

ASSIGNMENT COVER PAGE

Programme		Course Code and Title
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<ul style="list-style-type: none"> 0204516 KOONG YONG XIN 0203970 KHONG ZEN YI 0204677 LIM ZHE YUAN 0205096 THOR WEN ZHENG 0205430 TAN PENG HENG 		Ms. Ng Fong Chiu
Date issued	Submission Deadline	Indicative Weighting
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Assignment title	Assignment 2: Report writing (Group work with individual writing component)	

This assessment assesses the following course learning outcomes

# as in Course Guide	UOWM KDU Penang University College Learning Outcome
CLO4	Recognise and evaluate the cloud computing services.

Student's declaration

I certify that the work submitted for this assignment is my own and research sources are fully acknowledged.

Student's signature:

Submission Date: 26/11/2021



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DCL1274_Assignment2_Sept2021_(Koong Yong Xin and team)

ORIGINALITY REPORT

5%	4%	1%	2%
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MAIN REPORT

1. INTRODUCTION

During the COVID-19 pandemic, public health restrictions are enacted to prevent the ongoing spread of the virus. People are forced to work remotely using any device that they currently have in their possession, which may have significantly less technological capabilities compared to company workstations. According to Yang and his team (2021), not only do these changes in communication media make it more difficult for information workers to convey and process complex information, but the shift to remote work has drastically decreased synchronous communication. Fortunately, cloud computing technologies are massive lifesavers in this regard.

Cloud computing facilitates communication and collaboration in real time, which is why companies are steadily migrating their services onto the cloud. According to Costello (2021), end-user spending on public cloud services worldwide have accumulated up to \$270 billion in 2020 alone and is forecast to grow by 23.1%, which totals to \$332.3 billion by the end of 2021. Therefore, to avoid losing competitive edge, companies are opting to migrate their business models onto the cloud, which can be done with the help of a cloud service provider or cloud vendor. There is a wide range of cloud vendors to choose from in the cloud market. However, it is crucial that usage purposes and costs are thoroughly considered before deciding on a cloud vendor to ensure that desired cloud services are within one's financial and technical capabilities.

2. DISTINGUISHING DIFFERENT CLOUD COMPUTING SERVICES

According to research conducted by Kumar (2021), **Amazon Web Services, Microsoft Azure, Google Cloud, Alibaba Cloud, and IBM Cloud** are the top 5 cloud vendors that lead the cloud computing industry. They monopolize majority of the public cloud market, which makes them stand out among countless other unnamed cloud vendors. However, comparing market shares between these cloud vendors reveals significant differences. According to Richter (2021), in the first quarter of 2021, Amazon Web Services leads the cloud vendor market with a 32% market share, immediately followed up by Microsoft Azure with 20%. Google Cloud, Alibaba Cloud, and IBM Cloud each hold 9%, 6%, and 5% market shares respectively. These statistics show which provider among the top cloud service providers is the best in general, this becomes the deciding factor for users to make their choices on choosing a cloud service provider because it signifies how well they fulfill user considerations, such as cloud services offered by the vendor and their pricing structure (Wpengine, 2020).

- **Amazon Web Services**

Amazon Web Services (AWS) was an idea presented by Chris Pinkham and Benjamin Black in 2003 on how internal infrastructure should be structured. 3 years later, in 2006, AWS was successfully launched. Today, it is the **most popular cloud service provider** in the cloud market. It is a cloud computing platform offered by Amazon.com and it provides various types of cloud computing products and services that have high market demand (Swartz, 2019).

Currently, AWS offers over 200 products and **services** including storage, networking, database, analytics, deployment, management, machine learning, developer tools, and Internet of Things capabilities. Even with such a large catalog of services, there are specific services that AWS customers would most often use. First up is Amazon Simple Storage Service (S3), which is used to store, upload, and retrieve large files up to 5TB from the cloud. It is a fast, scalable, and

low-cost web-based solution for archiving and online backup of applications and data. Next up is the Amazon Relational Database Services (RDS), it is designed to simplify the setup, scaling, and operation, making it more user friendly. Users can save a lot of time by creating a dedicated database instance within minutes. It also helps users to maintain their database servers. Additionally, AWS also has Amazon Elastic Compute Cloud (EC2), one of the most popular services on the platform. EC2 is a web service that provides secure and scalable computing resources to users on-demand. It allows users to utilize highly customizable virtual machines, with the option to modify various server features such as security settings, network settings, and storage. It also helps users to automatically maintain their servers, allowing users to shift their priorities to business strategies and projects instead (SSI, 2020). With all that said, one point of AWS that stands out the most is that it is the most mature cloud service provider in the cloud market. Users will easily be able to find vast amounts of information regarding AWS in the form of documentations and guides, making it easy for self-learning and troubleshooting (Mendi, 2021).

In terms of **pricing**, AWS mainly applies the pay-as-you-go regulation. Users only pay for services and resources that are utilized in the period of active use. This allows users to flexibly adapt their business operations according to ever-changing demands without overcommitting budgets. Besides, for S3 and EC2, the pricing is tiered, which means that the more resources users use, the less they pay per GB. AWS also offers three types of saving plans such as Compute Savings Plans, EC2 Instance Saving Plans, and Amazon SageMaker Saving Plans, which are applied to different service categories. With saving plans, users are offered significant savings on service charges but must commit to a specific amount of usage for selected services within a 1 or 3-year period (Sharma, 2021).

- **Microsoft Azure**

Microsoft Azure, otherwise known as Windows Azure or just Azure, is Microsoft's public cloud computing platform with solutions including IaaS, PaaS and SaaS that can be used for a broad range of business services (McCoy, 2021). Since its debut in 2008 as its project codename "Project Red Dog" (Zerger, 2015) and commercial launch in 2010 (Bigelow, 2020), Azure has become one of the major contending cloud vendors in the cloud vendor market, taking **second place in global rankings** just behind Amazon Web Services.

With more than 200 cloud **services** (Microsoft Azure, 2021a), Azure sorts its services into nearly 2 dozen categories. It is said that Azure is popularly used for running virtual machines and containers using Virtual Machines (VM) and Azure Kubernetes Service, hosting databases using Azure Cosmos DB and Azure SQL Database, and disaster recovery and backup using Azure Backup (Bigelow, 2020; Microsoft Azure, 2021b; Microsoft Azure, 2021c). Most importantly, Dolittle (2016) boasts that Azure has more data centers and delivery points than most other cloud providers, which are interconnected with a round-trip latency of less than 2 millisecond (Microsoft Azure, 2021d), allowing Azure to deliver content faster and provide optimal user experience. They also provide built-in support for unique analytic services such as Cortana Analytics and Stream Analytics to let users capitalize on Microsoft insights. Though, one of the major drawbacks of Azure is that new cloud services are often rushed and are unreliable for at least a year before they become stable based on user experience (Vafa, 2018).

Azure **pricings** are determined in the form of subscriptions, mainly free, pay-as-you-go, or member offer subscriptions. For free subscriptions, Azure allows users to take advantage of Azure resources, free-of-charge for the first 12 months of registering a new Azure account. A \$200 credit will also be given for the first month of cloud usage to let them use paid services. After 12 months, Azure will start charging users normally based on the cloud resources that they used on a monthly

basis. Azure pricings depend on factors like the type of service, service capacity, location and the level of management. Apart from the normal pay-as-you-go subscription, member offer subscriptions, which offer substantial discounts for services, are also provided to long-term, loyal customers (Stillman, 2021; Spot, 2021).

- **IBM Cloud**

IBM Cloud is a cloud computing platform created by International Business Machines (IBM) Corporation. It was initially launched in 2009 as LotusLive, then renamed as IBM SmartCloud, and finally as IBM Cloud in 2017 (Harvey, 2017). IBM Cloud is **one of the biggest competitors** in the cloud market, being listed in the top 7 cloud service providers in Gartner's magic quadrant for cloud services (Bala et al., 2021). IBM also takes pride in the fact that IBM Cloud is used and trusted by 47 of the Fortune 50 companies (IBM, 2021b).

IBM Cloud offers over 170 cloud products and **services**, with emphasis on the latest, on-trend technology including big data, containers, IoT, AI, and blockchain. IBM boasts the most secure public cloud for businesses with services such as IBM Cloud Pak for Security, next-generation hybrid cloud services like IBM's Red Hat OpenShift for rapid digital transformation, and advanced data analytics and AI tools like IBM Watson (IBM, 2021b). IBM Cloud's data centers are built for local accessibility, low latency, and high security, with global service availability in regions and countries across the world including Malaysia (IBM, 2021c). Although they boast such a wide array of benefits and quality services, IBM Cloud is mostly left out of the spotlight in the cloud market as they actually fall behind in most public and hybrid cloud services when compared to cloud giants like AWS, Azure, and Google Cloud Platform. Where they truly stand out is in private cloud, primarily because of their high performance, highly customizable bare metal servers which are very attractive for companies opting for secure private cloud (IBM, 2021e; Rigg, 2021).

In terms of **pricing**, IBM Cloud primarily offers 3 purchase models including "Pay-As-You-Go", "Reserved Instances", and "Subscription and commitments" (IBM, 2021e). The "Pay-As-You-Go" model is flexible, customers only pay for what they use and can opt out of the services anytime. With the "Reserved Instances" model, customers pay to reserve a set of virtual servers for either 1 or 3 years, which is useful for guaranteed resources with global availability during the contract term (IBM, 2021f). "Subscription and commitments" means customers must commit to pay a set amount of money for services used in a fixed period of time, but with discounts at the end of that period, making it potentially cheaper than "Pay-As-You-Go" (IBM, 2021a). Additionally, IBM Cloud also offers free Lite accounts in which users have access to over 40 free services.

- **Alibaba Cloud**

Alibaba Cloud (AC), also known as Aliyun, is a cloud computing company founded in 2009, it is also a subsidiary of the Alibaba Group. Alibaba Cloud is the **leading cloud service provider in Asia Pacific** with a 19.6% market share (Alibaba Cloud, 2021a). In 2017, Alibaba Cloud was also selected as the official services partner of the Olympics (Alibaba Cloud, 2021d).

Alibaba Cloud offers over 100 **services** and products, ranging from cyber security, big-data processing, networking, database, analytics, artificial intelligence, and more. One of the main services of Alibaba Cloud is Elastic Computing, which has the ability to quickly increase or decrease computer processing, memory, and storage to meet users' demands without worrying about capacities, this is one of the core concepts of cloud computing. There are various categories of Elastic Computing in Alibaba Cloud, including Cloud Server, High-Performance Computing, Container Service, Elastic Orchestration, and Serverless, with each having several types of products. Elastic Compute Service (ECS) provides virtual cloud servers for cloud hosting, with a

variety of CPU and memory storage specifications to meet the demand of computing resources. Supercomputing Cluster (SCC) is for high-performance computing, it uses high-speed interconnectivity of Remote Direct Memory Access (RDMA) technology, which can provide superior network performance and increase the acceleration of large-scale clusters. Container Service for Kubernetes (ACK) provides enterprise-level efficiency using high-performance and scalable containerized application management service, which helps enterprises to manage applications throughout their lifecycle. Alibaba Cloud also provides artificial intelligence (AI) cloud services. Image Search is one of the AI services, it provides high accuracy search services using images or snapshots provided by users to find similar images. This is suitable for e-commerce platforms and stock photography or photo-sharing sites (Alibaba Cloud, 2021c).

For **pricing** options, Alibaba Cloud consists of “Pay-As-You-Go Billing”, “Save by Subscription Billing” and “Resource Packages”. For “Pay-As-You-Go Billing”, users only need to pay for the resources used with no upfront payment. “Save-By-Subscription Billing” is used when elasticity is not a concern, and users will pay at a lower rate to maintain their day-to-day services. Alibaba Cloud also has “Resource Packages” which are basically special subscription plans that offer greater flexibility and cost effectiveness, with the added plus of attractive discounts. Alibaba Cloud also offers free 1-month trials for certain services, giving users the opportunity to try them out before deciding whether to purchase these services. After-sales support plans on this platform include the Basic Plan which is free and paid plans including Developer, Business, and Enterprise plans that cost 19, 100, and 8000 USD respectively (Alibaba Cloud, 2021b).

- **Google Cloud Platform**

Google Cloud Platform (GCP) is Google’s cloud computing platform which was launched in the year 2008. Initially, GCP started off with only a “preview” version of their App Engine service, offered to only 10,000 developers. It was a development platform used for convenient development and deployment of scalable web applications hosted on Google’s infrastructure. In 2011, Google finally released App Engine along with various other services as official products offered to the public, this was the starting point of GCP’s path to becoming **one of the leading cloud service providers** in the industry (Sophia, 2018).

According to Google Cloud, GCP currently offers more than 100 **services** for clients to maximize the utilities of the platform, and to build or improve their projects. Their services are based on five main elements including Google Compute Engine, Google App Engine, Cloud Functions, Google Container Engine, and Container Registry (SpringPeople, 2017). One notable service offered by GCP is data analytics, used for clients to receive, store, and analyze data to gain useful insights on business operations. For example, BigQuery for business insights, Dataflow for stream and batch processing, Cloud Data Fusion for building and managing data pipelines, and more (Google Cloud, 2021d). Besides that, GCP offers advanced cloud security services like Chronicle, Advanced Protection Program, impressive built-in security tools such as Cloud Security Command Centre, and the open-source Forseti for helping clients manage security configurations (Moore, 2019). GCP also has AI and machine learning services such as Vertex AI, Deep Learning VM Image, TensorFlow Enterprise and more. One thing that stands out in GCP’s AI and ML services is their Speech-to-Text API which supports more languages than other cloud services (Altexsoft, 2021). GCP is also well-known for its compute engine, mostly used for accelerating clients’ digital transformation with high-performance VMs which are on par with those offered by AWS and Azure (Google Cloud, 2021a).

In terms of **pricing**, GCP mainly operates on the pay-as-you-go pricing structure, where clients pay only for what they use with no up-front fees or termination charges. GCP also offers

discounted rates based on clients' monthly usage and pre-paid resources (Google Cloud, 2021c). In addition, GCP offers free trials for clients to conduct first-hand evaluation on how GCP services perform. Clients are provided 300 USD free credits to spend over the next 90 days, with access to more than 20 free products including firebase, Google Maps Platform, and more. There is no auto-charge after the 90-day trial ends, GCP will request a confirmation from clients and ask for their credit card details before clients commit to paid subscriptions (Google Cloud, 2021b).

3. INDIVIDUAL BEST PREFERRED CLOUD COMPUTING SERVICE

- **TAN PENG HENG**

According to SpringPeople (2017), there are many cloud services that are provided by different providers such as Amazon, Google and more. Every service had different benefits and features, but I would mostly recommend Google Cloud Platform among these five cloud services. Google Cloud Platform was provided by a company known as Google. Google Platform has included five main elements which are compute engine, app engine, cloud functions, container engine, and last container registry. These elements were handling different functions such as the compute engine will provide VMs for the services, app engine will be hosting applications directly for clients and more. The main three reasons that I recommended choosing Google Cloud Platform is because it offers many services and brings efficiency to the clients.

First, Google Cloud Platform included a **strong infrastructure** which is having a complete trust and safe security system to secure the data and the information, user-friendly with a very good interface to interact with the users, cost-effective with a free trial to the new users and reasonable prices for the subscriptions and more. For example, the Google Cloud Platform has great connections across all Google applications and clients can access and link the data to one and another (SpringPeople, 2017).

Next, Google Cloud Platform included a **high and powerful data and analytics system**. Google Cloud Platform has a big data service which is provided by Google Big Query, Cloud Dataproc and Cloud Datalab which helps to analysis the usage and preference of the client day by day. Besides that, AI and machine intelligence in Google Cloud Platform will study the preference of the client and provides efficiency to the client such as Gmail was having a smart reply function and Google Translate will automatically translate the language preferences that clients always used. Last, Citizen Data Science is a very powerful feature, it directly hands over data needed to all the employees who run the business (SpringPeople, 2017).

Lastly, Google Cloud Platform **support coding** which means Google Cloud Platform will decrease the configuring infrastructure. Besides that, containers in Google Cloud Platform will hand over the coding to Linux Foundation and then create an orchestration engine to launch containers every week. Out of that, Google Cloud Platform makes the cloud easier to use. For example, Google App Engine supports SQL and noSQL databases, searching and security scanning, Memcached, and more (SpringPeople, 2017).

In conclusion, Google Cloud Platform was a strong and capable company. They provided the best service between five of them and their services were all more user-friendly compared to other cloud services. Besides that, I would recommend Google Cloud Platform among these top five cloud services because it brings a lot of benefits and mostly efficiency for me.

- **LIM ZHE YUAN**

Digital transformation is the process of using digital technologies to create or modify existing business processes, culture, and customer experiences to meet changing business and market expectations in today's digital age (Salesforce, 2021). Based on some key factors that guarantee successful digital transformation using the cloud given by Suriano (2018), **Microsoft Azure** seems to be the better cloud service provider option to be chosen compared to other providers.

Despite ranking below Amazon Web Services (AWS), Microsoft Azure is still able to **revolutionizes customer experience and business networks** because of its initiative to diversify its services. According to a public cloud computing service market share statistic (LeanIX, 2021), SaaS leads with a 39.4% market share in 2021, followed up by IaaS with 20.9%, and PaaS with 18.7%. Even though it is said that Azure spearheads the development of IaaS (SysGen, 2021), SaaS and PaaS solutions are being given enough attention by Azure too to encompass most of the increasing cloud use cases by small-medium businesses nowadays, especially SaaS which generates more revenue because of its importance in the market. Some examples of SaaS offerings from Azure are Office 365, Dynamics 365, and Outlook (Stoenescu, 2021), which also gives Azure an edge over AWS because of how entrenched these applications are in businesses over the years.

Moreover, Microsoft Azure also provides an **integrated cloud and communication infrastructure** with service-based architectures and open application programming interfaces. The demand for integrated cloud and communication infrastructure requires the simplification and integration of network functions and IT operational processes in an on-premise or cloud setting (Suriano, 2018). In Azure's case, Azure Arc is a prime example of simplifying and integrating the visibility of IT resources of any environment into a central management service, allowing two-way communication between different environments to accelerate application development (Kumar, 2021). Recently, Azure also added new capabilities to simplify application management by partnering with Elastic, the company behind Elasticsearch, to integrate and utilize its benefits of adding powerful search and visualization capabilities and workload monitoring directly within the Azure portal, facilitating infrastructure management and maintenance (Shah, 2021).

It is not far-fetched to say that Microsoft Azure **takes advantage of latest technology innovations** as well. According to Suriano (2018), the technologies that count as latest cloud technology innovations include 4G or 5G mobility infrastructure and platforms, AI, machine learning, and biometrics. Azure do have its offerings that tends to the need for these technologies. To name a few, Azure Bot Services, Azure Machine Learning and Azure Cognitive Services are some of the services that specializes in the AI and machine learning field (Microsoft Azure, 2021b). Azure had also made use of biometric data in Azure Active Directory for multi-factor user authentication purposes (Sennovate, 2020). Even better, Azure have disclosed about a new Azure service recently, called Azure Private Multi-Access Edge Compute, which support enterprises tapping private 5G networks and edge computing services (Mackie, 2021).

Overall, Microsoft Azure satisfies most of Suriano's requirements for successful digital transformation using the cloud. But that is not all, one of the key reasons why Microsoft Azure is chosen over AWS is because of the lower global expectations compared to AWS. As the leader of the market, AWS needs to continue making new breakthroughs in cloud technology to maintain its dominance over the market. This enables Azure to put more focus in enhancing existing service architectures and improving consumer ratings (Comport, 2021). Customers would be more familiar with using Azure on top of being able to work in the same environment with the entrenchment of Microsoft products too.

- **KOONG YONG XIN**

Digital transformation is a process that modifies or creates a new business process to be more effective and efficient. It is imperative for all businesses nowadays due to the revolution of technology. Digital transformation involves using digital technologies to transform the services that exist into a significantly better and provide benefits to all the firm. It really means something to business today. However, without the help of cloud computing, it might be hard to accomplish (Boulton, 2021).

In my opinion, Amazon Web Service (AWS) is the best-suited cloud computing provider for digital transformation to be successful. AWS is a cloud platform that is fully managed by artificial intelligence (AI) and machine learning. It provides the firm with unique solutions and services to foster digital transformation.

AWS offers Identity and Access Management (IAM) to ensure secure access to the resources and data on the cloud. IAM is a feature that provides access control across all of AWS. With IAM features, the user is allowed to specify who can access which resources and data under which condition. It gives the host of resources and data complete control over the firm to ensure least-privilege permission.

Digital transformation can be expensive due to the investment in new technologies or increase the amount of IT needs due to the requirement. But with the help of services from AWS, the client might get to reduce its cost by using the services. AWS offer clients to pay by the following method, which the client only has to pay for the resources or services they use. Besides, different types of services might have a different kind of trial for the client to experience the service before they pay for it. It also costs far less than constructing and running its own data center where the client has to pay for all the bills, such as IT staff to maintain the operation or actual devices to run the server (Sharma, 2021).

However, security will be the most significant concern when migrating to the cloud. AWS offers a full stack of cloud security solutions to secure data and resources. The client can also use some of the security tools from AWS to reduce the vulnerability of the cloud. For example, without overburdening IT employees, the user can use automated threat detection for hunting for cyber threats or using its automated cloud configuration to avoid misconfiguring.

In conclusion, digital transformation can always be expensive and complicated, but having a cloud platform like AWS, which is comprehensive, can provide help and increase the progress of digital transformation to be achieved. With all the features and benefits that AWS offers, such as better identity and access management or reduced IT costs. It will definitely make the journey more effective and efficient.

- **KHONG ZEN YI**

Nowadays there is a multiple selection of cloud services online with different features and functions there are a lot of well know services that user use like Amazon web service, IBM cloud, Google cloud, Alibaba cloud and more. For my perspective I would recommend Alibaba cloud, Alibaba cloud is a subsidiary from the Alibaba group also call as aliyun, yun is cloud in Chinese. Alibaba Cloud is also the top 1 rank cloud service in Asia Pacific (Alibaba Cloud, 2021a). I would say Alibaba cloud is the best cloud service is best for Asia user and the best cloud services in Asia.

Elastic computing service (ECS) this is one of the services that Alibaba cloud provide this is to increase or decrease the computer or storage memory to meet the user demand, this is one of advantage for elastic computing service user can increase or decrease anytime time or anywhere if user want. This can help to save cost and time; users will only need to pay for the service they want from the cloud having their own server hardware save up the hardware cost. Also, the service can be customized for user different uses at a low cost. It not just saved the cost hardware it also saves the cost rent example like server room and save the time for the server it can be use in anytime. In Alibaba cloud they provide customized servers and packages service with multiple service in the package at a low cost. Alibaba cloud is an Asia service compared to other services like Amazon web service or IBM Cloud, Alibaba cloud has more of knowledge of need of Asia market and promotion for like 11.11 for Asia users to match the Asia holiday discount. Alibaba also provides a consultant to help users with the saving plan, it is a discount plan that will help users to plan their usage and bill at a discounted price.

Security is also one of the main services that Alibaba cloud provides for users. Security is particularly important to online information for either individuals or groups, if information was not secure by various security ways like security system or virus protect application. Without this kind of protection, the information will easily get stolen or hacked for different purposes it can be user sensitive information or user account hijack. For groups like enterprise company sensitive information can be stolen, it will cause a lot if that happens. Alibaba cloud security is committed to the highest level of security including Germany C5 standard, mean that it is the level of Government cybersecurity standard. According to Gartner Alibaba cloud security has higher than Amazon webservices and ranked No.2 in the world in cloud security assessment (Zhang, 2020). For price part Alibaba cloud will customization package for user purpose to get low cost for user.

Finally come to the pricing part, this is what most of the users are concerned about or care about, example 2 same service but with different prices user will normally choose cheaper one for less cost. Normally the other cloud service provider will offer their service purchase term for more than one year while some others have different purchase terms like an on-demand payment system, pay as go or subscription basis. Well, Alibaba cloud has all these terms offer and besides Alibaba cloud also reserved instance and preemptible instance. All these purchase terms help users spend money based on the user demand also save the overall cost that is related to cloud usage. There is a pricing calculator for user to key in to estimate on the price with their service of demand, of course there is plan call saving plan in Alibaba cloud saving can help user to get the best price with the service package the customization to get discount as they can. Compared to Amazon web service, Alibaba cloud monthly subscription is cheaper than Amazon web service this is a fact. Alibaba cloud has also always made promotion for the service to get discount which made it cheaper compared to other cloud service providers (Chapel, 2019).

In summary, when it came to budget saving or cost reducing Alibaba cloud is always the best option for users that have this kind of demand and trustable. Well known as the top 1 cloud service provider in Asia Pacific.

- **THOR WEN ZHENG**

Amazon Web Services (AWS) is the best cloud service provider for digital transformation for various reasons. Firstly, it goes without saying that AWS is the **most trustable provider** out there just by reputation. AWS is the oldest and the world's leading cloud provider, having established its successful business in public cloud since 2006, at least 4 years ahead of its competitors (Agilisium, 2021). Their experience and reputation, along with their relationship with industry leaders like Netflix and NASA, reaffirms that AWS is the safest option not only for digital transformation, but for many other purposes as well (Amazon Web Services, 2021a).

For successful digital transformation, the benefits and profits must outweigh the costs of transformation, otherwise companies may not be able to sustain operations on the cloud and continue transformation processes due to lack of capital or revenue (Gareiss, 2021), resulting in failure of transformation. Therefore, companies should choose a cloud provider that offers the **most flexible pricings** and services with reasonably **low costs**. In that regard, AWS best fulfills those criteria as AWS pricings outperform other cloud providers in most use cases (Rigg, 2021). When comparing pricing of virtual instances, AWS has cheaper hourly on-demand pricing structure than Azure and GCP; for comparison of discounted pricing and per-second billing, AWS and Azure are similar and cheaper than GCP, but AWS has slightly higher discount rates than Azure. Furthermore, AWS pricing structure is the most flexible as they offer the most payment options, allowing customers to have more control over their budget (Solanki, 2021; Weins, 2017).

One important thing to note is that digital transformation does not occur at once or overnight, it can be a very long process divided into several stages (Figone, 2021). Thus, for a smooth transformation process with minimal setbacks, a highly reliable cloud platform should be chosen. With that said, AWS has an excellent reputation of being a stable and **reliable** cloud platform. According to Leopold (2015), the reliability goal for cloud providers is “five nines” – 99.999% reliability, and statistics from 2014 show that AWS came the closest to reaching that goal, with AWS EC2 achieving 99.9974% while having only 2.14 hours of downtime in the entire year of 2014. Closely following AWS EC2 in the rankings is GCP's Compute Engine with 99.9815% reliability and 4.46 hours of downtime in 2014. Meanwhile, other cloud providers including Azure were much farther down the rankings. Even in 2020, AWS's reputation of reliability has never been toppled, having only 1 major service outage throughout 2020; while its main competitors, both Google and Microsoft had 11 major outages each (Total Uptime, 2021).

According to Engler (2020), the lack of workers with digital skills, specifically cloud computing skills, is a major factor that could jeopardize the digital transformation of companies. The COVID-19 pandemic and its adverse effects on the global economy is pressuring many companies in the race to obtain talents with digital skills and cloud expertise. Therefore, it is essential for companies to choose a cloud platform for which there is a **higher availability of skilled workers**. In regard to that, AWS is the most suitable as the majority of cloud developers and experts are experienced with AWS. A survey by Statista showed that 54.22% of developers use AWS while its competitors have 31% or below (Liu, 2021). AWS skills are also in the highest demand, this will continue to attract even more developers to learn AWS, further increasing the availability of AWS developers (Davis, 2021). Furthermore, AWS has in-depth digital transformation guides and many certification courses which provide more learning material than other cloud providers, making it easier for companies to train their current workforce (Amazon Web Services, 2021b; Willis, 2020).

To summarize, AWS is the best for digital transformation as it is the cheapest, most trustable and reliable, and has highest availability of skilled workers. Azure and GCP are strong competitors but fall short in certain aspects; IBM Cloud and Alibaba Cloud are difficult to compare with the big 3 due to lack of popularity, but mostly fall behind in the cloud market based on most reports.

4. CONCLUSION & RECOMMENDATIONS

To summarize the individual preferences of the best cloud service provider, AWS gained 2 votes; GCP, Azure, and Alibaba Cloud each has 1 vote, while IBM Cloud has 0 votes. By unanimity, it is decided that **AWS is the victor** as it has more votes when compared to other individual providers. Upon analyzing the reasons for choosing AWS as the best provider, several key findings could be made. Firstly, one of those reasons is AWS is the most mature and reputable cloud service provider in the cloud industry. Its long-time reputation of excellence and relationship with various industry-leading organizations helps it to easily gain the trust and interest of customers. Second, because of its maturity, AWS have also become the most reliable provider out there who boasts nearly 99.999% availability throughout the whole year (Metarouter, 2021). Last but not least, it pioneers new cloud technologies, allowing customers to enjoy the early-bird benefit of being among the first to use such technologies for streamlining business processes.

To be frank, there are no winners or losers in today's competitive cloud market. Customers are signing with multiple cloud vendors to lower costs and cobbling together the best services from different providers. According to Upadhyay (2020), organizations should not depend on a single cloud network, be it public or private. By using a **multi-cloud approach**, cloud service providers can compensate each other's weaknesses and cost-effectively segment organizational workloads. Multi-cloud became so common, 93% out of 500 IT professionals from public and private sector companies indicated that their organizations adopted a multi-cloud approach to meet their computing needs in the ninth annual State of the Cloud Report (Faction, 2020a). So, the battle for the cloud, which had once been primarily Amazon vs. Microsoft, is slowly turning out to have many more fronts (Tilley, 2021).

Despite this, it is still important to decide on a cloud provider that acts as the main powerhouse for business models. Long story short, customers should carefully **consider their exact needs and capabilities** before they are about to entrust their entire career to a third-party. Aside from actual cloud usages and budget to fund their cloud usage, the nature of their data, existing technical skills, and the necessity for personal assistance are some more considerations that customers should expect to revise and re-evaluate in order to ensure zero future complications. Referring to a Comport article, businesses do not necessarily lose functionality if they decide on a more hands-on provider than cloud giants like Amazon Web Services. They may not absolutely require the biggest infrastructure as a service in the world, and it all boils down to customer preferences that ultimately allow key requirements to be met (Comport, 2021).

On another note, it is important to know that by choosing any cloud vendor to migrate on-premises resources to the cloud, customers are essentially bound to their chosen cloud vendors via **vendor lock-ins**. Vendor lock-ins are situations where an organization wishes to sever ties with its vendors but is unable to do so due to the projected cost, duration, or complexity of switching. Vendor lock-ins could cause various consequences, such as inability to switch providers when a cloud vendor fails to meet service-level agreements, inability to move data and applications out of cloud environments, and risk encountering data breaches and cyberattacks. To avoid vendor lock-ins, customers are recommended to create an exit strategy, preferably before signing an initial service agreement with their chosen cloud services provider. IT professionals responsible for cloud management should also develop technical capabilities to avoid knowledge-based vendor lock-in. Not to emphasize again but implementing a multi-cloud strategy can help in avoiding vendor lock-ins as well since no services are always tied to 1 cloud provider (Faction, 2020b). Ultimately, customers will not regret taking precautions over vendor lock-ins as an escape route will always be ready for them whenever the quality of service of their cloud providers is not on par with expectations.

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[DCL1274: CLOUD COMPUTING]							
MARKING RUBRIC ASSIGNMENT [2]							
Report Writing (15%)							
REPORT COMPONENT (100%)							
LEARNING OUTCOME	MARKING CRITERIA	SCALE					
		Fail (0-49)	3 rd Class (50-59)	2 nd Lower Class (60-69)	2 nd Upper Class (70-79)	1 st Class (80-100)	YOUR MARKS/COMMENTS
CLO4: Recognise and evaluate the cloud computing services.	1. Introduction (10%)	Weak or no introduction of the topic and background of the topic. Purpose of the writing is unclear or missing. Topics were not addressed properly.	Basic introduction that states the background of topic but lacks interest.	Adequate introduction and states the background to topic.	Proficient introduction that is interesting and states background to topic	Exceptional introduction that grabs interest of reader and states topic. All issues are critically addressed.	
	2. Quality of analysis of knowledge of subject (30%)	Fails to provide a level of information that answers the question. Information are internally contradictory without explanation.	Information are sometimes on target and sometimes off center. Segments of the writing hang together but other parts are unclear or contradictory with no good resolution.	Information are on target and sometimes off center but with minimal explanation.	Information are at the best level of answers the question. Analysis are made and related to the topic.	Information are at the best level of that answer the question. Analysis are critically made.	
	3. Quality of information (30%) (Individual)	Information provided has little or nothing to do with the question.	Information clearly relates to the main topic. Points are insufficiently developed. Analysis is weak.	Information clearly relates to the main topic. Points are made, but analysis is minimal.	Information clearly relates to the main topic. Points and analysis are made and related to the topic.	Information clearly relates to the main topic. Points are critically made. Analysis is insightful and sophisticated.	
	4. Conclusion and Recommendation (20%)	Little or no evaluation is offered. Conclusions and recommendations are missing or inadequate.	Some attempt at a conclusion and recommendation, but the work is weak have been achieved, or the conclusion and recommendations for further work are missing or ill-considered.	The conclusions and recommendations are on balance acceptable. The conclusion and recommendations for further work are limited and do not show the necessary broader perspective. Not outstanding in any respect.	A sound conclusion and recommendation that covers a good range of issues. The conclusion and recommendations for further work are appropriate and may show a broader perspective than that of the project. No section has serious weaknesses, and there may be excellent or outstanding features. On balance the work is good but not wholly excellent.	An outstanding conclusion and recommendation of the work undertaken, incisive, self-critical, evidence-based and complete in all respects. The conclusion and recommendations for further work are take a broader perspective.	

	5. Citation and References (10%)	Missing or no citation/ references and major flaws on the format.	Very minimal amount of cited works and references, with incorrect format.	Adequate amount cited works and references, both text and visual, are done in the correct format. Inconsistencies evident.	All, both text and visual, are done with minimal errors on the format. Reference section with minimal errors.	All cited works and references, both text and visual, are done in the correct format with no errors. Reference section properly formatted.	
	Total (100%)						