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A Comparative Economic Analysis for Cloud Computing

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Maseeh College of Engineering and Computer Science
Department of Engineering and Technology Management

A Comparative Economic Analysis for Cloud Computing

Course: ETM 535/635 – Advanced Engineering Economics

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Term: Spring 2022

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Report No.:

Type: Student Project

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Abstract

Analyzing the economic viability of using cloud computing services within an organization is an important aspect for business today. Significant cost savings can be obtained through selecting the best net benefit alternative between the defender and multiple challengers of business technology systems being considered. A simple definition of cloud computing is the use of software systems and storage accessed through the Internet. Traditionally, these services are managed and provided from in-house, on-site systems. There are several cloud computing service providers to choose from. This study provides an economic comparison between on-site, Amazon Web Services, and the Google Cloud Platform. This analysis uses present worth, and the minimum attractive rate of return using a five (5) year time-frame. A benefit-cost analysis is provided to determine if the efficiency ratios warrant viability of each alternative. An incremental analysis follows, using each viable alternative to find the best option that provides the highest net benefit to the firm. Outcomes from this methodology will vary depending on the specifics of the alternatives being examined. In this example scenario, a fully remote, cloud computing based company is the recommended strategy to pursue.

Introduction

The options available for information technology (IT) services used within an organization today include several viable alternatives. Traditional on-site infrastructure where the IT services are fully managed and located within the physical location of the organization, and cloud computing, in which these services are located externally with access through the Internet. To decide which technological paradigm best fits the requirements of an organization, this study uses an economic analysis to determine which solution provides the best net benefit.

Using Sky Stream, a fictitious company as a scenario, this work highlights how engineering economic methods can be used for this specific need. Sky Stream provides video streaming services to its customers. The organization is examining options to optimize its current operations, while at the same time, reduce expenses. Part of this decision is whether the firm should embrace a fully remote workforce or to maintain a physical office space presence. Additionally, the company is considering two different cloud service providers: Amazon Web Services, and the Google Cloud Platform.

Consisting of 50 employees working for Sky Stream, the estimated physical office space required is approximately 10,000 square feet [1]. Given this workspace footprint, the national average cost within the United States for this location is \$35,000 per month [2], with utility expenses of \$500 monthly [3].

From an organizational perspective, the company consists of Human Resources, Engineering, Customer Support, Sales & Marketing, and Finance departments. Each department has differing enterprise application needs to perform each functional role. These applications and the number of staff are shown in the table below (see Figure 1).

Human Resources Staff: 2	Engineering Staff: 35	Customer Support Staff: 5	Sales & Marketing Staff: 3	Finance Staff: 5
Oracle Netsuite HR Management	Github Source Code Control	Zendesk Trouble Ticket Mgmt	Salesforce Contact & Deal Mgmt	Oracle Netsuite HR Management
	Jira Agile Project Management	Jira Agile Project Management	Jira Agile Project Management	
Desktop Applications Staff: 50 – All Departments				
Word Processing Documents	Spreadsheets Numeric Processing	Presentations Format & Display	Calendars Time Management	Communications Email, Video, Live Chat

Figure 1: Organizational Functional Roles, Departmental Size, and Applications

Wage compensation for the Sky Stream organization is broken down by functional role, and number of employees in each role are shown in the table below (see Table 1) [4].

Employee Wages			
Role	# Staff	Annual Salary	Annual Cost
Manager	5	\$130,000.00	\$650,000.00
Finance	4	\$78,500.00	\$314,000.00
Sales	2	\$68,000.00	\$136,000.00
HR	1	\$74,000.00	\$74,000.00
Software Engineer	34	\$92,000.00	\$3,128,000.00
Technical Support	4	\$60,500.00	\$242,000.00
			\$4,544,000.00

Table 1: Job Role Wage Salary & Annual Costs [4]

The network landscape used by Sky Stream is composed of three primary functional areas; employee data file storage, digital video content storage, and the content delivery components that provide video streaming to its customers. Each employee is designated to have 100 GB of storage space available for the storage of documents and other company related digital materials (see Figure 2).

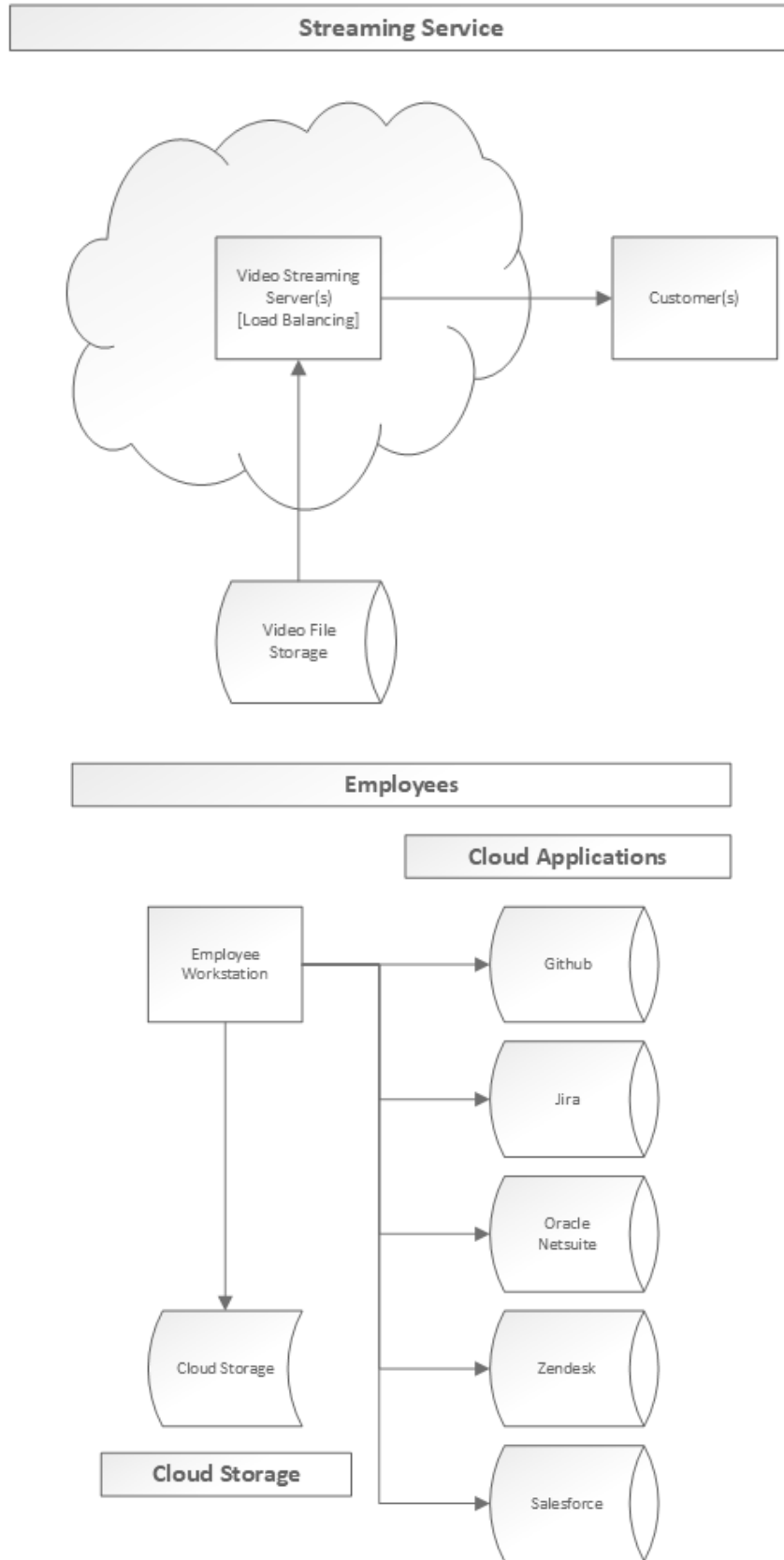


Figure 2: Network Landscape Diagram

Cloud Computing

Cloud computing is all about the delivery of computing resources and services. This includes a wide range of things, such as: storage, software, servers, and analytics. These services are in what we call “the cloud” which is referencing the Internet. Typically, these cloud service models are “pay-as-you-go” [5]. With this model, customers would only pay for what they actually use. This model allows customers to lower their operating expenses and help build up the infrastructure needed very quickly. When companies use services such as the servers and networking in the cloud, it allows the companies to then focus on the products that they provide. Without actually owning and maintaining these data centers and servers, customers can access the technology with these cloud services. These cloud services allow their customers to spend less on teams focused on networking and servers, and spend more time on their products. These cloud services also allow affordable storage and help scale a business affordably.

The main leaders in cloud computing are: Amazon Web Services (AWS), Google Cloud Platform (GCP), Microsoft Azure, Alibaba Cloud, Salesforce, and Oracle. According to data from the Synergy Research Group, the top 4 companies (AWS, GCP, Azure, and Alibaba) own 67% of the cloud market [6]. The top two providers (AWS and Azure) alone own 52% of the market.

For this economic analysis, we have decided to focus on two major cloud service providers: Amazon Web Services and Google Cloud Platform. Both offer the “pay-as-you-go” model so that customers are only paying for what is used.

Traditional On-site Infrastructure (The Defender)

The Defender to this economic analysis is the “do-nothing” case. In this case, that means that the company will house all employees on-site in their own building/campus. The technology will need to be all “in-house” meaning that the company will have to house the data centers, servers, and more.

Cost Analysis

There are many costs and expenses that are associated with being on-site and in-person. The breakdown for the costs can be found in Table 2 below.

On-site Costs	
Building lease (annual)	\$420,000.00
Utilities (annual)	\$6,000.00
Server hardware	\$6,000.00
Backup solution	\$2,000.00
Offsite backup (25-75 cents/gig)	\$1,000.00
Setup fee	\$5,000.00
Server maintenance	\$5,000.00
Anti-virus	\$2,450.00
Licenses	\$60,050.00
Wages	\$4,544,000.00
Total	\$5,051,500.00

Table 2: Total expenses breakdown for On-Site Infrastructure

The biggest costs are the physical building costs, utilities, and equipment costs to maintain the traditional on-site infrastructure.

B-C Ratio Analysis

We will be using the Present Worth (PW) values for a study period of 5 years. Also, based on balance sheets from other streaming services, we will be using a Minimum Attractive Rate of return (MARR) of 9% as shown in Table 3.

On-site Costs and Benefits	
Capital Investment	\$81,500.00
Annual Operations	\$4,970,000.00
Total Expenses - Costs	\$5,051,000.00
Benefits	\$8,990,000.00
PW(9%) Costs	\$19,413,066.78
PW(9%) Benefits	\$34,967,964.86

Table 3: On-Site Infrastructure (The Defender) Costs and Benefits breakdown

$$B-C = (\text{PW}(9\%) \text{ Benefits}) / (\text{PW}(9\%) \text{ Total costs})$$

$$B-C = (\$34,967,964.86) / (\$19,413,066.76)$$

$$B-C = 1.80$$

Because the B-C ratio is greater than 1, that means that the on-site option is feasible, but does not mean that it is the ideal option. We will be conducting cloud computing B-C ratios for both AWS and GCP in the next section (The Challenger).

Cloud Computing (The Challenger)

Cloud Services

Cloud computing services allow firms to go through a digital transition in order to increase productivity and save expenses. Because cloud services are delivered via software platforms and virtualized networks, data for analytics and business intelligence may be easily accessed and analyzed. It also makes it easier to simplify all parts of monitoring by using cloud orchestration and cloud logging services to handle log files. Cloud computing services have the advantage of allowing us to access more resources just when we need them, eliminating the need to purchase additional hardware for redundancy.

Cloud Providers (Mutually Exclusive Challengers)

Google Cloud

Users may utilize Google Cloud to build business solutions utilizing Google's modular web services. It provides a wide range of services, including IaaS and PaaS. Users may be certain that everything they construct, develop, code, or store will be safe. In comparison to big revivals, Google claims to be a frontrunner in terms of pricing.

Google Cloud's Key Features:

- Adding new languages and operating systems on a regular basis.
- Provides self-service on demand
- Wide-ranging network access
- A better user interface aids in improving user experience.
- Resource pooling and flexibility in a hurry

Amazon Web Services

AWS is a cloud-based platform for integrating online services to create commercial solutions. Elastic Cloud Compute (EC2), Elastic Beanstalk, Simple Storage Service (S3), and Relational Database Service are some of the services available (RDS) [7]. Users may use a number of

features to access a variety of capabilities, such as encryption key generation and auditing. This is a fraction of the expense of setting a shop in your own space.

Amazon Web Services (AWS)'s Key Features:

- When compared to private/dedicated servers, the Total Cost of Ownership is extremely cheap.
- Billing and management are centralized.
- Has the ability to work in a hybrid mode
- With only a few clicks, you can deploy your app to various locations across the world.

Cloud Storage

What is Cloud Storage

Cloud storage is a cloud computing concept that uses the Internet to store data. It's on-demand, with just-in-time capacity and pricing, and it saves you money by not having to acquire and manage your own data storage infrastructure. With "anytime, everywhere" data access, you get agility, global scale, and durability.

How Does Cloud Storage Work

A third-party cloud provider owns and operates data storage capacity and offers it via the Internet in a pay-as-you-go manner. Many companies provide add-on services to aid in the collection, management, security, and analysis of large amounts of data.

Cloud Storage Benefits

There is no hardware to buy, no storage to supply, and no cash to set aside for "someday" situations with cloud storage. You may add and remove capacity on demand, modify performance and retention qualities fast, and only pay for the storage you use. The ability to centralize storage on the cloud provides a huge advantage for new use cases.

Cloud CDN

What is Cloud CDN

Cloud CDN is a content delivery network that speeds up the distribution of web and video content. It makes advantage of Google's worldwide edge network to provide content as close as feasible to your users. As a result, your backend servers' latency, cost, and load are decreased, making it easier to grow to millions of users.

How Does Cloud CDN Work

When Cloud CDN is enabled, material is delivered directly from the cache. The cache is a collection of servers that store and handle stuff that can be cached. This material is automatically

cached if you use the suggested "cache mode" to cache all static information. You may also use the Cache-Control directive in your response headers to compel all content to be cached.

Cloud CDN Benefits

Websites that use CDNs have seen load times cut in half, or even more in certain circumstances. CDNs distribute network traffic evenly, ensuring that no one server is overburdened. Because the CDN handles the majority of user requests, there are fewer that travel to the origin server, lowering bandwidth costs. Some CDNs, such as Cloudflare CDN, can route around network congestion, similar to how GPS navigation software can navigate around congested highways [8].

Cloud Security

When it comes to implementing a cloud computing solution, many businesses are concerned about security. What's to stop a cybercriminal from doing the same thing if you can access your data remotely? Employees are responsible for a shockingly high percentage of internal data thefts. When this is the case, keeping critical information offshore might actually be safer. According to RapidScale, 94% of firms reported an increase in security after moving to the cloud. The encryption of data being transported over networks and kept in databases is the key to this increased security. Only 9% of on-premises customers claim catastrophe recovery in four hours or less, whereas 20% of cloud users claim the same [8].

Cloud Business Applications

The following table contains the cloud based enterprise applications required for use by Sky Stream and includes the associated per seat and annual costs per employee. Github is a source code control system used by software developers, Jira is a project management and bug tracking system, Salesforce is for customer relationship management, Oracle NetSuite is for financial management, and Zendesk is for customer support (see Table 4).

Per Seat Software Licensing Expenses			
Application	# Seats	Per Seat Cost	Annual Cost
Github [9]	35	\$39.96	\$1,398.60
Jira [10]	35	\$90.00	\$3,150.00
Salesforce [11]	3	\$900.00	\$2,700.00
Oracle NetSuite [12]	5	\$1,188.00	\$5,940.00
Zendesk [13]	7	\$1,188.00	\$8,316.00
			\$21,504.60

Table 4: Per Seat Software Licensing Per Seat Pricing and Annual Costs

B-C Ratio Analysis

A plethora of cloud services are available from both AWS & GCP. For our analysis, we focused on cloud storage and cloud content delivery networks to arrive at the total operating expenses for the cloud alternatives.

Cloud Storage Costs

To calculate Sky Stream’s total storage requirements, we surveyed the library size of popular streaming platforms. Hulu offers on-demand streaming of 1650 movies and 2500 shows in 288p, 360p, 480p and 720p resolution formats [14]. Based on this information, we fixed the content library size to include 1000 movies & 500 episodes of TV shows available in 1080p HD. The average file size of a one-hour video in 1080p HD is about 1.5GB [15].

The total Cloud Storage Capacity Requirement is calculated as the sum of the following:

- 3TB for 1000 movies with an average duration of 2 hours
- 500GB for TV show episodes with an average duration of 1 hour
- 50-100GB for enterprise (employee) use

Sky Stream requires a total of 4TB storage to host 1000 movies and 500 TV show episodes along with supporting the enterprise applications. The storage pricing models offered by AWS & GCP for 2-50 TB/month packages are as shown in Table 5 [16].

Monthly per GB Price for the First TB	AWS	GCP
2-50 TB/month	\$0.02	\$0.03

Table 5: Cloud Storage pricing for AWS & GCP

Using the information from Table x, the annual cloud Storage costs are estimated to be \$1,130.50 for AWS and \$1,280.00 for GCP.

Cloud CDN Costs

Shifting to Cloud CDN would help Sky Stream deliver content to end-users faster with a high level of QoS across the North America region. We examined Amazon CloudFront & Google Cloud CDN as our primary options.

With a rough bandwidth scaling estimate of 150TB, the pricing models for Amazon CloudFront & Google Cloud CDN are shown in Tables 6 [17] & 7 [18]. The prices for the first 10 TB are very comparable but there is a significant cost saving for GCP after the first 10 TB.

Monthly per GB Price	Amazon CloudFront
First 10 TB	\$0.09
Next 40 TB	\$0.08
Next 100 TB	\$0.06

Table 6: Amazon CloudFront Pricing

Monthly per GB Price	Google Cloud CDN
First 10 TB	\$0.08
Next 140 TB	\$0.06

Table 7: Google Cloud CDN Pricing

Total Operating Expenses

The total operating expenses for AWS alternative is derived by adding the cloud enterprise application licenses from Table 4, wages from Table 1, hardware costs to the cloud service costs as shown in Table 8.

Description	Cost
Cloud Enterprise Application Licenses	\$21,505.00
Wages	\$4,544,000.00
Hardware (Laptops)	\$45,000.00
Cloud Services	\$121,731.00
Total Operating Expenses	\$4,732,236.00

Table 8: Cost Breakdown for AWS

Similarly, the total operating expenses for GCP alternatives is shown in Table 9.

Description	Cost
Cloud Enterprise Application Licenses	\$21,505.00
Wages	\$4,544,000.00
Hardware (Laptops)	\$45,000.00
Cloud Services	\$103,280.00
Total Operating Expenses	\$4,713,785.00

Table 9: Cost Breakdown for GCP

Costs & Benefits

We will be using the Present Worth (PW) derived using a Minimum Attractive Rate of return (MARR) of 9% for a study period of 5 years for both AWS & GCP as shown in Tables 10 & 11.

Amazon Web Services Costs and Benefits	
Capital Investment	-
Annual Operations	\$4,732,236
Total Expenses - Costs	\$4,732,236
Benefits	\$8,990,000
PW(9%) Costs	\$18,406,747.74
PW(9%) Benefits	\$34,967,964.86

Table 10: AWS (Challenger I) Costs and Benefits breakdown

Google Cloud Platform Costs and Benefits	
Capital Investment	-
Annual Operations	\$4,713,785.00
Total Expenses - Costs	\$4,713,785.00
Benefits	\$8,990,000.00
PW(9%) Costs	\$18,334,979.78
PW(9%) Benefits	\$34,967,964.86

Table 11: GCP (Challenger II) Costs and Benefits breakdown

AWS B-C Ratio:

$$B-C = (PW(9\%) \text{ Benefits}) / (PW(9\%) \text{ Total costs})$$

$$B-C = (\$34,967,964.86) / (\$18,406,747.74)$$

$$B-C = 1.90$$

GCP B-C Ratio:

$$B-C = (\text{PW}(9\%) \text{ Benefits}) / (\text{PW}(9\%) \text{ Total costs})$$

$$B-C = (\$34,967,964.86) / (\$18,334,979.78)$$

$$B-C = 1.91$$

Both the B-C ratios are greater than 1, which means that both the alternatives are feasible. In the Methodology section, we will discuss in detail about the advantages of the B-C ratio method and how we employ the incremental B-C ratio method to find the best alternative for our problem statement.

Methodology

MARR Calculation

The Minimum Attractive Rate of Return (MARR) is usually a policy issue resolved by the top management of an organization in view of numerous considerations [19]. Among these considerations are the following:

1. The amount of money available for investment, and the source and cost of these funds (i.e., equity funds or borrowed funds)
2. The number of good projects available for investment and their purpose (i.e., whether they sustain present operations and are essential, or whether they expand on present operations and are elective)
3. The amount of perceived risk associated with investment opportunities available to the firm and the estimated cost of administering projects over short planning horizons versus long planning horizons
4. The type of organization involved (i.e., government, public utility, or private industry)

In theory, the MARR, which is sometimes called the hurdle rate, should be chosen to maximize the economic well-being of an organization, subject to the types of considerations just listed. How an individual firm accomplishes this in practice is far from clear-cut and is frequently the subject of discussion.

Another way to look at the hurdle rate is with the Weighted Average Cost of Capital (WACC). As discussed above, a company obtains capital from the market at a variety of different costs, depending on the form of the investment. That blended average is its WACC. A hurdle rate tends to be a company's WACC plus a risk premium for the particular project or investment which is being evaluated [20].

WACC of popular streaming companies were obtained from their valuation [Appendix - A1, A2 & A3] as shown in the below table (see Table 12).

Company	WACC
Netflix	7.90%
Hulu	8.20%
Spotify	8.20%

Table 12: Weighted Average Capital Cost (WACC) of Streaming Companies

Using the data from the table, we arrived at the value of MARR for our study, fixing it at 9% for a study period of 5 years.

Assumptions

For calculating The Defender and The Challenger, the MARR we use is 9%. We determined this MARR from other similar streaming services such as Hulu, Netflix & Spotify.

B-C Ratio Analysis using the Present Worth (PW)

The B–C ratio method has been the accepted procedure for making go/no-go decisions on independent projects and for comparing mutually exclusive projects. B–C ratio is defined as the ratio of the equivalent worth of benefits to the equivalent worth of costs. The equivalent-worth measure applied can be present worth, annual worth, or future worth, but customarily, either PW or AW is used.

We use Present Worth (PW) to calculate the B-C ratios of the three alternatives - On-site, AWS & GCP as shown in Table 13.

	On-Site	AWS	GCP
Capital Investment	\$81,500.00	\$0.00	\$0.00
Annual Operations	\$4,970,000.00	\$4,732,236.00	\$4,713,785.00
Total Expenses - Costs	\$5,051,000.00	\$4,732,236.00	\$4,713,785.00
Benefits	\$8,990,000.00	\$8,990,000.00	\$8,990,000.00
PW(9%) Costs	\$19,413,066.78	\$18,406,747.74	\$18,334,979.78
PW(9%) Benefits	\$34,967,964.86	\$34,967,964.86	\$34,967,964.86
B-C Ratio	1.80	1.90	1.91

Table 13: B-C ratios of On-Site, AWS & GCP Alternatives

The B-C ratios of all the alternatives are greater than 1, which makes them all attractive options. Since the company has to decide on picking the alternative that best suits their strategy, the next step is to conduct an incremental B-C ratio analysis.

Incremental B-C Analysis using the Present Worth (PW)

When comparing mutually exclusive alternatives with the B-C ratio method, they are first ranked in order of increasing total equivalent worth of costs. This rank-ordering will be identical whether the ranking is based on PW, AW, or FW of costs. The do-nothing alternative is selected as a baseline alternative. The B-C ratio is then calculated for the alternative having the lowest equivalent cost.

If the B-C ratio for this alternative is equal to or greater than 1.0, then that alternative becomes the new baseline; otherwise, do-nothing remains as the baseline. The next least equivalent cost alternative is then selected, and the difference in the respective benefits and costs of this alternative and the baseline is used to calculate an incremental B-C ratio (B/C). If that ratio is equal to or greater than 1.0, then the higher equivalent cost alternative becomes the new baseline; otherwise, the last baseline alternative is maintained. Incremental B-C ratios are determined for each successively higher equivalent cost alternative until the last alternative has been compared. The flowchart of this procedure is included as shown in Figure 3.

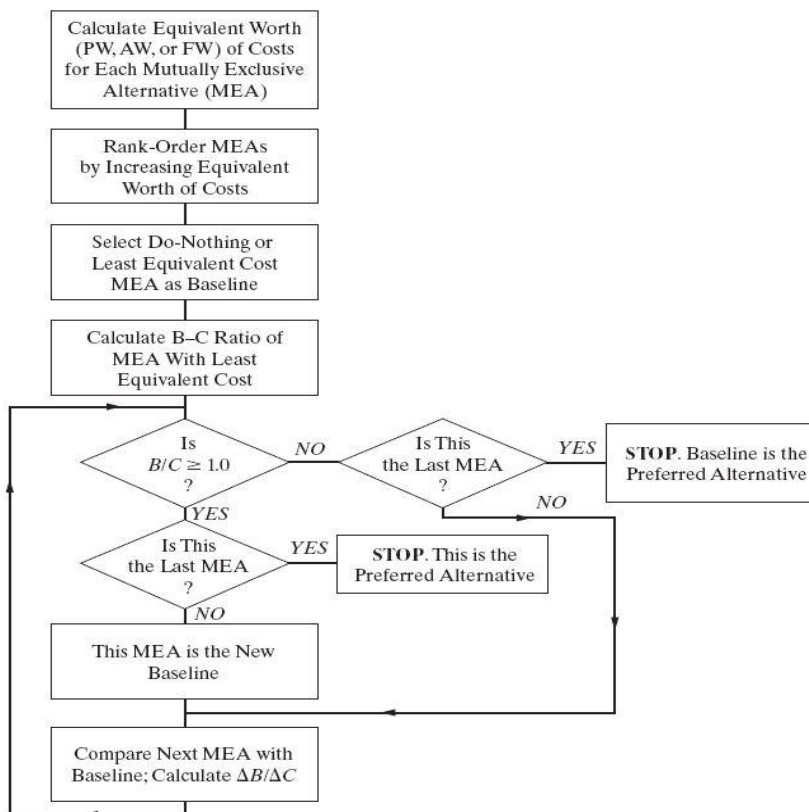


Figure 3: Flowchart depicting Incremental B-C Ratio Procedure

We apply the procedure from the flowchart [20] to obtain the difference between the costs and benefits of the two alternatives as shown in Table 14.

	AWS - GCP	On-site - AWS
Capital Investment	\$0.00	\$81,500.00
Annual Costs - Wages	\$18,451.00	\$237,764.00
Annual Expenses (Costs)	\$18,451.00	\$319,264.00
Total Benefits	\$0.00	\$0.00
PW(9%) - costs	\$71,767.96	\$1,006,319.04
PW(9%) - benefits	\$0.00	\$0.00

Table 14: Incremental B-C ratio analysis of On-Site, AWS & GCP Alternatives

The incremental B-C ratio analysis yielded the following observations:

- ▲ Benefits (AWS - On-site) & ▲ Benefits (GCP - AWS) is 0 since the total benefits value (projected annual revenue) is fixed and only costs vary.
- In this case, we need to consider the alternative with the lowest equivalent cost to maximize the benefits.
- Therefore we need a deciding metric in the form of Net Benefit.

Net Benefit is determined by summing all benefits and subtracting the sum of all costs of a project. This output provides an absolute measure of benefits (total dollars), rather than the relative measures provided by the B-C ratio. Net benefit can be useful in ranking projects with similar B/C ratios [21]. GCP with the highest Net Benefit emerges as the best option as shown in Table 15.

	On-Site	AWS	GCP
PW(9%) Costs	\$19,413,066.78	\$18,406,747.74	\$18,334,979.78
PW(9%) Benefits	\$34,967,964.86	\$34,967,964.86	\$34,967,964.86
B-C Ratio	1.80	1.90	1.91
Net Benefit	\$15,554,898.08	\$16,561,217.12	\$16,632,985.08

Table 15: Net Benefit of On-Site, AWS & GCP Alternatives

Conclusion & Recommendations

Cloud Computing Economic Perspective

After the pandemic, working styles changed when people preferred working from home rather than coming back to the campus. 74% of respondents stated that they wanted to move at

least 5% of the on-site workforce to remote work after the pandemic on March 30, 2020 [22]. During the pandemic, cloud computing has been used, so it is becoming popular for all small and large businesses. 68% of respondents claimed that cloud services would become more significant by 2021 [22]. Currently, all companies want to use cloud computing to improve their systems and create a dynamic working environment for all employees. And then, the economy will increase when people use more streaming methods and work everywhere globally. Sky Steam has become more popular when the company uses streaming services to provide movies and tv shows for everyone. With this service, the company can gain profits of 4 million in 2022 and over 94 million in 2026. It contributes to the development of the economy in the U.S now and in the future.

Some benefits of cloud computing explain why businesses prefer using it now and in the future. Firstly, companies can save a lot of costs when they change to cloud services. According to Burkhalter, "95% of respondents said their use of the cloud would reduce setup and maintenance costs" [23]. A considerable number can help companies invest this amount of money in their services or IT systems. Secondly, data security is a significant issue when hackers steal information and sell it to other businesses. Cloud services are an intelligent solution when they can "protect sensitive company data from cyber-criminals and protect employees' work from unexpected loss due to home computing issues by providing a safe place to upload and backup files" [24]. Finally, employees can share files and updates frequently using the cloud service. Other people can read those documents when they have access to the system. It is convenient for everyone to read and keep on the same page on the projects and avoid misunderstanding the concepts. However, cloud storages are more expensive than regular storage, so businesses can consider reducing the virtual storage when they want to use cloud services. With the benefits of using cloud computing, the economy will change when people focus on sharing and protecting data.

The development of cloud computing has changed the way of sharing information, but people still can keep their data safe. The government understands the importance of cloud computing and has used it in many government departments such as the U.S Army, Air Force, Navy, Department of Education, etc. [25]. Moreover, the U.S government focused on cloud computing in 2014 when they invested \$1.7 billion in private cloud and \$118.3 million in public cloud [25]. The government believes that cloud computing can help them save money and get better performance than traditional methods. They can get a massive volume of data storage and secured systems. Thus, the government's security system will be guaranteed.

Many federal government agencies prefer using cloud computing since there are some successful public, private, and hybrid cloud deployments cases. For instance, the Defense Information Systems Agency (DISA) wants to build cloud security for Defense Department agencies to protect their systems faster and more efficiently. Or, federal departments can use the website

cloud.cio.gov for deployments and usage, including private, public, and hybrid cloud systems [26]. Thus, using cloud computing in government departments can be an excellent example of the popularity and safety of this service. Businesses can use this model to support their system running faster and safer.

Best Viable Alternative & Projections

Based on cost analysis and net benefit for each option on-site, AWS and GCP. Sky Stream has some decisions to make when the business wants to maximize its values with the lowest prices:

- Sky Stream will adopt cloud computing due to its advantages and the future of the business
- Sky Stream will move the company to become fully remote after comparing all alternatives
- Main cloud computing provider is Google Cloud Platform
- The subscription fee is \$4.99/month. The company has many opportunities to compete with other brands like Hulu, Netflix, Spotify, HBO Max, Disney+, etc.

The table below shows the net income of Sky Stream from 2022 to 2026. The number of subscribers will increase from 1 million people in 2022 to 10 million in 2026. The advertisement revenue will increase from \$4 million to \$49 million in 2026. The subscription revenue will be calculated based on the subscription fee of \$4.99/month, so that the total revenue will be \$4.99 million in 2022 and \$49.90 million in 2026. Net income will include advertising and subscription revenue and deduct all expenses, so the profits will be \$4.276 million in 2022 and will increase dramatically to \$94.186 million in 2026 (see Table 16).

Year	# Subscribers	Subscription Revenue	Ad Revenue	Net Income
2022	1 million	\$4 million	\$4.99 million	\$4.276 million
2023	2 million	\$9 million	\$9.98 million	\$14.266 million
2024	4 million	\$19 million	\$19.96 million	\$34.246 million
2025	6 million	\$29 million	\$29.94 million	\$54.226 million
2026	10 million	\$49 million	\$49.90 million	\$94.186 million

Table 16: Five Year Growth Forecast

There are some possibilities for Sky Stream when it decides to work fully remote and sign a contract with Google Cloud Platform:

- Sky Stream can potentially get a lower price from Google Cloud Platform by negotiating a long-term contract
- The company can increase the subscription fee to \$5.99/month after three years
- Sky Stream can get more subscribers when other brands keep increasing the subscription fee every year.

Overall, Sky Stream has many opportunities to develop the business when the company decides to work remotely and use Google Cloud Platform to run the business. Using all calculations of net benefits and B-C measures, Sky Stream can find the best alternative with the best profits they can get in the first year and grow faster in the next few years.

Future Work

Many other aspects can be explored in the future where there have been many changes in the economy after the pandemic. Since inflation changes quickly from 2021 until now, it impacts the economy of the U.S when everything's prices gradually increase. Some big companies, such as Starbucks, MacDonal, etc., have to close many stores to survive after the pandemic. The war between Russia and Ukraine strongly affects the world's economy, such as gas prices going up quickly each month. People have to pay double the money for the same volume of gas compared with previous months. Businesses have stopped working and moved out of Russia, so the world's economy has changed crazily now. In this case, Sky Stream can consider new costs for all wages, expenses due to inflation, and the war.

On the other hand, the taxes also may change when businesses have to pay more taxes after the pandemic. It will impact a lot to Sky Stream if the company considers launching the industry this year. The taxes and inflation can directly impact Sky stream when launching the business in the year. The company may pay more money than expected in the first and second years. However, fully-remote working can help the company reduce many costs, so Sky Stream still has more opportunities to grow up quickly.

In conclusion, cloud computing has become popular with many advantages that support people's benefits. The comparison between the defender and challenger explains the advantages and disadvantages from the cost perspective. The report also describes two primary cloud services: AWS and GCP, and shows a cost comparison to select the best cloud for the business. Using B-C measures and net benefits formulas to calculate the on-site, AWS, and GCP costs and compare those numbers to make decisions. The recommendations describe an economic overview and significant findings for Sky Stream to run the business. Sky stream will go fully remote working and use Google Cloud Platform to begin streaming movies and TV series. Even though there is some future work that Sky Stream needs to focus on, such as taxes and inflation, the company will continue to grow up and gain more profits in the future.

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Appendices

A1. WACC Calculations for Netflix

Source: Templatemo, "Comprehensive value investing platform," *ValueInvesting.io*.
<https://valueinvesting.io/>

Netflix WACC - Weighted Average Cost of Capital		
The WACC of Netflix Inc (NFLX) is 7.9%.		
The Cost of Equity of Netflix Inc (NFLX) is 8.55%.		
The Cost of Debt of Netflix Inc (NFLX) is 4.65%.		
	Range	Selected
Cost of equity	7.4% - 9.7%	8.55%
Tax rate	16.1% - 16.5%	16.30%
Cost of debt	4.0% - 5.3%	4.65%
WACC	6.8% - 8.9%	7.90%
Netflix WACC calculation		
Category	Low	High
Long-term bond rate	2.60%	3.10%
Equity market risk premium	4.20%	5.20%
Adjusted beta	1.15	1.18
Additional risk adjustments	0.00%	0.50%
Cost of equity	7.40%	9.70%
Tax rate	16.10%	16.50%
Debt/Equity ratio <small>Click to show details about D/E</small>	0.18	0.18
Cost of debt	4.00%	5.30%
After-tax WACC	6.80%	8.90%
Selected WACC	7.90%	

A2. WACC Calculations for Hulu (Disney)

Source: Templatemo, "Comprehensive value investing platform," *ValueInvesting.io*.

<https://valueinvesting.io/>

The WACC of Walt Disney Co (DIS) is 8.2%.		
The Cost of Equity of Walt Disney Co (DIS) is 9.55%.		
The Cost of Debt of Walt Disney Co (DIS) is 4.65%.		
	Range	Selected
Cost of equity	8.0% - 11.1%	9.55%
Tax rate	22.5% - 26.5%	24.50%
Cost of debt	4.0% - 5.3%	4.65%
WACC	7.0% - 9.5%	8.20%
Disney WACC calculation		
Category	Low	High
Long-term bond rate	2.60%	3.10%
Equity market risk premium	4.20%	5.20%
Adjusted beta	1.29	1.43
Additional risk adjustments	0.00%	0.50%
Cost of equity	8.00%	11.10%
Tax rate	22.50%	26.50%
Debt/Equity ratio <small>Click to show details about D/E</small>	0.27	0.27
Cost of debt	4.00%	5.30%
After-tax WACC	7.00%	9.50%
Selected WACC	8.20%	

A3. WACC Calculations for Spotify

Source: Templatemo, "Comprehensive value investing platform," *ValueInvesting.io*.

<https://valueinvesting.io/>

The WACC of Spotify Technology SA (SPOT) is 8.2%.		
The Cost of Equity of Spotify Technology SA (SPOT) is 8.45%.		
The Cost of Debt of Spotify Technology SA (SPOT) is 8.5%.		
	Range	Selected
Cost of equity	7.2% - 9.7%	8.45%
Tax rate	32.4% - 47.2%	39.80%
Cost of debt	8.5% - 8.5%	8.50%
WACC	7.1% - 9.3%	8.20%
WACC		
Spotify WACC calculation		
Category	Low	High
Long-term bond rate	2.60%	3.10%
Equity market risk premium	4.20%	5.20%
Adjusted beta	1.1	1.17
Additional risk adjustments	0.00%	0.50%
Cost of equity	7.20%	9.70%
Tax rate	32.40%	47.20%
Debt/Equity ratio <small>Click to show details about D/E</small>	0.09	0.09
Cost of debt	8.50%	8.50%
After-tax WACC	7.10%	9.30%
Selected WACC	8.20%	