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# **Cloud Cost Management in the Perspective of FinOps**

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## Abstract

In this paper the structure of FinOps (Cloud Financial Operations) will be introduced and then the main structure of the cloud bill, cost allocation and tagging will be explained to achieve a successful Cloud Cost Management.

Firstly, I will explain six principles of FinOps, that should be adopted to achieve a successful cloud cost management. I will describe the differences between traditional infrastructure, named as data centers and cloud technology.

Secondly, I will focus on FinOps Domains to adopt the cloud culture. Accordingly, I will explain, why it is important to build a FinOps team in the organization. Then I will clarify the importance of building a FinOps team to motivate all the teams in the organization about cloud cost optimization and inspire the accountability to assume the responsibility of cloud spending.

Next, I will clarify one of the products of cloud consumption, that is cloud bill. Then I will explain the characteristics of cloud billing which help organizations to see more granularity about cloud costs. It will be better to start to understand the components of the cloud bill to grasp the huge amount of data created by CSPs. After that, I will explain the importance of timely data in cloud cost management and the organization structures to manage the cloud costs.

In the end, I will mention the importance of a well-organized cloud cost allocation and the vital feature of cloud cost management which is tagging. Cost allocation and tagging are powerful tools for anomaly detection and also forecasting and budgeting. In conclusion, it is normal that organizations may experience some challenges during FinOps adoption. While dealing with these challenges, some automation tools like Terraform will help them to accelerate the speed of the deployment processes.

**Keywords:** cloud, cloud computing, FinOps, AWS, GCP, Azure, cost allocation, cloud bill, tagging, accounts, tags, labels, reserved instance, commitment

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# List of Abbreviations

AWS	Amazon Web Services
CSP	Cloud Service Provider
CSV	Comma-separated Values
CUD	Committed Use Discounts
CUR	Cost and Usage Report
FinOps	Cloud Financial Operations
GCP	Google Cloud Platform
RI	Reserved Instances

### **1** Introduction

#### 1.1 Motivation

The demands on IT with regard to the speed of change in technology are becoming ever higher and higher in our everyday life. In order to meet these high requirements, Generali pursues an agile method with agile DevOps teams. Here, teams develop system parts independent from each other according to an agile cycle and also take responsibility for their productive operation. Regarding this independency of the teams, it is much more difficult to achieve cloud cost optimization.

The terms "cloud" and "cloud computing" describe the provision of various IT resources such as storage space, computing power or databases. Cloud computing has been rapidly gaining popularity in recent years due to the advantages it offers to its users. Many companies therefore want to move their products to the cloud to gain an advantage over their competitors. [1] There are also some challenges that comes with the cloud technology. Nowadays the performance of a team or a manager is not measured only by the availability of an IT service. Instead, it is measured by the control of the cost they manage. [2] Because of the absence of cloud cost optimization, most of the organizations exceed their cloud budgets. [3] So, cloud cost management is an important topic for all organizations which use cloud resources.

Due to all these requirements, it has become urgently necessary for organizations to measure, manage and even optimize their cloud costs. The organization should bring finance, technology, and business groups together to achieve value in the cloud and bring the organization competitive advantage. In this manner, FinOps plays a significant role by helping the organizations reducing the cloud costs and increasing the efficiency of the usage of cloud resources.

#### 1.2 Structure

In this paper I will introduce the structure of FinOps and then I will move forward to explain the most important steps, that will be regarded to achieve a successful cloud cost management.

Firstly, I will explain the cloud terminology that are used by the biggest three cloud service providers (CSPs), which are Amazon Web Services (AWS), Google Cloud Platform (GCP) and Microsoft Azure. I will describe six principles of FinOps and Domains to create a structured FinOps culture.

Next, I will describe the cloud bill which provides more insights about cloud usage and costs. Then, I will give some information about centralized and decentralized cloud organizations to grasp the importance of the organizational structure to optimize the cloud costs. While understanding the cloud bill, some cloud cost management tools make it easier to understand and structure the huge amount of data. But even if these tools provide more transparency into the data, it is essential for organizations to follow the steps of FinOps lifecycle loop, that is composed of inform, optimize and operate phases.

Reporting, anomaly detection, cost allocation, forecasting and budgeting are the most important topics in inform phase. During the inform phase, the organization will understand the cloud usage and costs in order to make real time decisions. While applying the optimize phase, the organization should use some Key Performance Indicators (KPIs) to optimize the cloud usage and rates. By the help of optimization, the organization can improve the efficiency of its cloud usage and optimize the rates by purchasing committed based discounts. As next, during the operate phase the collaboration between teams and educating the teams are so important to improve and refresh the motivation about FinOps. The cloud FinOps team will experience some challenges during these phases, so they need to automate several activities to reduce the cycle times. In this paper I will cover the tagging topic, which is the most important tool to allocate the cloud costs.

# 2 FinOps

According to the definition of FinOps foundation, "FinOps is an evolving cloud financial management discipline and cultural practice that enables organizations to get maximum business value by helping engineering, finance, technology and business teams to collaborate on data-driven spending decisions." [4]

Organizations should understand that the aim of the cloud migration is not about cost saving, but to accelerate the speed and innovation. With the advent of cloud technology, the traditional procurement techniques will not be enough and some of them will be hand overed to the engineers. On the other hand, an engineer does not prefer to think about cost, but about the performance of the system. In these circumstances, there should be an organizational change, which will be achieved by building a team that is responsible for the cloud cost optimization. FinOps will give the opportunity to the leadership to follow just-in-time costs and to prevent a surprising cloud bill.

If an organization decides to migrate into the cloud, then it needs a professional approach or a team that monitor the huge organization on the perspective of cloud cost optimization. In this manner, FinOps brings a financial accountability by enabling teams to make trade-offs between speed, quality and cost. FinOps is a cultural change with a set of processes that helps organization to optimize the cloud costs. FinOps is not used to save money, but it is used to make money, because FinOps helps organizations to have comparative advantage against their rivals in the same market. [4] By the help of FinOps the DevOps and IT Finance teams can collaborate with each other for the visibility of cloud spending. The sooner an organization starts with FinOps the better it makes accountable decisions about cloud costs.

As next, the core principles to adopt FinOps in every level of the organization will be explained.

#### 2.1 **FinOps Principles**

FinOps Principles are developed by FinOps Foundation. [5] These principles guide an organization to find its way in the journey of FinOps.

#### 2.1.1 Collaboration of the Teams

A cultural change is very important to implement the FinOps techniques. If it is achieved in an organization, then the cloud cost will be an efficiency metric not only for the finance team, but also for the engineering teams. [6]

#### 2.1.2 Decisions are driven by the business value of cloud

While implementing FinOps, the teams have to make decisions between cost, quality and speed to optimize the cloud costs and to improve the added value that is provided by utilizing the cloud resources. By using the cloud technologies an organization can have a higher level of innovation and it can improve its capabilities and the speed of production or services that satisfies the customers. So, the most essential role of FinOps is to maximize and even optimize the added value created by the cloud spend. [7]

#### 2.1.3 Everyone Takes Ownership of Their Cloud Usage

Decentralization of decision making also brings the accountability of cloud cost. This means that every small unit of the organization should be aware of the cloud budget and take the responsibility of the usage.

#### 2.1.4 FinOps reports should be accessible and timely

To keep the pace with the tremendously changing IT world, companies should not be satisfied with monthly or quarterly reports. In the world of cloud, it is possible to get nearly real-time reports, which enable organizations to drive their decisions in a smart and efficient manner. [8] To give agile and correct decisions about cloud cost optimization, it is important to get appropriate data just-in-time and to access the data at the desired time.

#### 2.1.5 A Centralized Team Drives FinOps

A centralized team leads and motivates other teams to participate in the FinOps cycle. In addition, centralization of cloud resources enables standardization and makes it possible to optimize the usage of cloud. By the help of FinOps team it will be easy to decide on the reserved instances or commitments and gain discounts from CSPs. [9]

#### 2.1.6 Take advantage of the variable cost model of the cloud

Planning the resources in an iterative manner is preferred rather than planning for the long term. It is better to make small adjustments in cloud cost optimization. The actual data usage should be calculated as near as the real situation. More realistic calculation of the cloud usage brings the advantage of the reserved instances or committed use discounts.

#### 2.2 FinOps Team

The FinOps team is not a gatekeeper, but a facilitator which helps the organization to adopt a FinOps culture and to improve the efficiency of the cloud usage. In an organization the most worried team about the cloud expenses is the finance team. It is mostly difficult to get engineers participate cloud cost optimization. [10] Therefore, the most important goal of the FinOps team is to inspire everyone for the accountability of the cloud spending. Another mission of the FinOps team is to manage and control Committed Use Discounts, Reserved Instances, Savings Plans, and Volume/Custom Discounts and also to coordinate with cloud service providers. FinOps team should have a macro view about the regions, instance types and the advantages between CSPs. The FinOps team should analyze the usage data, make commitments and be authorized for procurement.

Most of the FinOps teams start as a parttime job, but it would be better to create a dedicated team, that is point of center for all FinOps activities. By the help of a central FinOps team, it will be easier to commit huge volumes of reserved instances through a single center. The team size can differ due to the complexity of the cloud usage or the complexity of the company.

#### **2.3** FinOps Domains and Capabilities

If an organization created a FinOps team, as next what would be the task of that team? FinOps capabilities are the tasks that the team should deal with. In FinOps framework the capabilities are categorized into domains, that the team works on. However, it will not be always possible to achieve all the capabilities at the same time or at a desired level.

#### **2.3.1** FinOps Domains

FinOps domains are the activities that will be expected from a FinOps practice. Every migration to or usage of the cloud requires some cultural changes in an organization. FinOps domains are the reaction to adapt to these changes. Organizations should endeavor to work in each of these domains. [11] Each FinOps domain consists of FinOps capabilities, that must be performed as a practice of FinOps.

#### 2.3.1.1 Understanding Cloud Usage and Cost

Within this domain, the organization will gather all the information about its cloud usage and cost and make it available to review. The Capabilities within this Domain focus on understanding and allocating the cloud cost and usage. This Domain enables an organization to understand which cloud services are used, that lead to cloud spend and who owns that spending. A general overview of cloud usage and looking into the historical data enables the organization to support the second domain, which is called Performance Tracking and Benchmarking. [12] The most important capabilities to be performed in this domain are Cost Allocation (Metadata and Hierarchy), Data Analysis and Showback, Managing Shared Cost, Data Ingestion & Normalization, Managing Anomalies, Forecasting and Measuring Unit Costs.

#### 2.3.1.2 Performance Tracking and Benchmarking

Within this domain, the cloud usage and cost are mapped to budgets. Historical information is used for forecasting and KPIs and other performance indicators are measured and established. This domain enables the organization to analyze the historical and current data and according to that information to define thresholds and budgets and also to forecast the expected cloud spending to meet the organizational goals. The capabilities that should be performed in this domain are Measuring Unit Costs, Managing Commitment Based Discounts, Resource Utilization & Efficiency, Forecasting, Budget Management and Managing Anomalies. [13]

#### 2.3.1.3 Real-Time Decision Making

After understanding the anatomy of the cloud spend in the organization and making the performance regarding to the expectations and standards visible, that information can be used to make real-time decisions. The aim of this domain is to provide access consistent cost and usage data to make continuous adjustments. This domain enables the organization to take actions now to meet my organizational objectives. The capabilities to be performed are Managing Anomalies, establishing a FinOps Decision & Accountability Structure, Measuring Unit Costs and Data Analysis & Showback. [14]

#### 2.3.1.4 Cloud Rate Optimization

Within this domain, the organization works on defining its pricing model goals, uses historical data to buy commitment-based discounts and manages the pricing aspects of cloud services that is used in the cloud. The Rate Optimization domain enables the organization to ensure that the pricing models, purchase options, and committed use are consistent with the company's goals. After implementing this domain, the organization can achieve better price performance. The essential capabilities regarding this domain are Data Analysis, Showback and Managing Commitment Based Discounts. [15]

#### 2.3.1.5 Cloud Usage Optimization

In this domain, it is so essential to use the cloud resources with an optimum level, that the usage corresponds to the actual demand of workloads at any time. The techniques that can be applied during implementation of this domain are predictive rightsizing of resources, managing workloads to align with the correct number of scaling resources and turning resources off when not in use. To maximize the business value the organization should use the right resources in an optimum volume. This means that the resources should be used whenever they produce business value. The most important capabilities

for this domain are Data Analysis and Showback, Onboarding Workloads, Resource Utilization & Efficiency and Workload Management & Automation. [16]

#### 2.3.1.6 Organizational Alignment

Within this domain, the organization integrates FinOps capabilities with the existing organizational processes and units. By the help of this domain the organization can improve its employees' skills by FinOps trainings and align the existing processes to use cloud environment more effectively. The capabilities regarding organizational alignment are Establishing FinOps Culture, Managing Shared Cost, Chargeback & Finance Integration, Data Analysis and Showback, Budget Management, FinOps Education & Enablement, Establishing a FinOps Decision & Accountability Structure, Cloud Policy & Governance and FinOps Intersection with other Frameworks. [17]

# **3** Cloud Cost Management

By moving to cloud every organization face not also some opportunities, but also some challenges to deal with. In this section the structure of the cloud bill and cost allocation regarding Tags, Labels and Accounts will be explained.

### 3.1.1 Anatomy of the Cloud Bill

One of the most interesting challenge on the cloud journey is understanding the cloud bill. Understanding the bill is the most important step to take action for the cloud cost management. So that it will be clear who should take action to optimize the cloud resources. It is vital to expertise over the billing report to take the right precautions about cloud cost optimization.

Firstly, the cloud billing data is complex and there is so much information with every single details. On the other hands it is updated not every day, but every second. Therefore, it is so essential for the organization to have at least one FinOps team member, who is specialized in data science. So that it will be easier to interpret the data and make recommendations for the other teams. By the help of the cost tools that are represented by the CSPs, organizations have the opportunity to analyze the billing data and have visibility of cloud costs. Nevertheless, these tools will not help if the organization uses multi-cloud environment.

# 3.2 Components of Cloud Billing Data

It will be easy to understand the billing format, if the most common characteristics of the three major CSPs' (AWS, Azure and GCP) cloud billing are grasped. Each row corresponds to the quantity of a specific cloud resource usage and the attributes indicate the usage for a specific time period. The rows will include the following titles:

- Time period
- Amount of the resource used
- Rate details used for the charge during that period
- Region
- The resource ID
- Metadata attributes like account or project that can be used to allocate the spend to a product [7]

These billing reports contain the most comprehensive data available. It is possible to break down the data according to a timeline (hour, day or month) or by cloud resource type or by labels/tags that are defined before. [18] The granularity of the data gives op-

portunity to the FinOps team to evaluate the data and find the exact solutions for optimization. For instance, it would be possible to detect anomalies when a parameter changed unexpectedly. When thinking about cloud cost management we should not underestimate the small changes, because in the long run some of the small costs will build a big financial burden for the company. Every second costs while using the cloud resources. Time is the most important component of the cloud billing. The user is charged for every second while using the compute service, for every GB of storage or for every query during the execution of the request. On the other hand, serverless services are not time-based, but volume based. Cloud has a variable spend model contrary to on-premises, where the cost is fixed. The compute service of a CSP is charged by how long the resource is used. In other words, the cost depends mostly on the usage hours of the resource. So, the classical monthly reporting of the costs does not make sense in the cloud computing. Since not all the months in a calendar year includes the same number of days. So, it is inevitable to have the cost in a just-in-time manner.

Another approach about cloud cost billing is that the cloud cost exists not by using the resource, but for the period when the cloud resource is on. So, it should be understood from the organizations that they are not buying the cloud services, but rather they are paying for the periods of the used services. It costs for every hour or sometimes every second of the available service. So, the customers of the cloud service providers are buying the time not assets.

#### 3.3 History of Cloud Billing Information

The history of the cloud billing data can show the importance of the comprehensive information that is served by the CSPs. To have a rough view about cloud billing, the historical billing progress of Amazon Web Services will be introduced.

In 2008 there were invoices that give monthly information at service level. The metadata, such as tags were not available to understand the cost drivers. After 2012 the Cost Allocation Report is published by Amazon to give the information tag value and each linked account. On the other hand, this report only gives data at a monthly manner. It was not possible to see the start and finish point of the cloud spending. In 2013 a new version of reporting is introduced by Amazon, which is Detailed Billing Report. With that report it could also be possible to see the time of the month that the cost occurred. This gives users the elasticity to see when cost changes within the month. In 2014 the Detailed Billing Report with Resources and Tags is released by AWS. Introduction of that reporting was a key advance in the reporting of cloud billing. In this billing system it is possible to see each cloud resource with every tag in a single column. On the other hand, the volume of the billing data reached to hundreds of gigabytes. With that comprehensive data it would become to make better recommendations about cloud cost optimization. In 2017 AWS

developed a new Cost and Usage Report (CUR) that makes it easier for programmers to evaluate the data, which is issued in a JSON format, not CSV (comma-separated values) format. In addition, CUR gives the advantage to notify the applied Reserved Instances (RI). So, the CUR makes it easier to understand the usage of RI. [7]

#### **3.4** The Importance of Timely Data and Commitment

Hourly or secondly data is so vital during cloud cost optimization. For best cloud cost optimization, the advantage of the committed resources should be used. While benefiting from the usage of reserved instances, it is so important to know the types of the cloud resource that are running during a period. Compared with the on-premises the rates are stable for a period, but when using the cloud resources, the rates depend on the usage of reserved instances, that means a discount supplied by the CSPs. It is also possible to reduce the total payment by prepayments. On the other hand, it is very essential to amortize the reserved instances and prepayments, not to give fake information to the leadership about the cost reduction.

As a result, if it is summarized, the cloud spending is calculated by the multiplication of the cloud usage and rate.

```
Cloud Spend = Usage x Rate
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Here usage stands for the number of hours/seconds that a resource is used and rate stands for the payment per hour/second for the usage of a specific resource. If one of these values are raised, then the cloud spend will increase.

In this context, an organization should find a way to optimize its usage in order to reduce the cloud spending. It can be done by terminating the idle resources, rightsizing the oversized resources, scaling down the resources that are rarely used or shutting down the unused resources during nights and weekends.

The second way to reduce the cloud spending is the rate reduction. To reduce the rates the organization should benefit from the advantages that are represented by the CSPs. The most famous ones are the Reserved Instances by AWS or Azure and Committed Use Discounts by GCP. Volume discounting is also an option which is based on usage like Sustained Use Discount that is offered by GCP. There are also some custom pricing options for large-scale users. There are also some cheapest spot instances, although there is a risk of sudden loss of the resource. It does not matter which option the company uses, but in the end, it will pay less for the cloud resources.

#### 3.5 Centralized vs Decentralized Cloud Organizations

If a company wants to use less, then it should decentralize the organizational structure. On the other hand, if a company wants to reduce the cloud usage rates, then it should centralize the organization.

In a decentralized organization application owners / developers are the most responsible employees about the cloud spend. They have the sufficient knowledge about shutting down or resizing the resources and reducing the type of the demand. They are familiar with the need of workloads, so they can easily decide, whether an idle instance should be terminated or not. To make the infrastructure decisions centrally is not an effective way when it comes to cloud cost optimization. So, it will be better to give the application developers the chance to take the responsibility to give the decisions about optimizing the cloud resources. On the other hand, they don't feel responsible about the centralized decisions regarding Reserved Instances (RI) or Committed Use Discounts (CUD). At that moment a centralized FinOps team can take action to monitor the entire cloud resources for the best opportunities to reduce spending.

The cost reduction by the help of the offerings like RI and CUDs are good options to reduce the rates. Besides it is not always easy to monitor all the cloud resources in one centralized organization. There are also some disadvantages of a centralized cloud cost management regarding the increase in the shared costs. However, it should not be forgotten that the highest cloud cost reduction is achieved by the central management of the cloud resources. For example, some of the teams can use the cloud resources at night and some can use the resources during the day. So, a central cloud team will be useful to see the 24-hour cloud usage and can decide to a committed/reserved resource. A FinOps team enables to avoid the usage of waste resources and encourages the optimization for all cloud teams.

There are also some handicaps regarding a centralized cloud team. The transactions between the teams who use cloud services can slow down by centralization. In order to avoid the bureaucracy, the organization should adapt automation of the processes. By the help of automated processes, the failure of the transactions will be reduced and the speed of the transactions will increase. [19] The centralized cloud team can collect usage data by monitoring the cloud resources with the help of some tools created by CSPs. The team can also generate some alerts that react as soon as the previously determined thresholds are exceeded. These recommendations can be forwarded to the developer teams by a message or by creating a ticket. This recommendation process should also be automized to increase the speed.

In conclusion, it is so essential that the FinOps team should understand the data that was supplied by the Cloud Service Provider. After analyzing the data, the team has to create a methodology to focus on the most important drivers that increases the cloud spending.

In addition, small changes in the cloud billing can cause in the long run bigger cost burdens, so the anomalies should also be detected automatically.

After the analysis of the cloud usage data and the identification of the anomalies, the cloud team should design a standardization process to optimize the key elements of the cloud spending. The automation of the organization depending on a consistent metrics regarding costs is also important to increase the speed of transactions between the teams. Standardization is also important to create a common language and to avoid conflicts that everyone in the organization should understand the same meaning when they look at the same numbers.

#### 3.6 Cloud Cost Allocation

During optimizing of the cloud costs, it is so important to know who is spending. Every cost should be allocated by using tags. Cost allocation is so vital to avoid waste. In order to increase the business added value, the organization should allocate every cloud spend to the responsible unit of the organization. This will increase the awareness of cloud cost optimization in the whole organization. The awareness also triggers the accountability for the cloud resources. On the other hand, it is not always easy to put everyone in the same motivation since each team in the organization has different targets to achieve. So, it is also important to create a strategy that everyone can contribute to the common FinOps culture and adopt the cloud cost optimization as a part of their work.

There are two approaches when we apply cloud cost allocation. If the actual cost that is incurred returns to the budget or profit/loss of an individual team. This methodology is called as chargeback. On the other hand, if the actual cost for each individual team is only showed and paid directly from a central budget, that is called showback. Both approaches require accountability for the teams, but chargeback is more effective than showback. Chargeback is also faster than showback and gives more freedom and also responsibility to each unit that uses cloud resources. Contrary, showback is easy to implement, so it fits to the organizations which are new in cloud cost management. [20] It is also possible to use a combination of both approaches, if the company is composed of many small independent departments.

According the third principle of FinOps, everyone takes ownership for their cloud usage. Depending on this principle there should not be any unallocated cost in an organization that tries to adopt FinOps. In this context, allocating the shared cloud costs is also a big challenge for most of the companies. If the company has a managed central budget, it could be less harmful between the teams. In addition, it may be sometimes not easy to be fair while allocating shared costs, if the company does not have a central budget. During the management of shared cloud costs, it makes sense to have a common budget that is funded from all units of the organization. On the other hand, if the organization wants to

allocate shared cloud costs, there are some options to take in action. The organization can divide the total shared costs between each unit according to the direct costs that belongs to each individual unit or it can allocate the shared costs regarding the fixed percentages that is agreed before the sharing process. [21]

Another challenging, but also important topic about cloud cost allocation is the amortization. Some of the cloud costs, for example committed/reserved resources, are paid partly in advance and during the use of the resources the charge of the cloud expense is incurred. So, it is vital not to record these costs regarding the time of the invoice, but to record the costs during the period of cloud resource usage. [22] Therefore, the cost of a Reserved Instance should be shared inside the period when the compute service usage is realized. The payment in advance can be divided into per hour spend and then the cost can split per hour over the usage period. So, it is needed to have a schedule for each reservation.

### 3.7 Using Tags, Labels and Accounts for Cloud Cost Allocation

Cloud cost allocation is so important to give the right decisions for the future and even to make appropriate suggestions for cloud cost optimization. If the organization matures during the FinOps cycle, then the better allocation of the cloud costs leads to a better forecasting for the future budgets.

The cloud bill includes comprehensive data about cloud usage, but it is also important to know exactly about who owns the cloud cost in the organization. An organization cannot easily extract the ownership information from cloud bill. So, this information should be added in the cloud environment by tagging. AWS uses the terminology Tags to define the key/value pairs assigned to cloud resources. On the other hand, in GCP Labels correspond to the Tags in AWS.

In the cloud terminology, the resource groups are the atomic units of organization in each of the cloud service provider. In general, these resource groups are called hierarchy-based resources. They are called in AWS as Accounts, in Azure as Subscriptions or Resource Groups and in GCP as Projects. Tags, labels and other metadata are used to associate the values with the resources or resource hierarchy. Some examples of the Labels belonging to GCP Projects are shown in Figure 1.

=	Google Cloud Platform		Q Search res	ources				×	v 🛛 🖸 0 i 🚺
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	minion-nonprod-gss-image-repo	gx-nonprod-gs	June 3, 2022			legal-entity : gss scope : minion stage : nonprod	-	:	
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RE	SOURCES PENDING DELETION								

Figure 1: Project Labels in GCP [23]

In this paper the terminology that are used by AWS is utilized. "Account" refers to the resource hierarchy and "Tags" corresponds to the cost allocation metadata. Organizations often at first choose to allocate costs by account, because it is easy for everyone to understand. The costs that are not belonging to a tag also represented in an account. Tagging is useful when an account is used for multiple purposes. AWS enables to allocate tags to accounts and GCP also makes it available to add tags on projects.

Account-based allocation is the most used method of dividing costs. Azure Management Groups, AWS Organizations, multi-layered GCP folders make it easier to manage costs. Grouping the cost allocations depending on a hierarchy is called a hierarchy-based approach to manage the cloud costs. Besides, if each resource is monitored by tagging them, then it is called a tag-based approach. It is also possible to use both methods when the organization has a complex cloud environment. On the other hand, sometimes the CSPs do not support some of the cloud resources to be tagged. Then the costs belonging to these resources could be shown as untagged in the reports.

The most effective approach in cost allocation is using not only hierarchy-based, but also tag-based strategy. By using a hierarchy-based approach an organization can get the untagged costs and tag-based approach enables a more granular view of the costs. It means that if the organization wants to allocate the costs to the most essential departments, it will be sufficient to use accounts for allocation, but if the company wants to dig deeper, it needs to apply tagging. The companies that is more professional in cloud cost optimization uses tagging for almost every cloud resource to have a clear view of the cloud spending.

There are a lot of advantages to use tagging for the cloud resources. If a company wants to divide its ongoing accounts into test and production environments, it can separate the accounts into functional units and tag them as production or non-production accounts. By the help of tagging, it will be possible to know which costs belongs to the resources that are used by non-production services. So, the FinOps team can give suggestions to the engineering teams to shut down the non-production services when they are not in use.

It is also important to gather information about the required actions and restrictions to apply tags to the cloud resources and accounts. Some of the CSPs need some action to reflect the tags in the cloud billing. Table 1 shows which terminology each CSP uses and how it manages tagging for the cloud resources.

	AWS	Google Cloud Platform	Microsoft Azure
Hierarchy	Linked accounts	Folders and projects	Subscriptions
Key/value pairs	Tags	Labels	Tags
Number of tags per resource	50 (some services allow only 10)	64	50 (some services allow only 15)
Tags automatically allocated to your detailed billing data	No—manual selection required	Yes—some limits apply	Yes—some limits apply
Tag restrictions	Some services limit supported characters	Lowercase letters, numeric characters, underscores, and dashes	Some characters not supported
Tags can be applied to	Most services' resources (constantly changes; see AWS documentation for all current details), accounts (via AWS Organizations)	Most services' resources and projects	Most services' resources, Azure resource groups

 Table 1: Comparison of Tagging between CSPs [7]

In addition, tagging terminology is also an important issue to achieve a standardization for tagging. If an organization does not have a standard for tagging, then it will not be easy to manage the cost allocation. It is important to have a deep understanding of the cloud costs at each level of the cloud resource, but if there is not a tag standardization in the company, then it will not contribute to the aim of cost optimization. In this manner, it is a good way to automate the infrastructure with Ansible, Terraform or CloudFormation to manage the tagging policy centrally.

In conclusion, tagging enables companies to be aware of the cloud costs in details when they get the cloud billing as separated into each individual group that uses the cloud services. This will allow the organization to detect the anomalies as soon as they occur. On the other hand, it is also possible to get the required and selected tags reflected in the cloud billing, so the organization can select and compare the units with each other.

# 4 Summary and Conclusion

In this paper I have explained the principles of FinOps and focused on the importance of Cloud Cost Allocation and Tagging. By the help of a well-structured organization and a well-organized FinOps team it will be easy to adopt FinOps and to achieve the cloud cost optimization. To see the granularity of cloud spending tagging is a vital tool that is introduced by CSPs. While implementing tagging for the cloud resources the organization should regard standardization of tags to better manage the cloud cost allocation. Automation tools like terraform can be used for the sake of standardization.

# **List of References**

[1] Gartner Says Worldwide IaaS Public Cloud Services Market Grew 40.72020. https://www.gartner.com/en/newsroom/press-releases/2021-06-28-gartner-says-worldwide-iaas-public-cloud-services-market-grew-40-7-percent-in-2020 . – [Online; accessed 19. October 2022]

[2] Patrick Thibodeau. A third of virtual servers are zombies. <u>https://www.comput-erworld.com/article/3196355/a-third-of-virtual-servers-are-zombies.html</u>. – [Online; accessed 22. October 2022]

[3] The Cloud Is Booming - But so Is Cloud Waste. <u>https://devops.com/the-cloud-is-booming-but-so-is-cloud-waste/</u>. – [Online; accessed 25. October 2022]

[4] What is FinOps. <u>https://www.finops.org/introduction/what-is-finops/</u>. – [Online; accessed 26. October 2022]

[5] Principles. <u>https://www.finops.org/framework/principles/</u>. – [Online; accessed 30. October 2022]

[6] FinOps Foundation Principles. <u>https://github.com/finopsfoundation/defini-</u> <u>tion/blob/main/principles.md</u> . – [Online; accessed 01. November 2022]

[7] J. R. Storment, Mike Fuller: *Cloud FinOps*, California, 2019

[8] What is FinOps. <u>https://www.ibm.com/topics/finops</u> . – [Online; accessed 04. November 2022]

[9] An Introduction to FinOps. <u>https://www.hyperglance.com/blog/finops/</u>. – [Online; accessed 05. November 2022]

[10] FinOps team: roles and responsibilities. <u>https://hystax.com/finops-team-roles-and-responsibilities/</u>. – [Online; accessed 07. November 2022]

[11] FinOps Domains. <u>https://www.finops.org/framework/domains/</u>. – [Online; accessed 10. November 2022]

[12] Understanding Cloud Usage and Cost. <u>https://www.finops.org/framework/do-mains/cloud-usage-and-cost/</u>. – [Online; accessed 11. November 2022]

[13] Performance Tracking & Benchmarking. <u>https://www.finops.org/framework/do-</u> mains/tracking-and-benchmarking/ . – [Online; accessed 13. November 2022]

[14] Real-Time Decision Making. <u>https://www.finops.org/framework/domains/real-</u> <u>time-decision-making/</u>. – [Online; accessed 15. November 2022]

[15] Cloud Rate Optimization. <u>https://www.finops.org/framework/domains/cloud-</u> rate-optimization/ . – [Online; accessed 16. November 2022] [16] Cloud Usage Optimization. <u>https://www.finops.org/framework/domains/cloud-usage-optimization/</u>. – [Online; accessed 19. November 2022]

[17] Organizational Alignment. <u>https://www.finops.org/framework/domains/organiza-</u> tional-alignment/ . – [Online; accessed 21. November 2022]

[18] What are AWS Cost and Usage Reports? <u>https://docs.aws.amazon.com/cur/lat-est/userguide/what-is-cur.html</u> . – [Online; accessed 22. November 2022]

[19] Centralize or Decentralize? <u>https://aws.amazon.com/de/blogs/enterprise-strat-</u> egy/centralize-or-decentralize/ . – [Online; accessed 26. November 2022]

[20] IT Chargeback vs Showback: What's The Difference? <u>https://www.bmc.com/blogs/chargeback-vs-showback/</u>. – [Online; accessed 30. November 2022]

[21] Managing Shared Cost <u>https://www.finops.org/framework/capabilities/manage-shared-cloud-cost/</u>. – [Online; accessed 02. December 2022]

[22] FinOps Terminology <u>https://www.finops.org/resources/terminology/</u>. – [Online; accessed 06. December 2022]

[23] Google Cloud Console <u>https://console.cloud.google.com/cloud-resource-man-ager?orgonly=true&project=istsne-dev1-nonpod-001&supportedpurview=project&pli=1&rapt=AEjHL4Nd\_xyBvvdvFW-ZFsiJOdfyH-zOYkcdMY\_VKC50xON89rSVAOfbzCUti7CqfZBkZjfgEbUoYQI-ZZ-DnCU998wCSI3GPA . – [Online; accessed 09. December 2022]</u>