting partial functionality with the promise of enhanced functionality at a later stage, or that skipped proper validation to meet deadlines, ended up with problems that led to failure of the cloud services, or were very expensive to rectify.

Fonte: Conway, Gerard, and Edward Curry. "Managing Cloud Computing-A Life Cycle Approach." CLOSER. 2012.

Phase Engage → Step 5 – Select

Activities	Outputs
<ul style="list-style-type: none">• Define the tender/bid process.• Select and staff an evaluation team.• Invite bids/tenders.• Evaluate suppliers against the defined criteria.• Shortlist the supplier(s).• Carry out due diligence.	<ul style="list-style-type: none">• A tender process.• Evaluation criteria.• A shortlist of suitable suppliers with caveats.• A Due diligence report.

Fonte: Conway, Gerard, and Edward Curry. "Managing Cloud Computing-A Life Cycle Approach." CLOSER. 2012.

Phase II: Engage → Step 6 – Negotiate

Step 6: Negotiate

This step is to complete the final negotiation, pick the preferred supplier, get internal approval and sign the contract(s), considering:

- *Clearly defined and agreed contingency plans for disaster and change scenarios.*
- *To understand the cloud supplier **get-out clauses** and to make sure there is enough time to move cloud services in-house, or to an alternative cloud supplier.*

Fonte: Conway, Gerard, and Edward Curry. "Managing Cloud Computing-A Life Cycle Approach." CLOSER. 2012.

Phase II: Engage → Step 6 – Negotiate

Activities	Outputs
<ul style="list-style-type: none">• Define the negotiation strategy.• Select and staff the negotiation team.• Carry out negotiations.• Select the preferred cloud supplier.• Get internal approvals and sign the contract.	<ul style="list-style-type: none">• A negotiation strategy.• Results of the negotiation.• Signed final documents: Contract, SLA and Pricing document.

Fonte: Conway, Gerard, and Edward Curry. "Managing Cloud Computing-A Life Cycle Approach." CLOSER. 2012.

Phase III: Operate → Step 7 – Operational Roll-out

Step 7: Operational Roll-out

To put together a *project team that will manage the transition of the agreed services to the new cloud service.*

This will require the transition of the service itself, the management of staff impacted, communication to all stakeholders, knowledge retention / transition, and acceptance sign-off.

Fonte: Conway, Gerard, and Edward Curry. "Managing Cloud Computing-A Life Cycle Approach." CLOSER. 2012.

Phase III: Operate → Step 7 – Operational Roll-out

Activities	Outputs
<ul style="list-style-type: none">• Finalize and publish transition plans.• Select and staff the transition team.• Agree and publish acceptance criteria.• Carry out the transition.• Communicate progress.• Conduct knowledge transfer.• Manage staff (directly and indirectly) impacted.	<ul style="list-style-type: none">• A roll-out plan.• Progress updates.• A signed acceptance document.

Fonte: Conway, Gerard, and Edward Curry. "Managing Cloud Computing-A Life Cycle Approach." CLOSER. 2012.

Phase III: Operate → Step 8 – Manage the Supply Chain

Step 8: Manage the Supply Chain

It is important to manage the new cloud service as efficiently and effectively as possible.

*The organization will need to **adapt to the new setup**, particularly at IT management level – because rather than directly managing internal resources, the requirement will be to manage the cloud supplier and the supplier relationship. **[CULTURA]***

This will require effective monitoring and control so that issue, variations and disputes can be resolved to the satisfaction of both parties.

Fonte: Conway, Gerard, and Edward Curry. "Managing Cloud Computing-A Life Cycle Approach." CLOSER. 2012.

Phase III: Operate → Step 8 – Manage the Supply Chain

Activities	Outputs
<ul style="list-style-type: none">• Manage and report at cloud service operational level.• Capture and manage issues, variations and disputes.• Manage the supplier relationship.• Change management.• Continuous improvement.• Assess and validate how the cloud service is performing.	<ul style="list-style-type: none">• Day-to-day cloud service performance metrics.• Status on issues, problems, variations, and disputes.• Supplier meeting minutes.• A change management report.• Audit reports.

Fonte: Conway, Gerard, and Edward Curry. "Managing Cloud Computing-A Life Cycle Approach." CLOSER. 2012.

Phase IV: Refresh → Step 9 – Review

Step 9: Review

To *review* the cloud service requirements based on:

- *The cloud service itself*
- *Other changes within the business*
- *Changes within the supplier organization*
- *Or the need to change the supplier.*

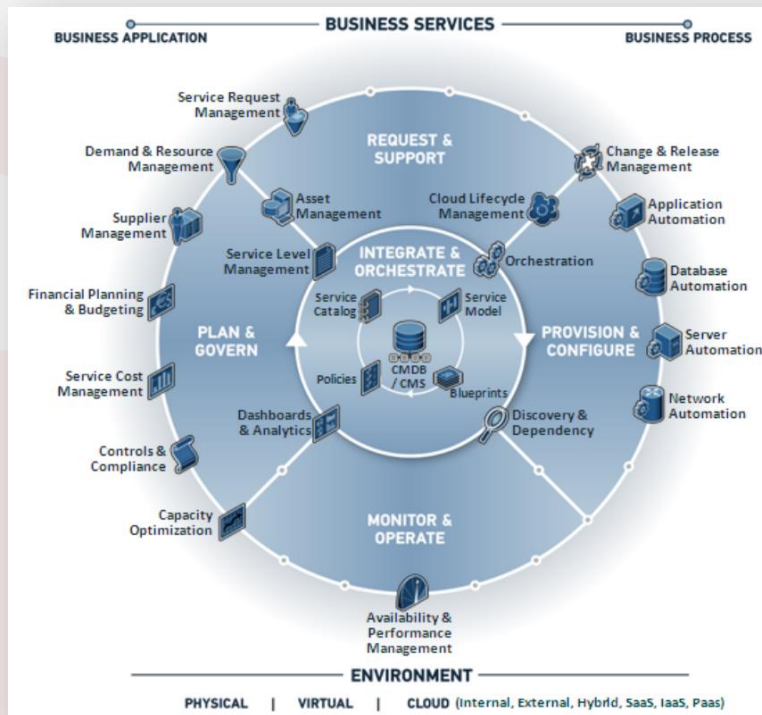
Fonte: Conway, Gerard, and Edward Curry. "Managing Cloud Computing-A Life Cycle Approach." CLOSER. 2012.

Phase IV: Refresh → Step 9 – Review

Activities	Outputs
<ul style="list-style-type: none">• Gather intelligence on the relevant market segment, cloud service technology trends, and supplier offerings.• Audit cloud supplier performance and compare to alternatives.• Understand and assess how other changes in the organization impact on the existing cloud service arrangement.• Based on the above inputs, regularly reassess and review requirements.• Make and present a business case for any significant change to the current cloud service arrangement in order to get approval to start a new cycle.	<ul style="list-style-type: none">• An intelligence report for next generation cloud service offerings.• Cloud supplier audit results.• A business case for any proposed changes.

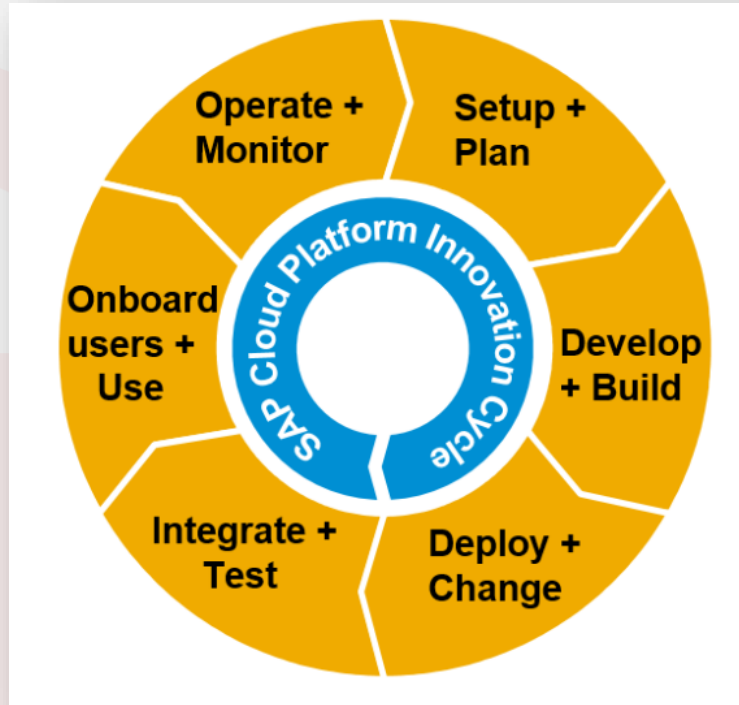
Fonte: Conway, Gerard, and Edward Curry. "Managing Cloud Computing-A Life Cycle Approach." CLOSER. 2012.

Exemplo prático - BMC Cloud Lifecycle Management solution



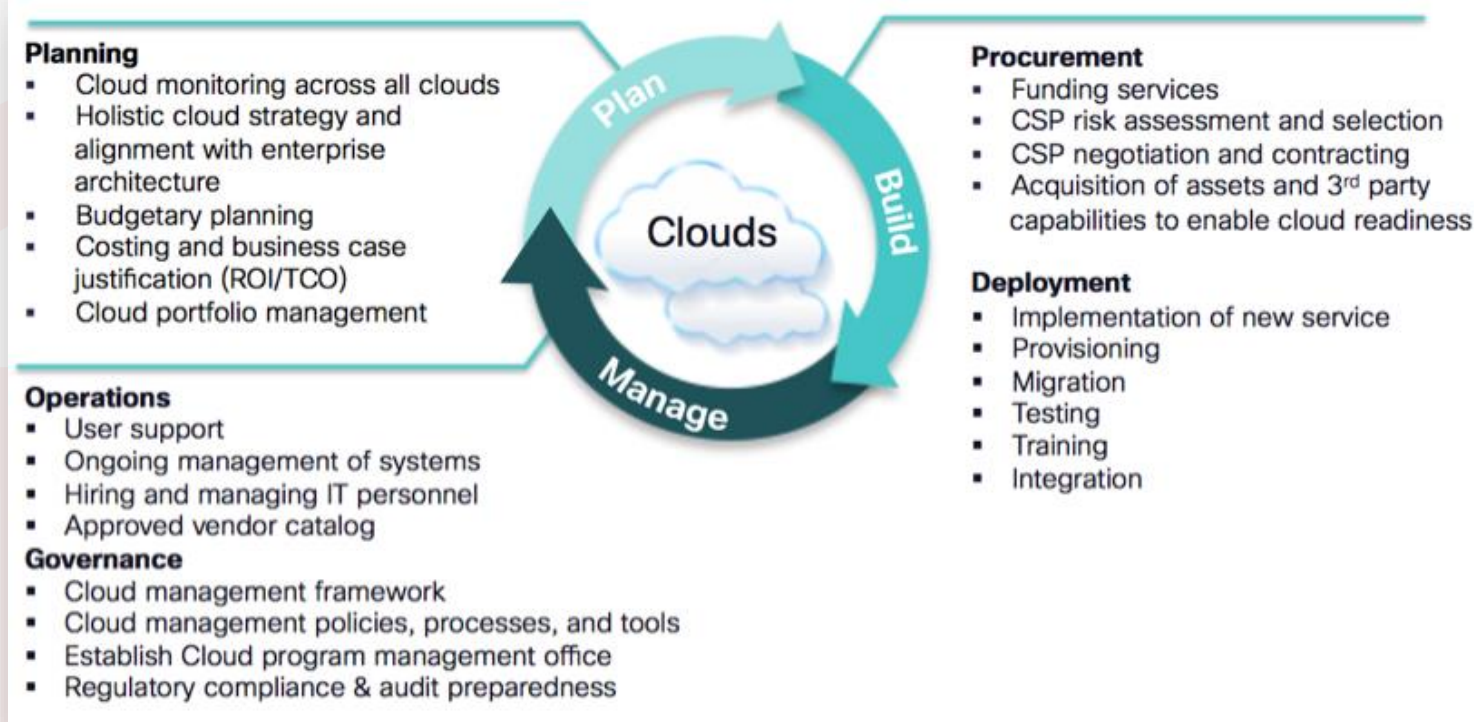
Fonte: <https://docs.bmc.com/docs/cloudlifecyclemanagement/21/key-concepts/the-bsm-for-cloud-computing-initiative>

Exemplo prático - Lifecycle of SAP Cloud Platform Apps



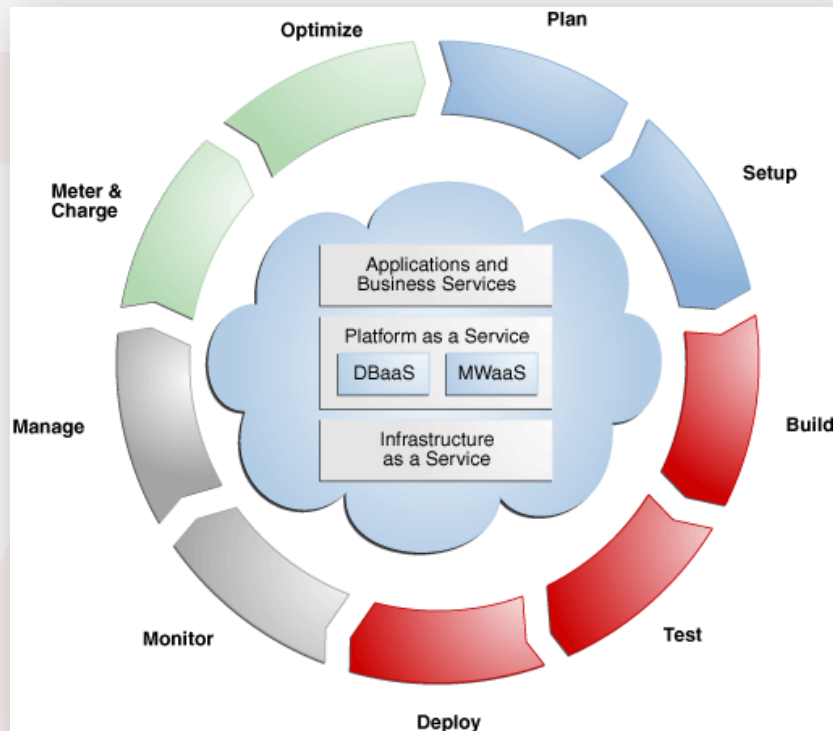
Fonte: <https://blogs.sap.com/2018/02/08/overview-of-the-lifecycle-of-sap-cloud-platform-apps-and-its-management/>

Exemplo prático - CISCO Cloud Lifecycle



Fonte: <https://blogs.cisco.com/datacenter/governing-the-new-wild-west-the-world-of-many-clouds>

Exemplo prático - Oracle Cloud Solution (Cloud Life Cycle)



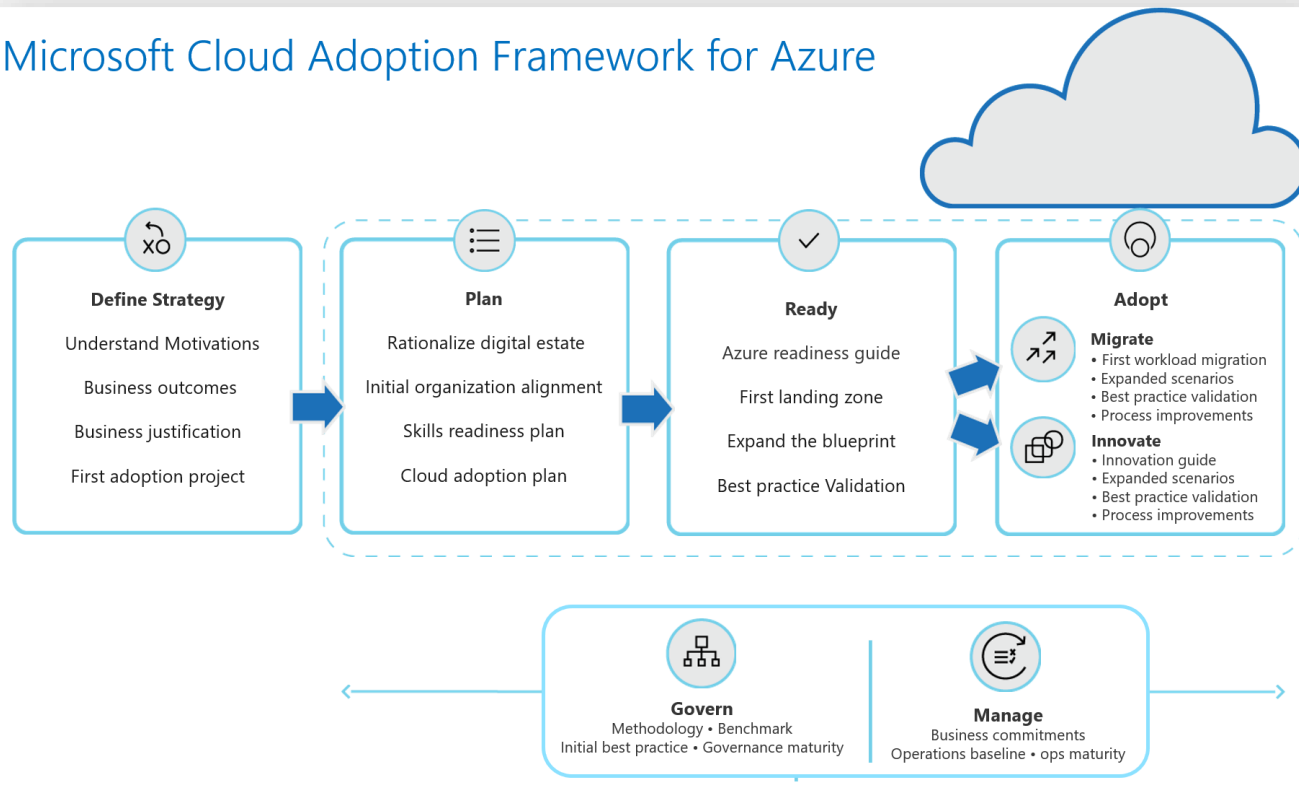
MWaaS: *Middleware as a Service*

DBaaS: *Database as a Service*

Fonte: https://docs.oracle.com/html/E28814_01/cloud_overview_new.htm

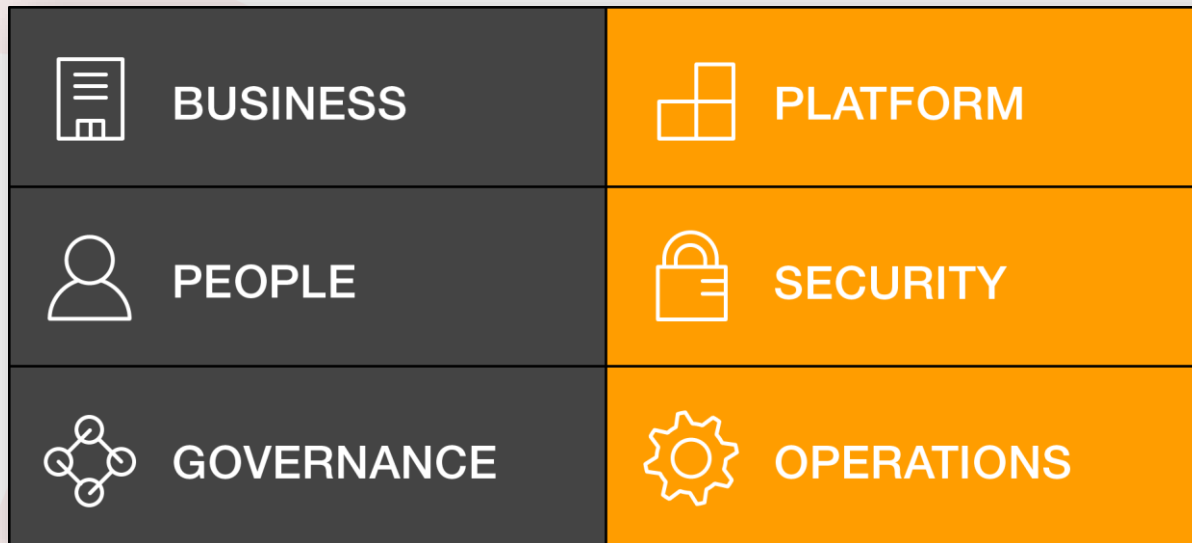
Exemplo prático - Azure Cloud Adoption Framework

Microsoft Cloud Adoption Framework for Azure



Fonte: <https://docs.microsoft.com/en-us/azure/cloud-adoption-framework/>

Exemplo prático - AWS Cloud Adoption Framework



Fonte: <https://aws.amazon.com/professional-services/CAF/>

Exemplo prático - AWS Cloud Adoption Framework

Action Plan: Summary

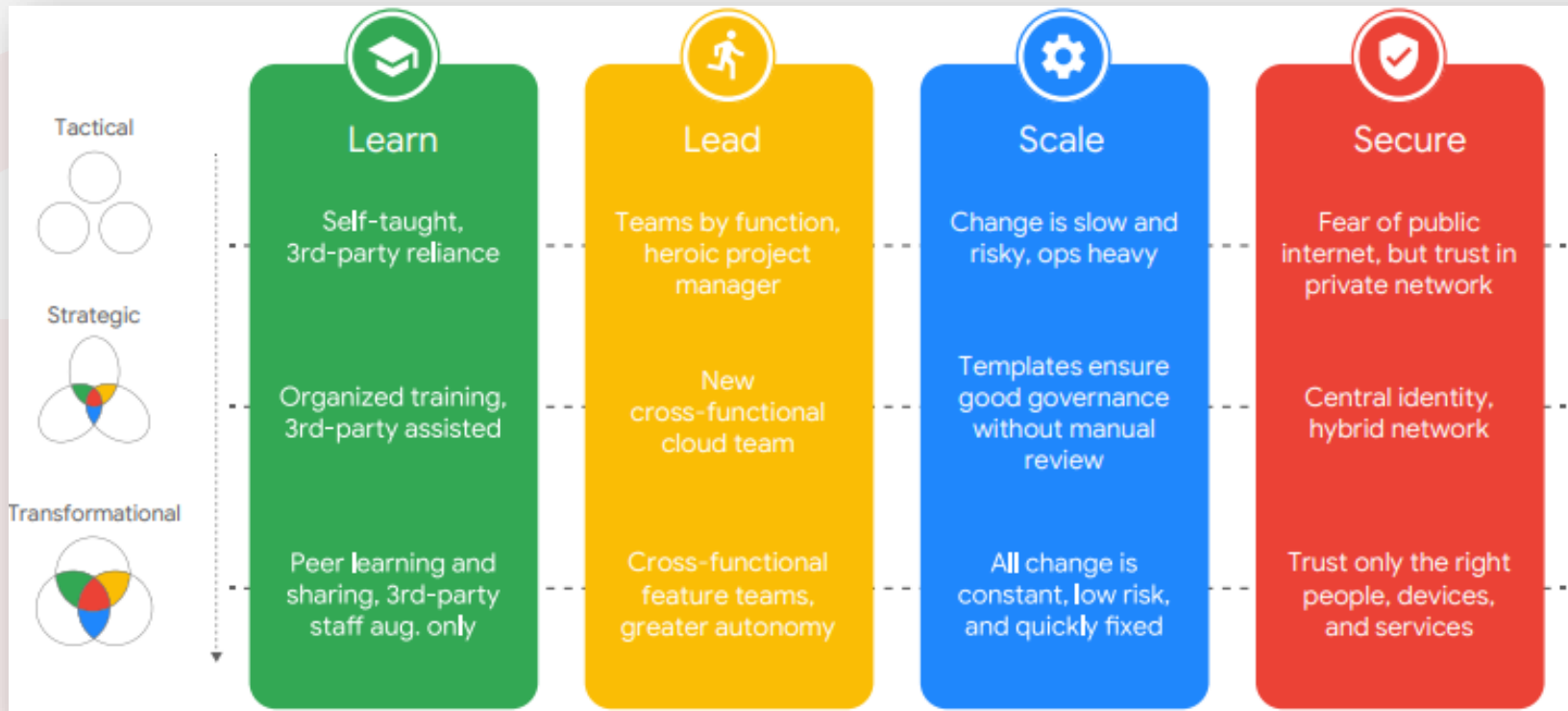
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Fonte: <https://aws.amazon.com/professional-services/CAF/>

Exemplo prático - The Google Cloud Adoption Framework



Fonte: https://services.google.com/fh/files/misc/google_cloud_adoption_framework_whitepaper.pdf?hl=pt-br

Exemplo prático - The Google Cloud Adoption Framework



Learn: The quality and scale of the learning programs you have in place to upskill your technical teams, and your ability to augment your IT staff with experienced partners. Who is engaged? How widespread is that engagement? How concerted is the effort? How effective are the results?



Lead: The extent to which IT teams are supported by a mandate from leadership to migrate to cloud, and the degree to which the teams themselves are cross-functional, collaborative, and self-motivated. How are the teams structured? Have they got executive sponsorship? How are cloud projects budgeted, governed, assessed?

Fonte: https://services.google.com/fh/files/misc/google_cloud_adoption_framework_whitepaper.pdf?hl=pt-br

Exemplo prático - The Google Cloud Adoption Framework



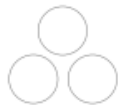
Scale: The extent to which you use cloud-native services that reduce operational overhead and automate manual processes and policies. How are cloud-based services provisioned? How is capacity for workloads allocated? How are application updates managed?



Secure: The capability to protect your services from unauthorized and inappropriate access with a multilayered, identity-centric security model. Dependent also on the advanced maturity of the other three themes. What controls are in place? What technologies used? What strategies govern the whole?

Fonte: https://services.google.com/fh/files/misc/google_cloud_adoption_framework_whitepaper.pdf?hl=pt-br

Exemplo prático - The Google Cloud Adoption Framework



Tactical: Individual workloads are in place, but no coherent plan encompassing all of them with a strategy for building out to the future.

The focus is on reducing the cost of discrete systems and on getting to the cloud with minimal disruption. The wins are quick, but there is no provision for scale.



Strategic: A broader vision governs individual workloads, which are designed and developed with an eye to future needs and scale.

You have begun to embrace change, and the people and processes portion of the equation are now involved. IT teams are both efficient and effective, increasing the value of harnessing the cloud for your business operations.

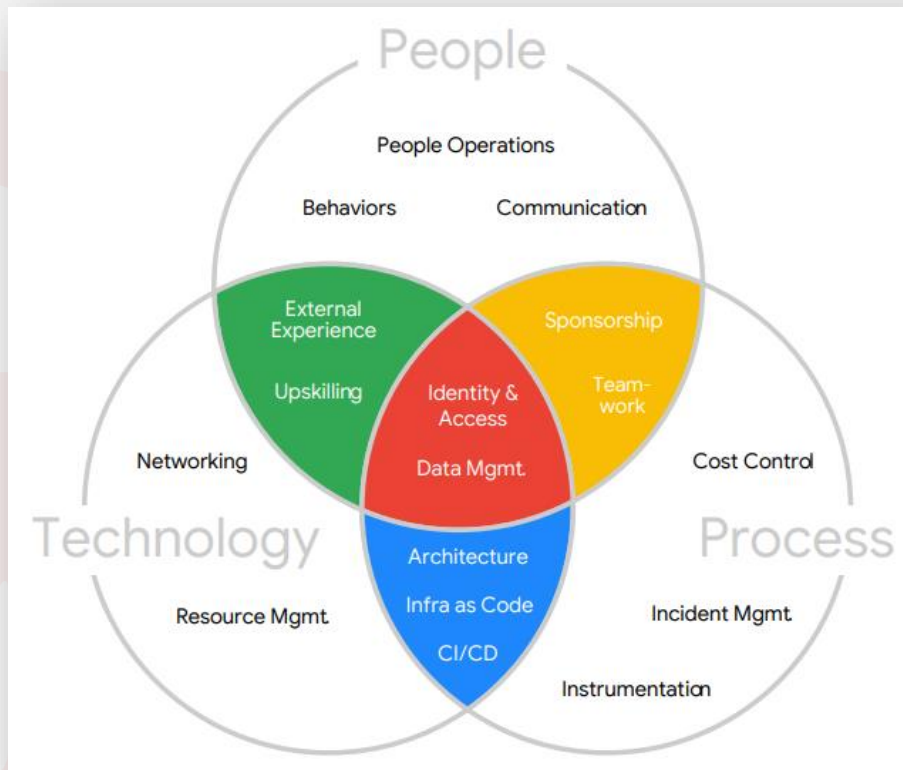


Transformational: With cloud operations functioning smoothly, you've turned your attention to integrating the data and insights garnered from working now in the cloud.

Existing data is transparently shared. New data is collected and analyzed. The predictive and prescriptive analytics of machine learning applied. Your people and processes are being transformed, which further supports the technological changes. **IT is no longer a cost center, but has become instead a partner to the business.**

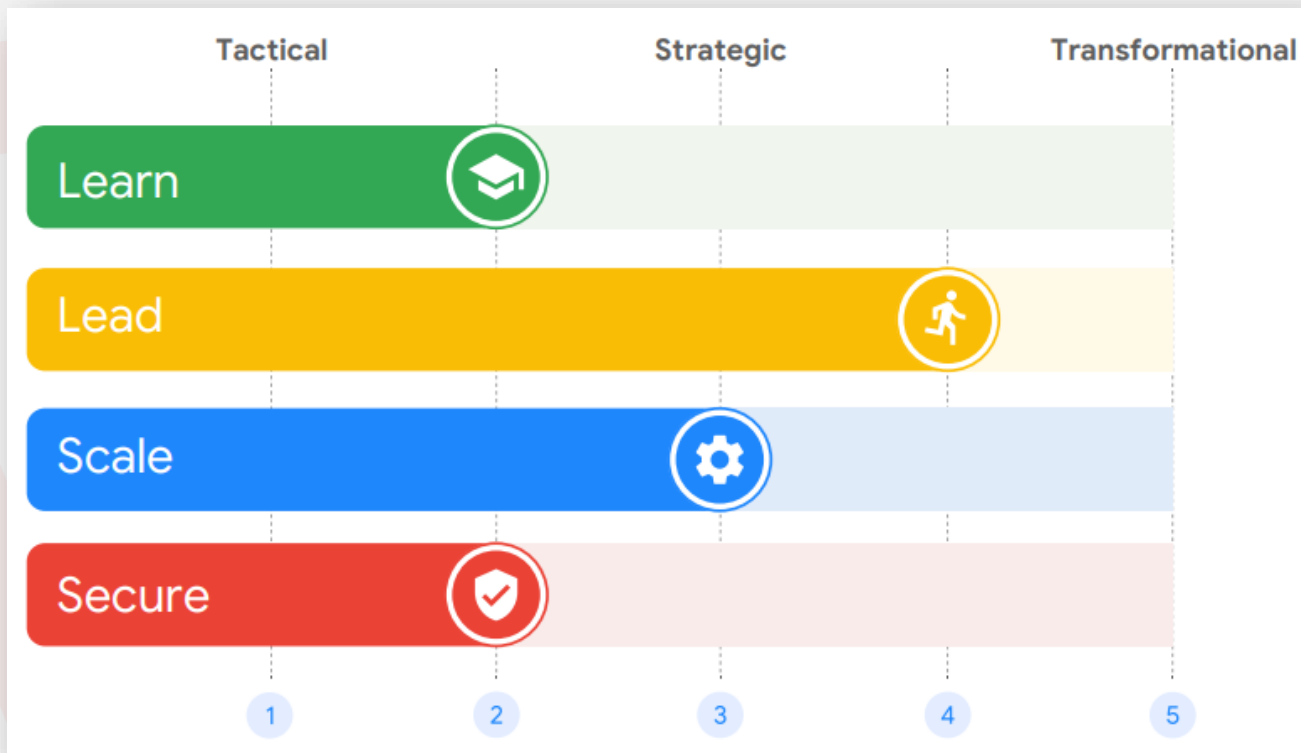
Fonte: https://services.google.com/fh/files/misc/google_cloud_adoption_framework_whitepaper.pdf?hl=pt-br

Exemplo prático - The Google Cloud Adoption Framework



Fonte: https://services.google.com/fh/files/misc/google_cloud_adoption_framework_whitepaper.pdf?hl=pt-br

Exemplo prático - The Google Cloud Adoption Framework



Fonte: https://services.google.com/fh/files/misc/google_cloud_adoption_framework_whitepaper.pdf?hl=pt-br

Entrega Parcial 03 – Data de Entrega: 10/09/2020 até às 12:00

Considerando o seu tema de trabalho e os requisitos críticos descritos na Entrega 2:

- Descreva pontos que considera importante nas 4 fases descritas no [Cloud Life Cycle](#) visto em aula. Basta descrever um paragrafo para cada uma das fases. Não é necessário descrever as 9 fases.
 - I. Architect*
 - II. Engage*
 - III. Operate*
 - IV. Refresh*
- Escolha um provedor de nuvem de sua preferência e crie uma máquina virtual. Descreva sucintamente o processo de criação.

Forma de entrega: enviar por e-mail para manzan@uol.com.br até a data de entrega.

Até a próxima aula

Muito Obrigado!

Feedbacks ?