

INTEGRATE AMAZON WEB SERVICE (AWS)
INTO APPLICATION ARCHITECTURE

ICT 4010 Enterprise Architecture

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Background

Amazon.com (Amazon) is a world famous electronic commerce and cloud computing enterprise that was found in 1994 by Jeff Bezos. It first started as an online bookstore on selling and renting the books. Later Amazon expanded its market to sell DVDs, CDs, Blu-rays, e-readers, tablets and other streaming video and audio. In addition, from Wikipedia reported, Amazon separated their retail websites for the United States, the United Kingdom and Ireland, France, Canada, Germany, Italy, Spain, Netherlands, Australia, Brazil, Japan, China, India and Mexico to offer international shipping. In 2009, because of the increasing of technology development, high-speed networks, low-cost computers, flexible management, big data analyzing and Internet of Things (IoTs) pushed the enterprises gaining demands in cloud computing, Amazon built a cloud computing service which was called Amazon Web Service (AWS) that allows enterprises and companies to run their applications on the platform that was served on the web.

According to AWS official website, AWS provides a simple way to that let user access servers, broaden networks, store databases and use other wide set of applications via Internet. The infrastructure bases usually runs on standard hardware, and offers huge capabilities for companies deploying their resources. The information can be processed in privately owned or operated in third-party data center and even combine to hybrid. The cloud spaces are likely to be placed at anywhere, which means an India's firm can control the applications without knowing where the hosting location in actual. As usual cloud computing definition, Amazon also separated the ideas into three main models: Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS) (see figure 1-1, P.23). After few years, AWS

explored its products to different types of services such as compute, storage, database, migration, networking and content delivery, and committed itself to the advanced cloud services provider. In 2006, Amazon introduced its Elastic Compute Cloud (EC2) (see figure 1-2, P.23) IaaS offering, which led cloud computing technology into a high peak for a while. In 2014, Amazon introduced a PaaS offering called Lambda, which is another compute service that automatically manages and runs code for applications and backend services without complex administration. In 2016, Amazon surpassed Walmart to become the most valuable global retailer in the world. Besides, according to Magic Quadrant report released by Gartner, AWS maintained its position as the leader of cloud IaaS providers. (see figure 1-3, P.24)

AWS offers benefits that allow user to build their applications. For example, instead of investing heavy data centers and servers, enterprise can implement AWS “pay-as-you-go” services to adapt the current scaling requirements. In other words, the expense typically set to bill by the hour for the time when the machine is up and running. Also, the companies can stop guessing their infrastructure capacity needs. With cloud computing, the cost can be experimented by continued data tracking and analysing. The time can also be measured to increase the speed and agility. Moreover, when enterprises deploy their applications on AWS, the application can be easily managed. There have certain web-based functions that allows user to control with a simple few clicks. For instance, there is a security configure that makes the applications network get into external international or internal governance.

Although AWS provides a lot of advantages to help enterprise compute their applications in cloud, there are still many terminologies for information technology development. The non-tech people lack of enough knowledge to understand what IT services are related to business

needs, and the tech people can not figure out how to make business efficiency. As the result, this research paper is focusing on how to integrate AWS into application architecture to achieve the enterprise successful. The analysing purpose is to assume the EA issues that general companies might face, and simplify each AWS services by applying different enterprise methodologies or frameworks to fit the business strategies. The EA practices should able to follow the changing world, and requires rapid, iterative, scaling development. Therefore, the decision-makers can have better understanding and opportunities while applying AWS applications, and can have clearer communication with their team members in the whole executing process in AWS platform. (see figure 1-4, P.24)

Major Enterprise Architecture Issues

- Lacking clear goal to solve the problem
- Complex capabilities for enterprise investment
- Lacking maturity model for application architecture
- Unsuccessful development of internal control
- Without standardization on cloud
- Unidentified risks on outsourcing AWS
- Weak service management to cloud partner
- Apply AWS without thinking enterprise architecture

Analysis

Lacking clear goal to solve the problem

“No matter how good the team or how efficient the methodology, if we’re not solving the right problem, the project fails.” said by Woody William, in Project Management Point of View. Some enterprise applied AWS to run their applications in cloud. However, they do not know what services they should apply for the organization. As the result, the business strategies failed because of poor problems solving. In SkillsYouNeed.com website wrote, all problems have a common feature: They must have a goal. Goal can be anything that decision-makers wish to achieve. In order to solving the problem, understand the application architecture in AWS is very important to clarify the firm’s ambition.

Before integrating AWS into enterprise, I found that the Oracle Application Development Framework (ADF) will be useful for enterprise setting target in the beginning. Oracle ADF is an end-to-end application framework that was built on Java EE standards to simplify and accelerate enterprise application. The ADF model is a component sets for web, mobile, desktop clients and is based on different types of business services that run on data services. There has a controller between view and model that help applications break up into a series of task flows into web application. Similar to Service-oriented architecture (SOA), the security and metadata service model are on the left side to include all the application architecture. (see figure 2-1, as below)

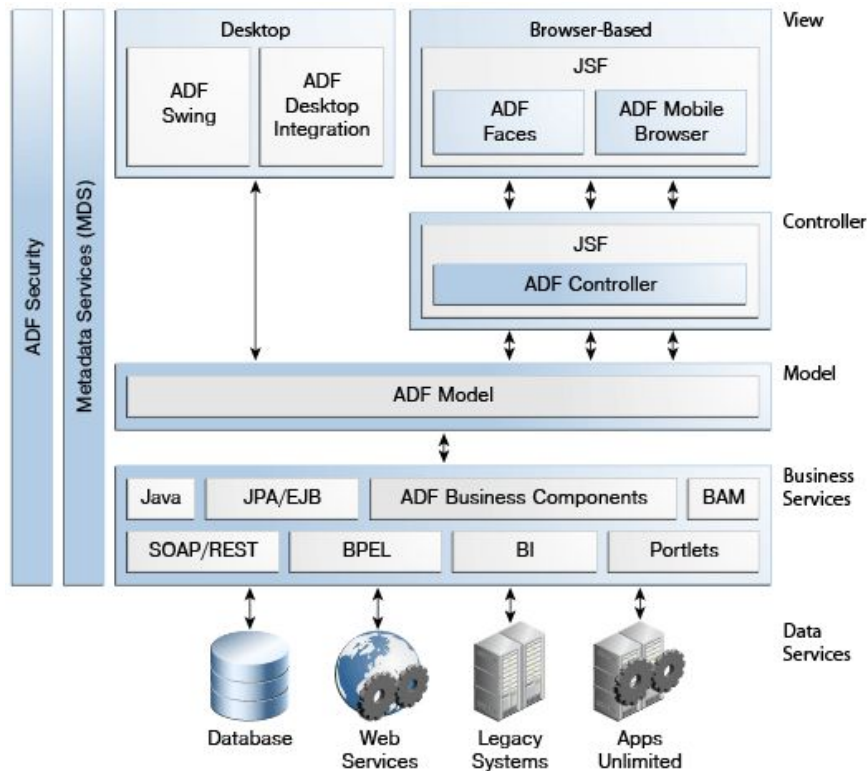


Figure 2-1, Oracle ADF Architecture. <https://docs.oracle.com/middleware/1212/adf/ADFDCG/intro.htm>

AWS provides multiple services that can also be categorized into ADF model. For example, if the company has a goal on implementing web application, they should start thinking about what kind of applications they need for this project. For instance, Amazon Relational Database Service (RDS), Amazon EC2, Amazon Simple Storage Service (S3), and Amazon Elastic Load Balancing (ELB) take charge of the infrastructure of data service to migrate the business services. The AWS Management Console transmits the task flows from ADF model to AWS WorkSpaces. The AWS Cloud Security and AWS metadata instances are included to whole application process. By sorting these AWS applications into ADF model can make the decision and goal much clearer to solve the business and technology problem. (see figure 2-2, as below)



figure 2-2, AWS ADF Architecture, created by Wei Lun Huang

Complex capabilities for enterprise investment

Most of companies spent lots of money on developing their IT infrastructures, or even took huge amount of funds to improve and maintain without efficiency. The exceed investment caused the Return of Investment (ROI) has been dragging down and made the stakeholders unhappy. Therefore, enterprises chose AWS as providers in order to reduce the cost. However, AWS offers broad capabilities sometimes means the services had attracted less customer's interest and would not get continued investment on the same level. According to Magic Quadrant Worldwide IaaS Report, the entire system cycle could be complex for vendor to manage, and the new capabilities often competed from AWS partners that might lead the cloud ecosystems have confliction.

Investor should able to understand the business capabilities before integrating AWS into enterprise. They should consider how IT strategy supports business strategy and ensure that the

business and IT portions are aligned to the best when developing their project. AWS provides a Cloud Adoption Framework (CAF) to guide organization to adapt the cloud transition process. The framework separates to six perspectives and the one is called “Business Perspective”. The business perspective focuses on using technology to identify, measure, create business value. In Amazon Whitepaper “An Overview of the AWS Cloud Adoption Framework”, the inside components and activities can help companies develop business case for cloud to manage cost of IT and support stakeholder engagement. (see figure 3-1, P.25)

To get deeper into managing the cost, according to AWS Cloud Adoption Framework “Business Perspective”, organization have to separate their budgets by facilities, staffing, suppliers, hardware, software, capital and other operational costs. (see figure 3-2, P.25) From this it seems creating a strategy or structure that to have identification will help to minimize the expand and increase transparency. AWS CAF offers visibility and wide approaches on cost investment. For example, if enterprise want to order the management capabilities, they should consider the people, processing, and technology as a whole and not just as scattered tasks. The perspective by using AWS is enterprise do not require to change the budget, but need a plan to structure cost allocation through CAF that is aligned to an existing accounting structure in enterprise architecture.

Lacking maturity model for application architecture

Apart from the business perspective, AWS also offers the maturity perspectives for application architecture in its cloud adoption framework. For the progressive implementation of

cloud-based IT capabilities. IT strategists must consider a good structure assessment for planning capability maturity that use cloud computing effectively. As a result, organizations can move their application to cloud maturity model that is typical provided governance to support its own migration and transformation.

In order to implement a cloud maturity model, there is a “Cloud Maturity Heat Map” inside AWS Cloud Adoption Framework “Maturity Perspectives” article that highlights the areas to which organization focus on achieving business and technology objectives. The heat map provides three key areas of assessment: IT management; governance, risk, and compliance (GRC); technology and architecture. To put them into strategy, analysis, design, transition operations, and improvement to do analyzing. I found that the maturity model can also be fit with the enterprise architecture maturity levels that based on Capability Maturity Model Integration (CMMI). So that the process of cloud performance levels can also be measurable and integrating into application architecture. (see figure 4-1, as below)

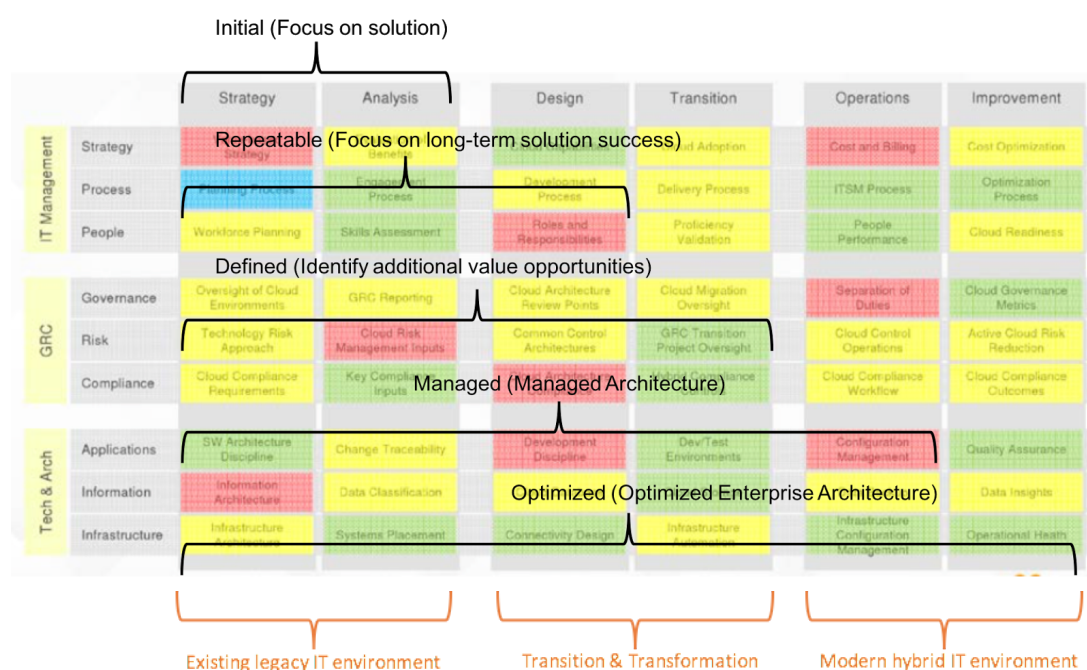


Figure 4-1, Analyzing Current Maturity & Enterprise Architecture Maturity Levels, created by Wei Lun Huang

Unsuccessful development of internal control

Most of cloud services offered a space for companies to store their data in there, but most of them did not have a control panel or dashboard to have management. Even their had, the functions in there were incomplete and lack of security to protect enterprise management in private. Therefore, some companies decided to develop their own applications and data centers. However, the infrastructure expands usually took too much that as they expected and the executions could not be measurable. As the result, the development process failed and wasted lots of time and money.

The point was that they did not consider that the internal control must be interoperated with external control to have management. AWS provides a service that could have a hybrid IT combination called Amazon Virtual Private Cloud (VPC). VPC builds a bridge in some functions such as private connections, workload migrations, access control integration, and management tools between on-premise applications and cloud applications. (see figure 5-1, as below)

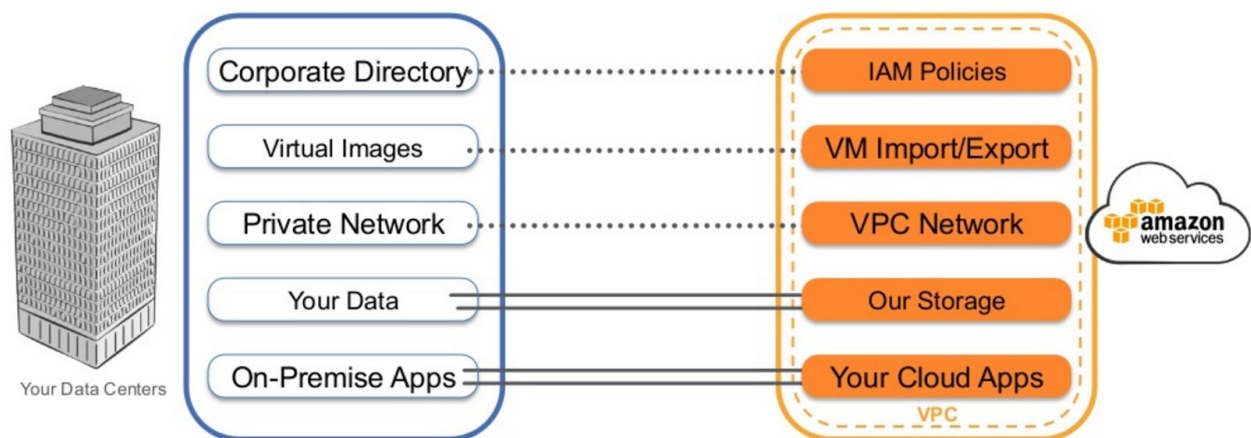


Figure 5-1, VPC Tools to support hybrid IT, <https://www.slideshare.net/AmazonWebServices/hybrid-it-kl>

By figuring out how to migrate IT system into hybrid cloud. The process can be viewed as having data on the on-premises and cloud side. The management should create both backup and archive with effective solution. For example, company can create a public subnet for their web servers that has access control to the Internet, and place their backend system such as applications and databases in a private subnet with no Internet access. Then using VPC to access control lists to enable inbound and outbound filtering at every subnet level, so the business outcome and applications can be supported in a secure condition.

Without standardization on cloud

With the rapid changing world, the cloud environment has become more and more complex as before. Lacking of cloud standards could make the whole technology market fragmented. Lots of enterprises wanted to avoid lock-in vendor and were looking at more flexibility applications in cloud. This behavior showed that enterprises would like an application architecture which could apply to make one cloud work seamlessly with another. Therefore, finding a standardization became the top-one issue when migrating IT environment on cloud.

AWS had an architecture overview diagram that depicts the main services available in multiple layers. (see figure 6-1, P.26) The bottom layer is the global infrastructure that represents different availability zones, regions and locations. Certain concepts were up through the Foundation service layer. In Application services layer, you can understand the diverse set of technology and platforms and to have deployment and management within AWS.

In general perspective, the AWS takes charge of aligning the infrastructure architecture and application architecture, so the companies can be confident in any proposed change in the

infrastructure architecture (e.g. moving internal storage to AWS S3) and will suit the requirements in application architecture. The companies can schedule the data management and minimize the impact on system downtime. Also, the company can more focus on business architecture to form and executed team to set some new governance structure and roles or new strategy for enterprise standardization. (see figure, as below)

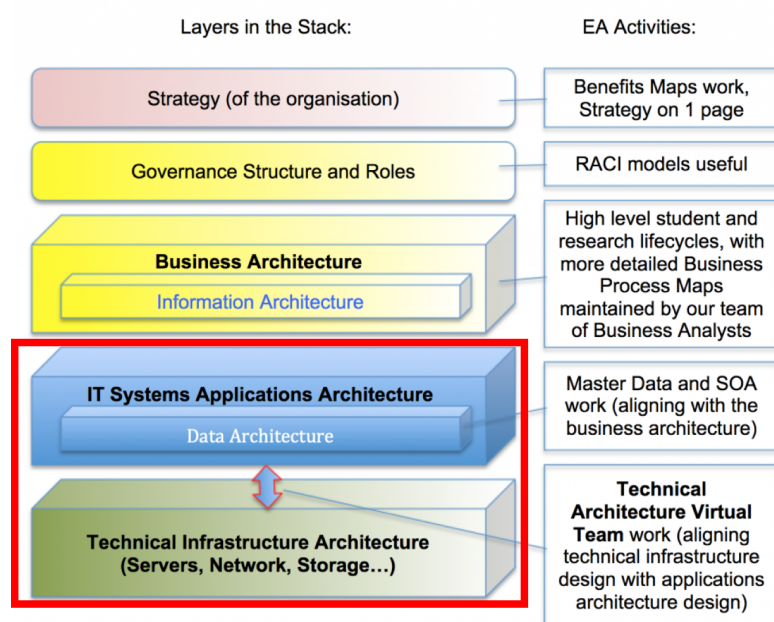


Figure 6-2, Layers in the enterprise architecture stack,
<https://enterprisearchitected.blogspot.com/2014/04/27/aligning-the-infrastructure-architecture-with-the-systems-application-architecture/>

Unidentified risks on outsourcing AWS

Recently, AWS encountered the shutdown issue that caused millions of websites went down. The “Summary of the Amazon S3 Service Disruption in the Northern Virginia (US-EAST-1) Region” report showed that it was an engineer using a playback executed commands that was intended to remove a small amount of services in Simple Storage Service (S3). One of the input command entered incorrectly caused a large set of servers was removed.

In order to fixed that, part of system required a full restarted. While these system were being restarted, S3 was unable to work, and Amazon Elastic Compute Cloud (EC2), Amazon Elastic Block Store (EBS), AWS Lambda were also impacted while the S3 were unavailable.¹⁰

The problem indicated that the risk of outsourcing has to be concerned, even applied applications in AWS. Although Amazon has their responsibilities for foundation services in compute, storage, database, networking and other global infrastructure, customers still have to manage the security of their data in the cloud. The security includes application, platform management, networking, firewall operating system, and other client-sides encryption and protection (see figure 7-1, P.26), which could be implementation in enterprise risk management architecture.

When enterprise integrating AWS into its application architecture, in “A structured approach to Enterprise Risk Management (ERM) and the requirements of ISO 31000” article, there is a risk assessment framework that helps identify, analysis, and evaluation the risk. The risk in every process could be took over into monitor and review within good communication and consultation. For example, let’s establish a hypothesis that if IT applications happened downtime, the firm should identify the risk with current knowledge at first. What approaches and activities are appropriate to put forward. Did this happen because my legacy applications or it is from AWS? Ok, it is from AWS, then move to the analyzing part. Now the risk should be mapping into business area affection. Is the risk level big? How many percentage of money does enterprise lose for a second? After that, find out the way to evaluate for responding to the risk. Should we tolerate and ignore the risk? Should we transfer AWS to another service or just terminate AWS? Finally, the organization can decide how to improve the treatment for dealing

with that application risk in the future. (see figure 7-2, as below)

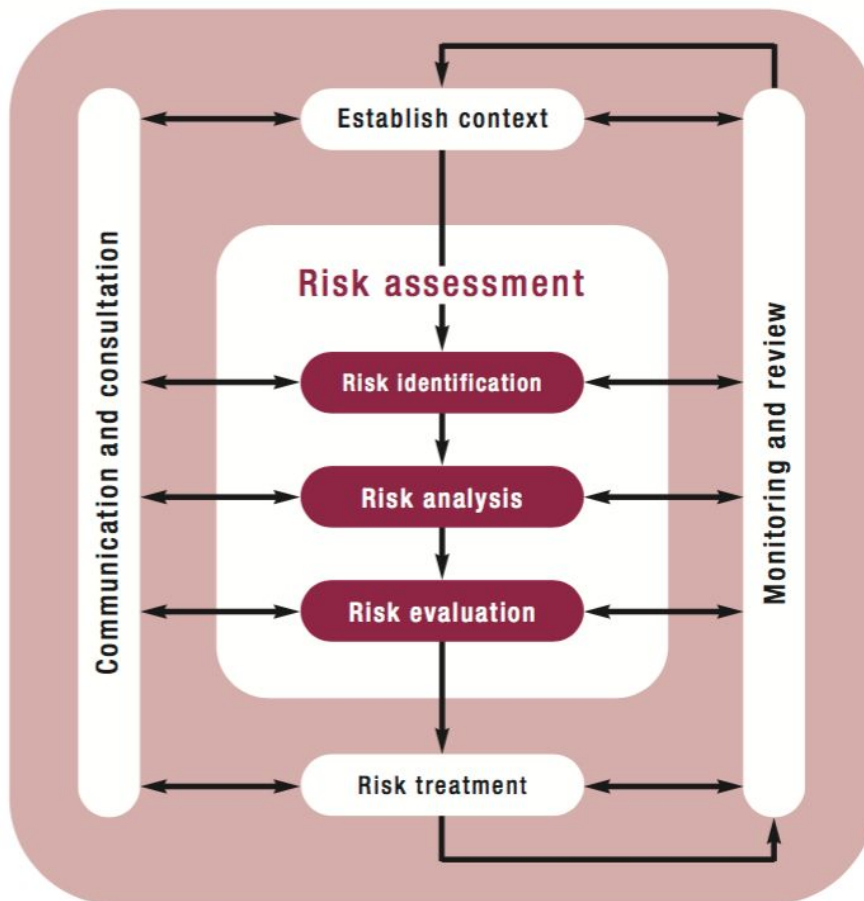


Figure 7-2, Risk management process, <http://www.ferma.eu/app/uploads/2011/10/a-structured-approach-to-erm.pdf>

Weak service management to cloud partner

While AWS provides innovative services day by day, sometimes it means that there is no considering at all the cloud partners and its updated cloud product impact. Of course AWS now become the world leader of cloud computing services, but if the partners can not catch up or understand the new technology initiative seems meaningless. Due to that, AWS offers a training resources called Managed Service Provider (MSP) Partner Program to implement AWS Partner Network (APN).

APN is designed for a group of cloud vendors that are skilled at application migration, and able to deliver value to their customers by automation, monitoring, and management. AWS separate it partners into two group. APN Consulting Partner helps AWS customer implement and manage an AWS cloud deployment. On the other hand, APN Technology Partner offers software tools and services that are hosted on or integrate with AWS. (see figure 8-1, page 27)

To realize AWS how to manage cloud service to its partner. National Institute of Standards and Technology provide a cloud computing reference architecture that describes all the actors in cloud. (see figure 8-2, as below)

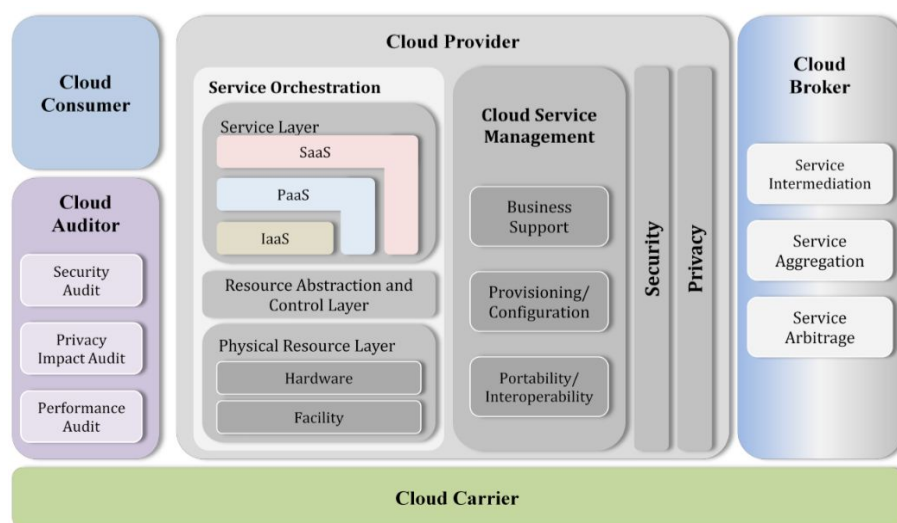


Figure 8-2, The Conceptual Reference Model, https://bigdatawg.nist.gov/_uploadfiles/M0008_v1_7256814129.pdf

We can set AWS as a cloud provide service in the middle, and conducts its activities of service deployment, service orchestration, cloud service management, security, and privacy. For SaaS, AWS deploys, maintains, configures, and update the software application on cloud infrastructure so the service can offer at the expected level to cloud consumer. The consumers have limited control of application administration. For PaaS, AWS manages the computing infrastructure for operating on the cloud platform. The consumers has all control over the

application and maybe some hosting environment setting. For IaaS, AWS acquires the physical computing resources such as servers, networks, storage and hosting on infrastructure on virtual machines (VM). The consumer uses these computing resources to have more access control into application. Overall, the service management could be improved if the partners understand what application should be controlled when integrating cloud to enterprise.

Apply AWS without thinking enterprise architecture

The tricky final issue is that some of companies integrated with AWS without thinking enterprise architecture. They designed an approach rather than design toward on-premise infrastructure. Without thinking the AWS principals they made are fitting with the current enterprise architecture. For example, it might be easy for engineer to run the AWS infrastructure, but the security, compliance, and other complex requirements have to be planned into business needs. Instead of spending money to attribute high-level server and storage in AWS, the organization should first understood their actual infrastructure costs at the beginning.

There are some good practices for enabling enterprise AWS. First of all, try to make the migration roadmap separately. It is always the best to have non-production applications deploying in AWS, so that the risk of cost or security can be minimum. Also, try to make the application automatically deploy so that the business goal can be reached in a simple way. Next, turn off the AWS service that do not use so the budget can be saved with efficiency. Finally, making good use of other third-party providers that cooperate with AWS to make the integrating application process much easier.

Besides, it is always nice to adapt some service oriented or new IT solutions framework

to gain business value by using AWS. For instance, start with the view as people and organization. What problem do my company or my client trying to solve with AWS? Move to the process part for asking what service or application flows need to implement with AWS? Try to use some useful tools and technology to simplify the development. Then drive the enterprise to success by managing data and information. (see the figure 9-1, as below)

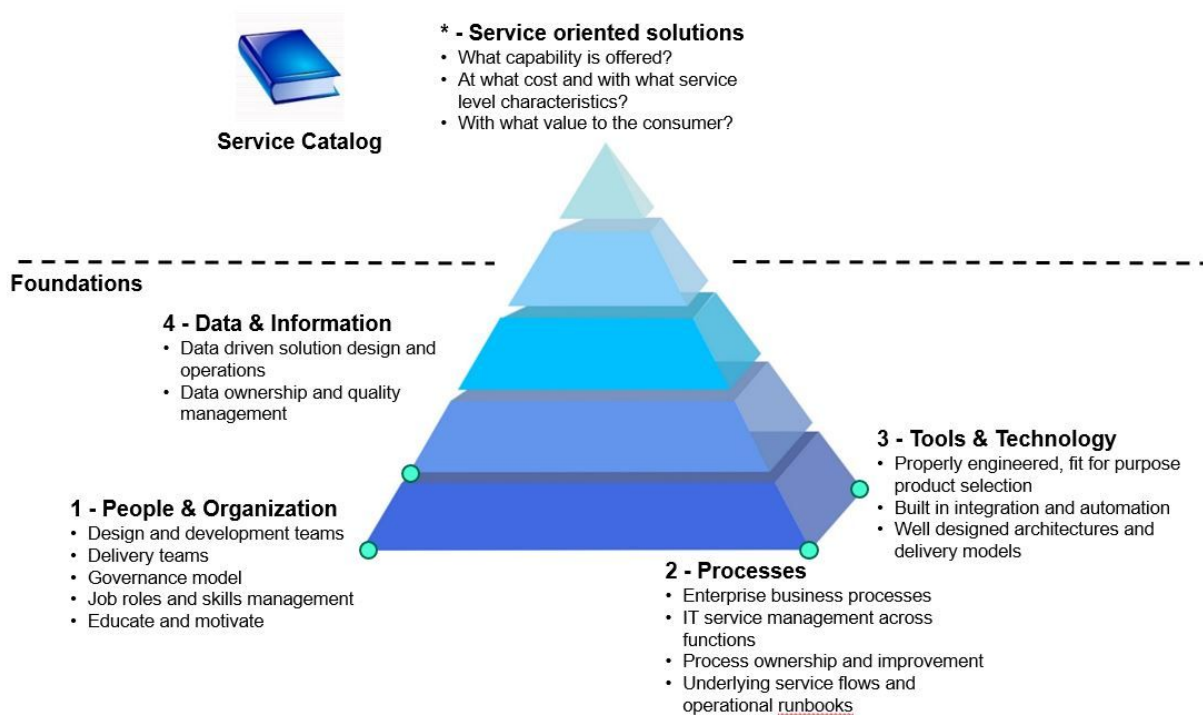


Figure 9-1, IT Solutions with a mental framework, <https://cloudit4you.wordpress.com/category/architecture/>

Conclusion

“By 2017, 60% of Global 1000 organizations will execute on at least one revolutionary and currently unimaginable business transformation effort” reported by Gartner Business Transformation & Process Management Summit in 2016. The cloud computing world changing too fast. Today technology may not be useful on tomorrow anymore. However, the cloud

services and application architecture will still maintain their existing model to fit the company demands such as available to scale, reduce the cost, and manage easily features.

According to the RightScale “Cloud Computing Trends: 2016 State of the Cloud Survey” written by Kim Weins. AWS continues leading in public cloud adoption. In addition, the increasing of private cloud adoption drives the hybrid cloud demands higher year by year. (see figure 10-1, 10-2, P.27, P.28) The figure shows that more enterprise are willing to shift their workload to cloud, especially in the private cloud. By integrate application into cloud, they should overcome some business challenges such as lack of expertise to control the complex of building private cloud. If the resources and knowledge is not enough, it may leave some security and compliance issues when managing multiple cloud service. In addition, the costs, governance, and performance are the important factors to think of when migrating legacy application to cloud.

Same as integrating application into AWS, to the IT people, they might think: “Where I should use the virtualization, how to combine private and public cloud into hybrid, and what are the services in IaaS, SaaS, and PaaS...” To business managers, much simpler, they might think: “Aha , finally! I don’t need IT anymore. I can get anything I want in the AWS.” In order to not let this tragedy happen, the enterprise architecture should involve into reduce the gap between information technology and business.

At the beginning, the company executive officer should has good understanding what is the structure and what kind of services should be applied with AWS to rise the entire business value. The should ask what, why, and how questions to make sure the purpose of cloud adoption

is clear. So the executive team will have consistency vision to make effort. Next, the business managers should communicate with IT managers regularly, so that the project process can deliver correctly. Moreover, the managers should have motivation and blueprint on business model in order to understand the relationship between cloud application and business strategy. They have to think of what business capabilities are involved in organization to support the information technology, and how is this new initiative going to affect and interact with stakeholder. Ensure that the frameworks all have enough maturity development to adapting the changing cloud, and the system control environment are should able to interoperate with internal and external management. Moreover, setting a complete standardization on information technology for future expandable and scalable requirements. Do not forget to assess the risk when outsourcing AWS into enterprise. By implementing that, the loss and security issues can be minimized. Final, the decision-maker should understand the partner's relationship from AWS cloud, so it will be much easier for the whole company having cloud service management.

AWS is designed to allow application providers, and vendors can quickly and securely host their applications. Also, the enterprise can flexibly select the operation system, database, programming language, application platform, and other services by their own. However, one scary thing is, once failure of cloud sever, means the company deployments in AWS will 100% lose their data, am not able recover anything. It is because in the physical world, the loss of server is a small catastrophe; however, in the virtual world, it will become a disaster when your entire data center disappear. In “Cloud Application Architectures - Building Applications and Infrastructure in the Cloud”, George Reese wrote that AWS promise that it has about 99.5% high-level availability to ensure their application always uptime. That does not mean the

companies can ignore the whole risk assessment, instead they can save their budget on maintaining some IT infrastructures or applications, and switch their concentrate on business and marketing needs.

From my point of view, I think in the future, the lines between what is cloud and what is not cloud will become more blurred. Most of AWS services were trying to move the traditional infrastructure to dynamic and virtualized environment, that means they will all look similar like cloud. Besides, the organization will realize that the cloud value is not at the cost, is at the agility and the ability on outsourcing to scale. It is because when the technology continue improving, the cloud provider will decrease their cost to attract more enterprises to invest. Also, AWS competitors like Microsoft Azure, Rackspace, IBM or even Google Cloud are catching up behind, push the price going down for adapting marketing requirement.

In conclusion, while applying AWS into organization, the enterprise architecture should be considered at the beginning. Enterprise architecture provides various frameworks such as Zachman Framework, The Open Group Architecture Framework (TOGAF), Extended Enterprise Architecture Framework (E2AF), and Federal Enterprise Architecture (FEA) so on. Although these frameworks have different model to support application architecture, the basic concept still suit for the components on cloud integration as well. The cloud application architecture should design for enterprise deploying their application smoothly, and let enterprise understand their expectation in the future.

Recommendations

- Decision-maker should have good understanding and communication when apply AWS applications.
- Create a business model to make sure the goal is clear to solve the problem.
- Understand the business capabilities and how IT support business before integrating AWS into enterprise
- Build a maturity framework for adapting cloud application architecture
- Considering the internal control interoperates with external control to have better management.
- Finding a standardization when migrating IT environment on cloud.
- The risk assessment should be concerned when outsourcing third-party provider.
- Understand the cloud partners relationship and how the cloud service work to strengthen the management.
- Thinking enterprise architecture when enables AWS into organization.

Figures

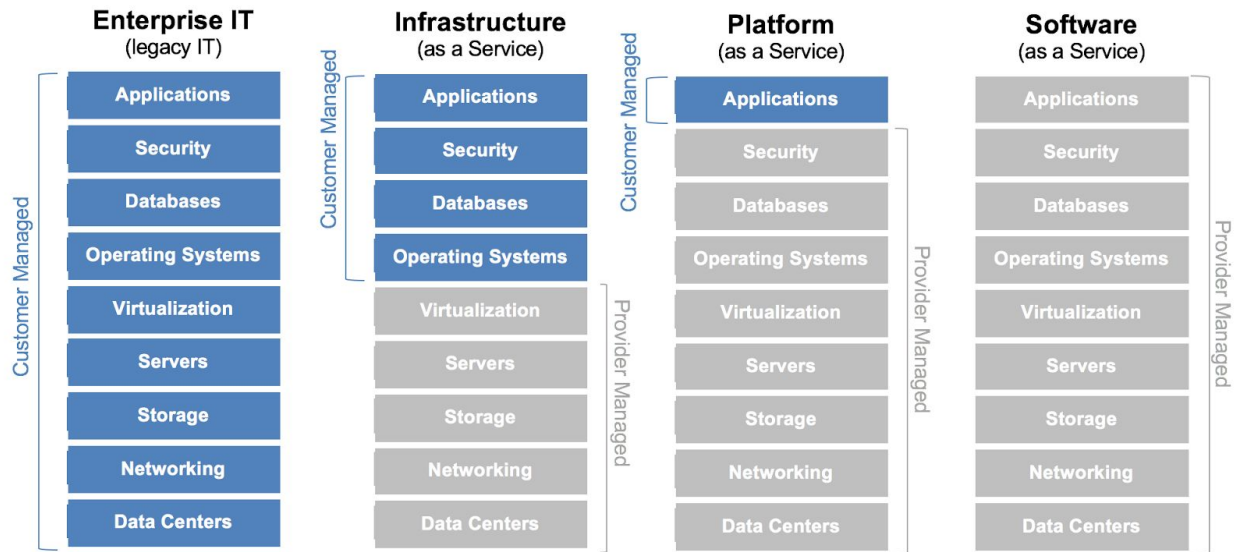


Figure 1-1 ,View of the provide and customer roles for IaaS, PaaS, and SaaS.

<https://mycloudblog7.wordpress.com/2013/06/19/who-manages-cloud-iaas-paas-and-saas-services>

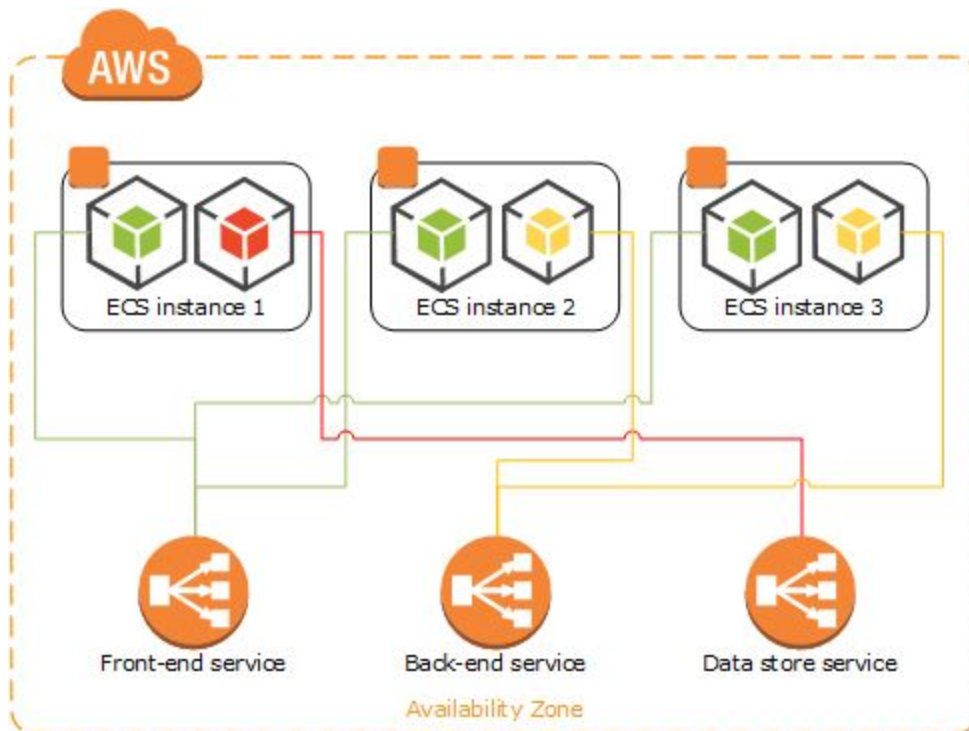


Figure 1-2, Amazon ECS Application Architecture.

http://docs.aws.amazon.com/AmazonECS/latest/developerguide/application_architecture.html



Figure 1-3, Magic Quadrant for Cloud Infrastructure as a Service, Worldwide.
<https://www.gartner.com/doc/reprints?id=1-2G2O5FC&ct=150519>

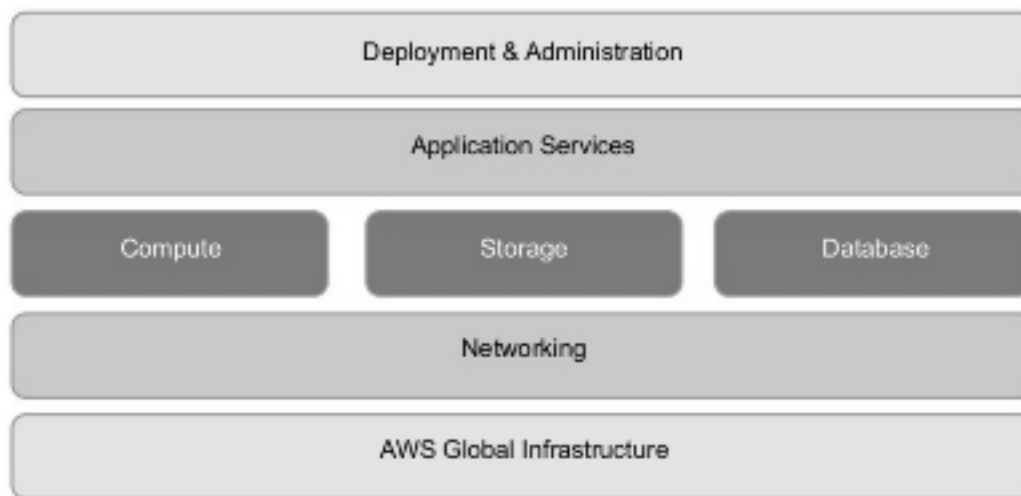


Figure 1-4, Amazon Web Service platform architecture.

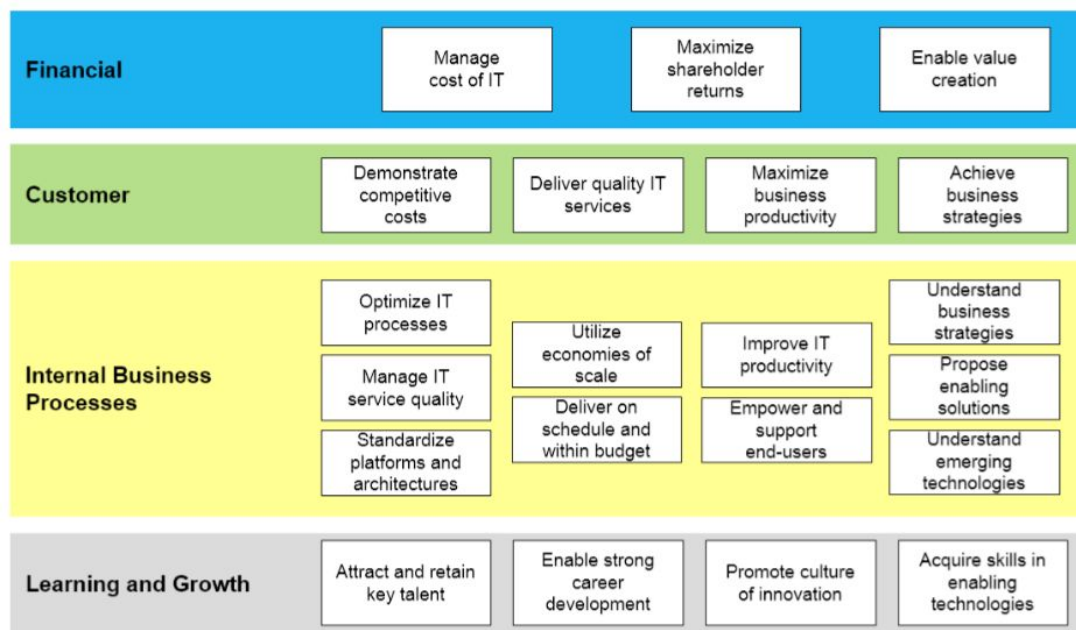


Figure 3-1, Aligning IT Strategy to Business Strategy.
https://d0.awsstatic.com/whitepapers/Business_Perspective_v1.0.pdf

Software Costs	OS, hypervisor, data center management software Software Licensing and Maintenance
Server Costs	Server Hardware + Maintenance Server Software + Maintenance (OS, Virtualization)
Storage Costs	Storage Infrastructure (SAN switches, Disk) + Maintenance Storage Admin
Network Costs	Network Infrastructure (LAN switches, WAN capacity) + Maintenance Network Admin
IT Admin Costs	virtualization admin, system admin, storage admin, network admin, security admin, data center admin
Facility Costs	Building cost, Maintenance, Taxes, Security staff, Facilities staff, Power cost, Cooling cost

Figure 3-2, Cost Modeling Considerations. https://d0.awsstatic.com/whitepapers/Business_Perspective_v1.0.pdf

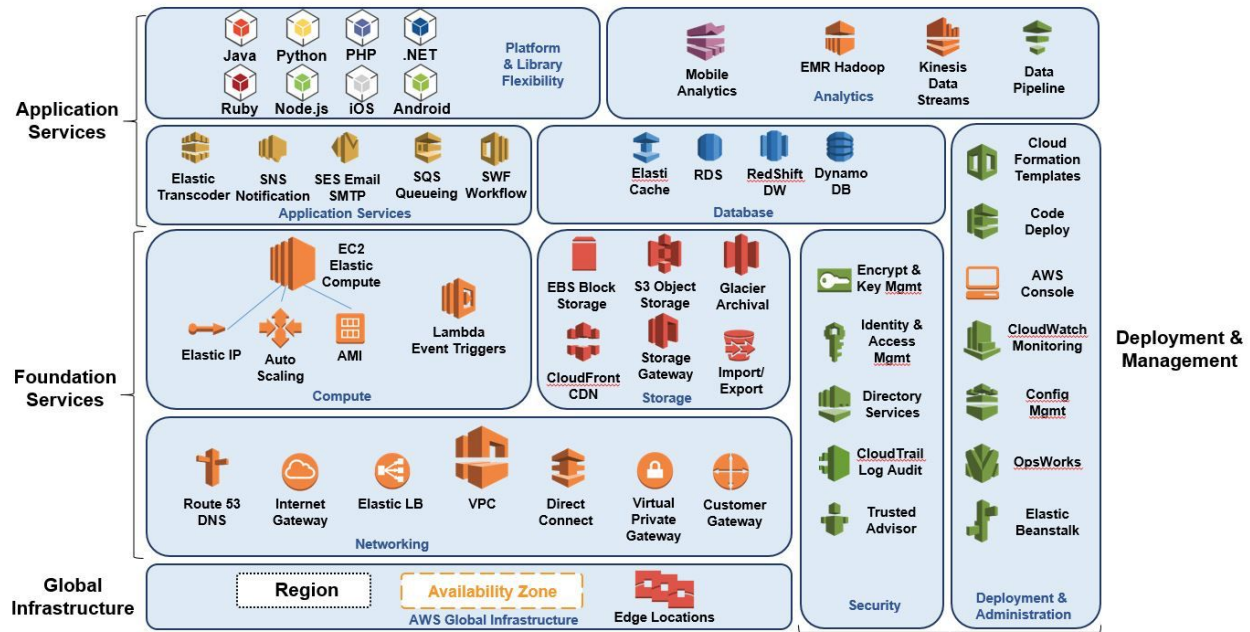


Figure 6-1, AWS architecture overview, <https://cloudit4you.wordpress.com/category/architecture/>

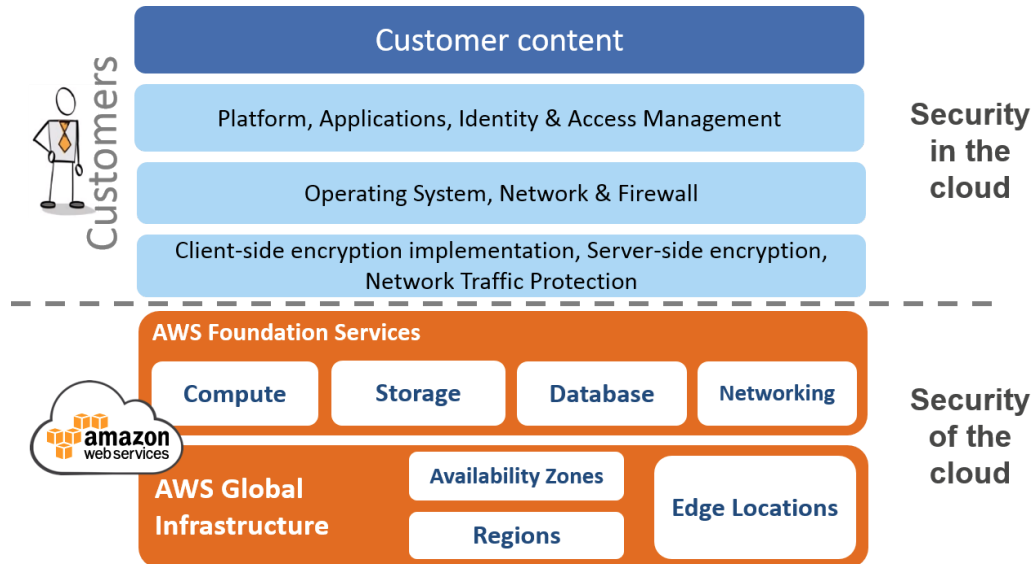


Figure 7-1, AWS architecture overview, <https://cloudit4you.wordpress.com/category/architecture/>



Figure 8-1, AWS Partnership Model,
<https://www.slideshare.net/AmazonWebServices/awesome-day-warsaw-aws-partnership-model>

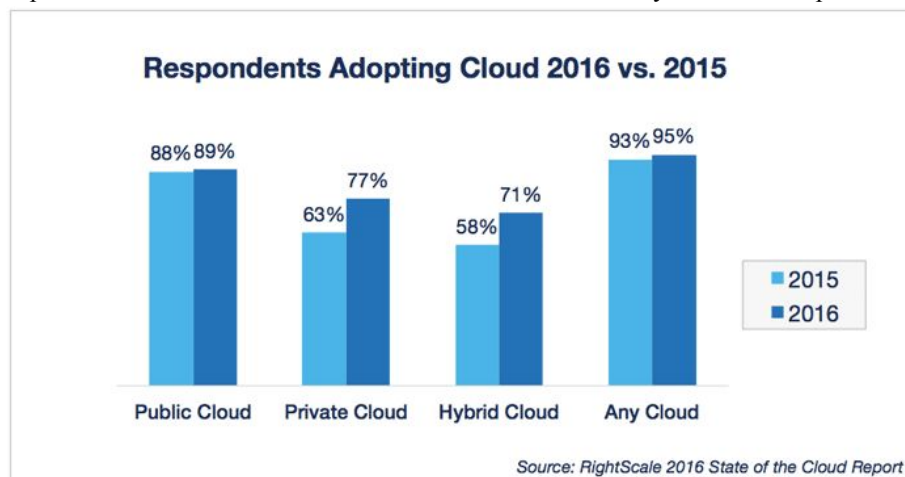


Figure 10-1, Respondents Adopting Cloud 2016 vs. 2015,
<http://www.rightscale.com/blog/cloud-industry-insights/cloud-computing-trends-2016-state-cloud-survey>

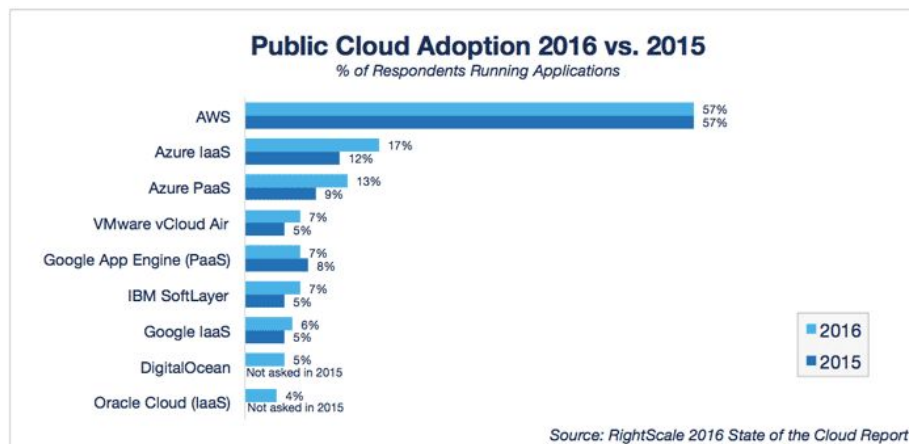


Figure 10-2, Public Cloud Adoption 2016 vs. 2015,
<http://www.rightscale.com/blog/cloud-industry-insights/cloud-computing-trends-2016-state-cloud-survey>

Bibliography

- Amazon Web Service, Application Architecture,
http://docs.aws.amazon.com/AmazonECS/latest/developerguide/application_architecture.html
- Amazon Web Service, AWS Managed Service Provider (MSP) Program,
<https://aws.amazon.com/partners/managed-service/>
- Amazon Web Service, Lambda, <https://aws.amazon.com/lambda/>
- Amazon Web Service, Partner Network (APN) Blog, Introducing HIPAA Compliance-as-a-Service – Aptible, an APN Healthcare Competency Partner,
<https://aws.amazon.com/blogs/apn/aptible-on-aws/>
- Amazon Web Service, Summary of the Amazon S3 Service Disruption in the Northern Virginia (US-EAST-1) Region, <https://aws.amazon.com/message/41926/>
- Amazon Web Service, VPC, <https://aws.amazon.com/vpc/>
- Amazon Web Service, What is cloud computing, <https://aws.amazon.com/what-is-cloud-computing/>
- Best Practices for Building Partner-Managed Services on AWS,
<https://www.slideshare.net/AmazonWebServices/best-practices-for-building-partnermanaged-services-on-aws/5>
- Bryce Johnson, Top 5 Success Factors to Enable Enterprise AWS,
<http://odecee.com.au/top-5-success-factors-to-enable-enterprise-aws/>
- Daniel Lambert, Migrating Legacy Applications to the Cloud Using Business Architecture,
<http://community.biz-architect.com/about-ba/strategies-for-migrating-legacy-enterprise-applicatio>

ns-to-the-cloud-using-business-architecture/

EA Maturity Model, <http://iea.wikidot.com/ea-maturity-model>

Enterprise Architecture at Bristol, Aligning the Infrastructure Architecture with the Systems Application Architecture, <https://enterprisearchitected.blogspot.in/2014/04/27/aligning-the-infrastructure-architecture-with-the-systems-application-architecture/>

I4 Process, Setting up a BPM Measurement System,
<http://www.i4process.com/2927/setting-bpm-measurement-system-part-1-3/>

Kim Weins, Cloud Computing Trends: 2016 State of the Cloud Survey,
<http://www.rightscale.com/blog/cloud-industry-insights/cloud-computing-trends-2016-state-cloud-survey>

Magic Quadrant for Cloud Infrastructure as a Service,
<https://www.gartner.com/doc/reprints?id=1-2G2O5FC&ct=150519>

Markku Lepisto, Using Amazon Virtual Private Cloud (VPC) SlideShare on LinkedIn,
<https://www.slideshare.net/AmazonWebServices/webinar-aws-201-using-amazon-virtual-private-cloud-vpc-36578994>

Oracle ADF model, <https://docs.oracle.com/middleware/1212/adf/ADFDCG/intro.htm#ADFDCG>

Problem Solving, <https://www.skillsyouneed.com/ips/problem-solving.html>

Project Management Point of View, <https://gimmarrusti.wordpress.com/pm-quotes/>

TechTarget. AWS Partner Network (APN),
<http://searchaws.techtarget.com/definition/AWS-Partner-Network-APN>

Veeraj Thaploo, Evolution of Cloud Standards, Evolution of Cloud Standards, Feb 18, 2013,
<http://blog.blazeclan.com/evolution-cloud-standards/>

Wikipedia, Amazon.com, <https://en.wikipedia.org/wiki/Amazon.com>

Wikipedia, Capability Maturity Model Integration,
https://en.wikipedia.org/wiki/Capability_Maturity_Model_Integration

Wikipedia, Cloud computing, https://en.wikipedia.org/wiki/Cloud_computing

Wikipedia, SOA, https://en.wikipedia.org/wiki/Service-oriented_architecture

End Notes

Airmic, the public risk management association, A structured approach to Enterprise Risk Management (ERM) and the requirements of ISO 31000,
<http://www.ferma.eu/app/uploads/2011/10/a-structured-approach-to-erm.pdf>

Amazon Web Services Cloud Adoption Framework, WhitePaper, Business Perspective,
 August, 2016, https://d0.awsstatic.com/whitepapers/Business_Perspective_v1.0.pdf

Amazon Web Services Cloud Adoption Framework, WhitePaper, Maturity Perspective,
 August, 2016, https://d0.awsstatic.com/whitepapers/Maturity_Perspective_v1.0.pdf

An Overview of the Amazon Web Services Cloud Adoption Framework, WhitePaper, version 2,
 Feb. 2017, https://d0.awsstatic.com/whitepapers/aws_cloud_adoption_framework.pdf

Fang Liu, Jin Tong, Jian Mao, Robert Bohn, John Messina, Lee Badger and Dawn Leaf, National Institute of Standards and Technology (NIST), Cloud Computing Reference Architecture, Special Publication 500-292, https://bigdatawg.nist.gov/_uploadfiles/M0008_v1_7256814129.pdf

George Reese, Cloud Application Architectures, Building Applications and Infrastructure in the cloud,
 O' Reilly, <https://ameensheriffmca.files.wordpress.com/2014/07/text-book1.pdf>