Time to Value: Bespoke Smart Cloud Economics

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I. Introduction

Evolution and diversity of cloud have instituted the   concept of **Cloud Economics**. Cloud economics encompasses value organization derives on moving to cloud , with trade-offs between Hard and Soft - Costs and benefits.This model evaluates clouds   inherent capabilities of quick provisioning, ease of implementation, allowing shorter time-to-market for software and bringing customer value. The capability is generic to all three cloud platforms covered in the article.

With changing customer behavior, it is essential to channelize customer fascination and translate to valued services for customer engagement, this is key to boost market share and derive business value for - small, medium and largesize organizations.

It enables a culture and operation shift — to increase an organization's ability to understand cloud costs and make tradeoffs. In the same way that DevOps revolutionized development by breaking down silos and increasing agility, and SRE with concept of robotics and automation to optimize Production and enhance performance and stability, Cloud economies increases the business value of cloud by bringing together technology, business and finance professionals with a new set of processes.

As part of research - study was conducted on sample population of 50 Organizations of small, medium and large size, who were interviewed on their experience on Cloud Migration Journey. Most of the standards and best practices are driven part of analysis and recommendations from the research conducted. This article will be useful for the Organizations who are planning to undertake Cloud Journey and looking to establish strong Cloud Economics framework.

80% of respondents acknowledge poor cloud financial management has had a negative impact on their business. 73% still manage cloud using a capex rather than opex model. 85% of respondents report overspending their budgets. A majority (67%) say cloud cost management is a daily worry. 75% rely on spreadsheets and manual tracking or cloud vendor portals or have no visibility into cloud costs. 62% of finance says they overspend on cloud compared to 37% of IT - showing a clear lack of alignment

II. Cloud Transformation Models

There are several ways an Organization can plan to move to Cloud, this section gives insight on transformation models analyzed from study to create business Value .

1. Homogeneous Lift and Shift

A lift-and-shift migration is exactly what it sounds like: lifting an application or landscape out of its current hosting environment and shifting it to another environment — for example, from on-premise hosting to a public cloud. Lift-and-shift migrations transport an exact copy of the top three layers: application, database and OS layer. This is also commonly called as 'Rehosting" , because it involves moving your stack to a new host without making extensive changes. This enables a rapid, cost-effective migration, minimal disruption and quick ROI.

A lift and shift from on-premise to cloud hosting also increase agility, simplifying future transformation. This makes it a good first step for businesses with a conservative culture, or indecision about long-term cloud strategy. 42% of Companies who undertook the journey weighed the quick payoff and low disruption of a lift and shift against the greater benefits of a more transformative cloud migration strategy.

2. Technical Migration

In technical migration existing applications undergo the OS, 3rd party software's and Databasesupgrades to meet certain transformational goals. As a cloud migration strategy, this is often done in phases in order to harness cloud native features such as scalability or automation, but it also has other benefits. For example, migrating from on-premise Linux 6.x to Linux 7.x in the public cloud gives organizations the benefit from latest OS and DB Versions and dramatically increased performance, in addition to the benefits of extended EOL on public cloud.

Cloud provides several options on software license policy - bringing your own licenses or buying AMI from Open Market or using the Public Cloud offerings of native technologies offered.

For example –in case of databases for OLTP system,Oracle RDBMS On-Prem to Oracle Enterprise on Cloud under BYOL (Iaas), or move to AWS OracleRDS or Azure SQL Server (PaaS), which provides shared responsibility model , and assists easy administration capabilities. This enables the organization to minimize disruption and gain experience in the cloud, which they can use to plan the next stage of their transformation.

3. Application Migration

In an application migration, the application layer is transformed, along with the OS and DB. There are three provenstrategies for application migration: new system implementation, system conversion and landscape transformation.

New System transformation

New system implementation involves transforming from Legacy to new software system. Although data is generally preserved and transferred in this process, the applications are either rebuilt from scratch by developers, or replaced with new, off-the-shelf applications. This can be a complicated process. The organization needs to ensure that all functionality is replicated by the new system, along with business process flow.

Old data must be audited, discarded where appropriate and reformatted to work with the new system. On top of that, there's the requirement to retrain the team in a new suite of applications, which might function quite differently from the previous application stack. In some scenarios this cloud migration strategy was found to be the most cost-effective choice.

19% organizations under study,traversed this strategy for upgrading from a highly customized legacy landscape with poor documentation, reason -auditing the code and designing an upgrade and migration path was more costly and time-consuming than rebuilding the landscape. The new system implementation is also the correct strategy for organizations who wish to switch to a new application stack, rather than staying with their existing vendor.

The benefits of a new set of cloud-native tools often outweigh the costs of adapting to a new system — particularly for development:Rebuilding requires losing the familiarity of existing code and frameworks, the advantage of rebuilding an application is access to innovative features in the provider's platform. They improve developer productivity, such as tools that allow application templates and data models to be customized, metadata-driven engines, and communities that supply pre-built components.

System Conversion

This is famously called as brownfield migration, a system conversion transforms your application layer, along with the DB and OS layers. The process may involve extensive changes to the way your landscape is run and managed as well as the landscape itself. Upgraded system has greater automation and require different competencies than respective on-premise legacy system.

Landscape Transformation

A landscape transformation combines a system conversion with a significant change to the way your landscape is structured. Landscape transformation scenarios which companies used were :

a)   Combining multiple enterprise system landscapes into a single system to meet the needs of a business consolidation

b)   Splitting off segments of your data along with certain functional components for a divestiture

c)   Upgrading and migrating multiple regional implementation landscapes into a single, global landscape

Landscape transformation enabled to meet business goals, technical and functional upgrade requirements with a single upgrade process. This can significantly accelerate transformation, reduce overall downtime and control costs when compared to multiple projects.

Analysis -Study conducted showed most of the enterprises preferred to breakdown there systems to Customer facing applications -Frontend and Backend   areas based on functional aspects , which helped them to identify the low hanging fruits for cloud Transformation. The evaluation of benefits/value on moving to Cloud and Speed – Combination of ease and time with which they could move to cloud were done to select appropriate applications . Most of the respondents mentioned that having Front end / UI on cloud allowed to harness benefits of Cloud global networkdistribution channels , buffering and caching technologies and autoscaling abilities available on the cloud - which increased their reach and also helped in improving customer experience multifold .

III. Data Centre Economics

The data center cost comprises of -direct cost, administrativecost and Indirect cost

Direct Costs : Direct costs are the ones that enterprise pays outright and directly hits the balance sheet – they are the Data Centre Costs. This includes physical servers, software licenses, maintenance contracts, warranties, supplies, material and spare parts.It also includes the Power supplies, racks and other logistics which comes with operation on-premises data center , Also including facilities used to house IT hardware, staff needed to maintain these facilities, real estate costs, and other facilities-related costs.Networkor Internet connectivity Costs and any other costs that can be attributed to upkeep of your IT and Data Center cost

Administrative Costs: Administrative costs are necessary to maintain your IT department. These can include the resources from your Finance, HR, and Procurement departments that are dedicated to managing your IT staff or outside service providers. The IT Staff cost to upkeep of the system.

Indirect Costs: Indirect costs may be more difficult to calculate but are just as important as direct costs. The largest source of indirect costs is the downtime and loss of productivity your employees and customers suffer if your IT infrastructure goes down. You can calculate these costs by reviewing log files to determine how often your servers go down and for how long and multiply that time by an average hourly rate. If you can estimate the revenue your company might lose due to downtime, that should be included as well.Indirect costs can be difficult to estimate, but are very important to consider, as they can make up a significant portion of overall IT costs.
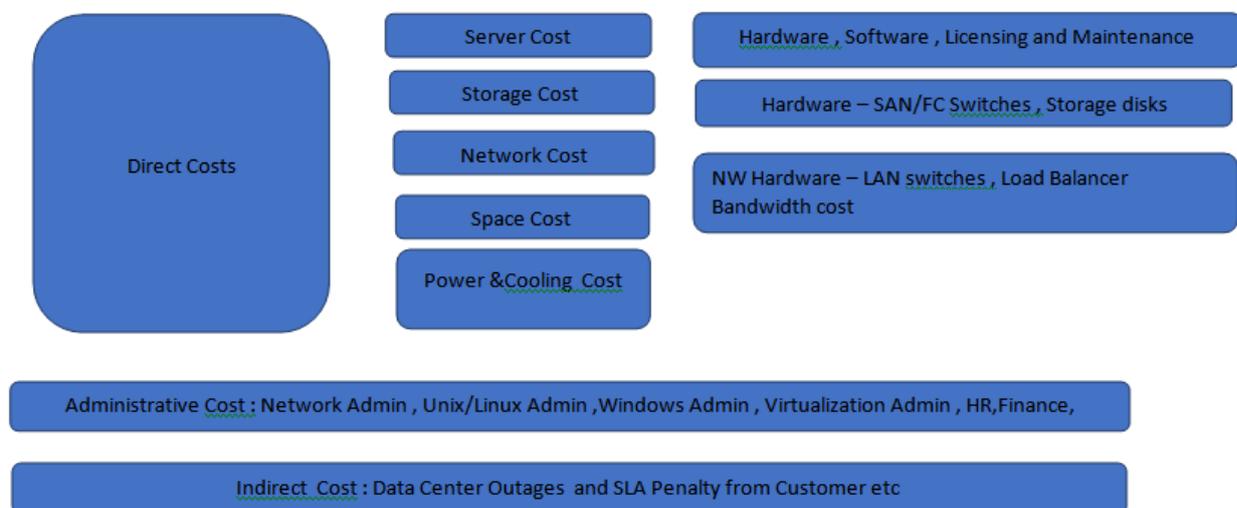
Fig 1: Data Center Cost

Cloud reduces all these costs. It remove capital costs of infrastructure and the maintenance cost and reduces administrative cost to great extent .**I**ndirect Costs can be avoided by building HA and DR within your Cloud architecture.

IV. Design Cloud Strategy

Decide the Cloud Migration Plan

By establishing cloud migration priorities and objectives before planning, you can ensure a more successful migration. Automated cloud migration tools will also provide insights into your environment and dependencies to build out your cloud migration project plans. Assess your environment now to build a template for future use that aligns to individual apps, locations or groups within your organization. Start with applications that are expected to have few dependencies to get your migration moving quickly.

Design for Cloud

Create blue print for -Production, On-Production and Landing Zone that will be used for connecting from corporate network. Thebasic principle to be taken into consideration "Design small or optimal and then expand" .A landing zone is a configured environment with a standard set of secured cloud infrastructure,

policies, best practices, guidelines, and centrally managed services. It is used to host the centralized infrastructure management for security ,performance-monitoring tools , System Management ,networking and identity management tools .

Hybrid Cloud

Hybrid Cloud technology is useful, when full transition from On-Prem to Cloud is not required , however the capabilities of On-Prem and Public Cloud are harnessed to harness value – on Data Center extension to cloud , Disaster Recovery . Cloud services on premises allows - Extend Cloud services to any data center, co-location space, on-premises datacenter so customers can utilize infrastructure, APIs, services, and tools to run applications with low latency or local data processing requirements..

Determine TCO on Cloud

Assess the current Usage pattern of the On -Premises Infrastructure with On-Prem TCO calculator, rationalize with Optimal ;Evaluate the Cloud Cost based on the Capacity and Infrastructure you plan to provision using TCO calculator provided by public cloud .The potential cost savings of migrating to cloud by comparing your total cost of ownership (TCO) for Cloud with on-premises . TCO calculator will build a customized cloud assessment in a matter of minutes that will help create a personal business case to support aCloud migration.

Organization Structure for managing Cloud

As you build Cloud Strategy, one of the important factors is to create Human Capital ready for Cloud [1]. It is also important to build culture-sensitivity within organization for Cloud finances, so that teams are aware and cautious with provisioning and usage on Cloud. Some of the basic principles for it are:
1.   Build Cloud Competency:Cloud competency of excellence (CCOE), formedwith representatives from Applications, Infra/ IT, Testing , financial analyst and Management stream. CCOE enables central IT to express the CIO's cloud strategy, enables the business to choose the best solutions, provides governance through policies and cloud management tools, and gathers and disseminates cloud best practices. And finance to calculate the cost projections and alignment with quarterly /yearly spend .
2.   Build Transparency and Accountability:There needs to be transparency on solution provisioned on cloud and its Usage pattern. COE hasto create cloud-computing-related policies and select governance tools. It will review and takes decision together regarding the Deployments. COEholds accountability onsolutioning, sizing, provisioning and monitoring systems .
3.   Weekly Reporting of Costs
Build mechanism for Weekly evaluation on Cost and Value and determine area of financial leaks and wastage. Have CCOE evaluate the architecture, workload flow and usages to make decisions based on-KEEP, CHANGE orDISCARD to optimize system , on regular basis .

V. Managing CloudEconomics on Various Platforms

Statistics
The study shows that poor cost management negatively impacts the business objectives. Respondents reported that the budget was inappropriately expend as below
Waste on unused resources - 40% ,Sub-optimal service levels – 32% ,Cloud Migration slowed down – 30%,Innovation negatively impacted – 15%,Cloud migration halted – 25%
None Of the above -20%

*Majority of the companies are concerned on Cloud costs :*78% of respondent were concerned on the cost management practices. 69% spend 50 – 100 % more than budget ,11% spend 25 -50% more than budget , 5% spend more than 100-200% more than budget .

Majority rely on spread sheets to manage costs : 38% manually extract cost information from cloud providers and aggregate into a single view, such as a spreadsheet, 12% - use a third-party tool that aggregates and reports all our costs ;35%- rely on cloud providers' own portals for visibility , have no single view of all cloud costs across multiple providers .

*Economic decline in Covid-19 phase will not impact cloud spend :*90% of respondents believe we are approaching a recession ; 85% say a downturn won't impact their cloud investment; 30% plan to invest even more in 2021.

Based on studyconducted among 50 Organizations working with diverse Cloud platforms – AWS, Azure and GCP, best practices have been formulated based on their implementation experience

Comparative Strengths

Based on the Analysis from the study following Strengths and Challenges were faced by the Organizations during theirCloud journey.

Cloud Provider	Strengths Feedback	Challenges Feedback
AWS	- Dominant market position - Extensive, mature offerings - Support for large organizations - Extensive training - Global reach	- Difficult to use - Cost management, not straightforward. - Overwhelming options.
Microsoft Azure	- Integration with Microsoft tools and software. - It has broad feature set. - Hybrid cloud. - SLA centric. - Support for open source.	- Documentation is not comprehensive. - Management Tooling has limited scope and features
Google Cloud Platform (GCP)	- Designed for cloud-native businesses. - Commitment to open source and portability. - Deep discounts and flexible contracts - DevOps expertise	- Late entrant to IaaS market. - Fewer features and services - Historically not as enterprise focused

Smart Cloud Economics
The section provides practical best practices from the study of 50 Organizations to optimize cloud spend when working on different platforms.

Amazon Web Services

1.   Stop Paying for Idle Resources -EC2 and RDS Instances
If the resources are provisioned and are not used 24*7, then you must setup monitor to identify -when they are not getting used .
EC2 Instance, are up on weekends, holidays and evenings, and if you are paying for them when they are idle , Then take decisions to shutdown during this period to have savings . AWS Instance Scheduler Can help in scheduling the Downtime and uptime of EC2 and RDS when they are required, so that you actually pay for what is required. This can be useful for Non-Production resources. This helps in reducing up to35% of the cost.
2.   Resize the Redshift Elastic Cache
Elastic Cache is expensive component and should be best fit , Check if you can Elastic Resize to optimize the sizing per need , Pause and resume to use On-demand ability . 35% Savings on usage.
3.   Enable Amazon S3 Intelligent Tiering
If S3 Storage Class is being used, you may be paying for the S3 storage you don't use. If Lifecycle policies are not implemented for S3 Storage,then it is pertinent to enable the S3 Intelligent Tiering, which will access and analyze the access pattern of the objects and will move the objects not being used for last 30 days to Infrequent access tier , which is at lower cost storage .
This is useful, when the access patterns are not known. This helps to save the lifecycle cost. AWS quotes that it saves 20-30% cost.70% of the respondents confirmed they saw benefit as they applied .
4.   Use Amazon Dynamo DB On demand to save costs.
5.   Stop Paying for Underutilized EC2 Instances
If you are running EC2 Instances, which are less than 40 % CPU utilized, then you are overprovisioned .Use Cost Explorer to identify resource overprovisioned, and check recommendations to suggested sizes or shutdown. Analyze the recommendations and take actions in context of the Applications you are running.
6.   Cleanup Underutilized Network resources
Route 53, EIP and ELB are chargeable resources , you are paying for them if they are not fully utilized . Check if there are resources created as part of POC's and test setup – and they are not cleanup after the desired use.

AWS Trusted Advisor can help identify underutilized network resources, which are not linked with active accounts.

7.   Compute Saving Plans

In this you commit to Fixed Compute Usage plan in AWS and Allows the Workloads to move from EC2 to Fargate or Lambda and you continue to get discounts. You can choose 1 year no upfront compute saving plan .

Take the starting point as AWS Cost Explorer recommendations for EC2 compute and get started with this option. It can give up to 54% savings, breakeven 7-9 months.

8.   Reserved Instances

You have RDS, Redshift, Elastic Cache and Elastic Search workload that are always on , Reserved instances can help save cost on those instances ; when you commit .Specific usage and family. With 1 yearcommitment you save up to 42% cost as compared to On Demand.
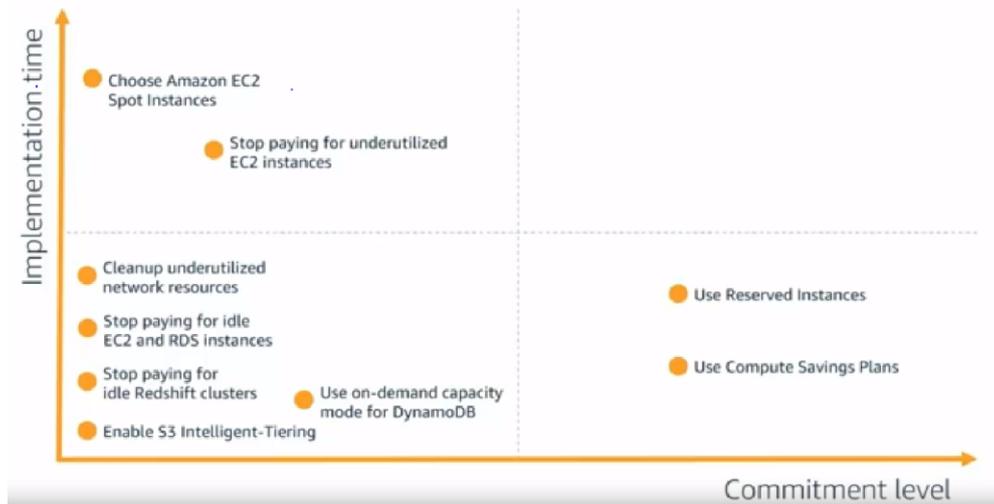
Fig 2: AWS

AWS has developed hardware and software that is optimized for large-scale clouds. They have acquired manufacturers of customer servers and net gear, delivering capabilities required for largescale deployments. Similarly, through direct purchases of disk, memory, and CPU, AWS can drive economies of scale that are otherwise difficult to replicate. AWS helps customers reduce large capital investments with lower variable costs. AWS also gives customers the opportunity to work on their own terms without long-term lock-in, reducing the risks from unplanned capacity and demand. AWS helps finance teams plan and forecast more effectively, while giving IT teams the capacity and resources they need, even during peak periods.

Microsoft -Azure

1.   Cut Out Waste using AZURE Advisor

Review usages regularly withAzure Advisor. It is a service that, among other things, identifies virtual machines with low utilization from a CPU or network usage standpoint. From there, you can decide to either shut down or resize the machine based on the estimated cost to continue running the machines. Advisor also provides recommendations for reserved instance purchases. The recommendations are based on your last 30 days of virtual machine usage. When acted on, the recommendations can help you reduce your spending.

2.   Size your VM's properly

VM sizing has a significant impact on your overall Azure cost. The number of VMs needed in Azure might not equate to what you currently have deployed in an on-premises datacenter. Make sure you choose the right size for the workloads that you plan to run.

3.   Use purchase discounts

Azure has several purchase discounts , which organizations can make use of .

4.   Azure Reservations

Azure Reservations allow you to prepay for one-year or three-years of virtual machine or SQL Database compute capacity. Pre-paying will allow you to get a discount on the resources you use. Azure reservations can significantly reduce your virtual machine or SQL database compute costs — up to 72 percent on pay-as-you-go prices with one-year or three-year upfront commitment. Reservations provide a billing discount and don't affect the runtime state of your virtual machines or SQL databases.

5.   Use Azure Hybrid benefit

If you already have Windows Server or SQL Server licenses in your on-premises deployments, you can use the Azure Hybrid Benefit program to save in Azure. With the Windows Server benefit, each license covers the cost of the OS (up to two virtual machines), and you only pay for base compute costs. You can use existing SQL Server licenses to save up to 55 percent on vCore-based SQL Database options. Options include SQL Server in Azure Virtual Machines and SQL Server Integration Services.
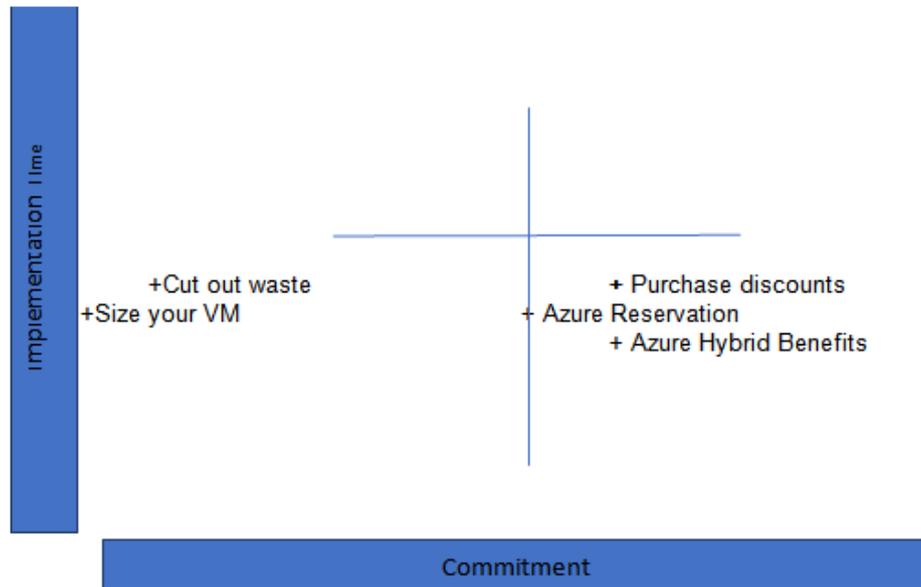
Fig 3: Azure

Google Cloud Platform

1.   Identify Idle VM's and Disks .

The easiest way to reduce your Google Cloud Platform (GCP) bill is to get rid of resources that are no longer being used. Think about those proof-of-concept projects that have since been deprioritized,

Recommender (GCP Tool) – Each Recommender helps admins optimize Google Cloud resources by making proactive, actionable recommendations with a data-driven machine learning approach. This empowers to automatically detect issues like overly permissive access or wrongly sized VM instances or idle resources.

2.   **Rightsized VMs**: On Google Cloud, you can already realize significant savings by creating custom machine type with the right amount of CPU and RAM to meet your needs. But workload requirements can change over time. Instances that were once optimized may now be servicing fewer users and traffic. To help, our rightsizing recommendations can show you how to effectively downsize your machine type based on changes in vCPU and RAM usage. These rightsizing recommendations for your instance's machine type (or managed instance group) are generated using system metrics gathered by Cloud Monitoring over the previous eight days.,

3.   **Leverage preemptible VMs**: Preemptible VMs are highly affordable compute instances that live up to 24 hours and that are up to 80% cheaper than regular instances. Preemptible VMs are a great fit for fault tolerant workloads such as big data, genomics, media transcoding, financial modelling and simulation. You can also use a mix of regular and preemptible instances to finish compute-intensive workloads faster and cost-effectively, by setting up a specialized managed instance group.

4.   Select appropriate instance storage

On the Google Compute Engine, If you select a 50GB drive, you will be charged for that drive even if your apps use only 5GB. Design your applications to move data that is not required locally to lower cost storage such as Cloud Storage Standard, Nearline or Cold Line tiers.

5.   Select the most appropriate Google Cloud Storage tier

Google offers several tiers with different levels of redundancy, availability and ingress/egress costs. Be sure to select the tier that is most appropriate for each workload:

Multi-regional redundancy—suitable for frequently accessed, mission critical data

Regional redundancy—suitable for frequently accessed, important data

Nearline—suitable for data accessed less than once per month

Cold Line—suitable for data accessed less than once per year

Smart Cloud Economics Index

The Index is devised on collective cloud capable organizations data based on research , and provides a quantitative benchmark for cloud excellence based on criteria such as purchasing efficiency, provisioning optimization, resource utilization and infrastructure tagging.

Pricing of Resource - Percent spend on Demand resource

High performers are able to drive down the unit economics of cloud by minimizing costly on-demand pricing and taking advantage of discounted public cloud pricing, such as Commitments, Reserved Instances (RIs) and Spot.

Rightsizing
Percent of infrastructure resources which are over provisioned. High performers operate with more optimally sized infrastructure and fewer over-provisioned resources.

Elasticity
Percent of idle or wasted infrastructure. By obtaining visibility into their workloads, high performers have fewer idle resources and less waste.

Tagging
Average number of tags or categories used to describe the infrastructure. The volume of tags used to describe an organization's cloud infrastructure enables high performers to perform more granular cost management.

Agility
The velocity with which the Application developed and deployed to generate revenue. The high performers are able to deploy applications in shorter cycles , giving them ability to generate revenue and get more business continuously .

VI. Smart Cloud Economics Maturity Model

Cloud assists organizations to ease Operational aspects and reduce the IT and Infra Cost , at the same time opening opportunities for -Agility, shorter time to market , help Organizations increase market share, increase stability of Production System , give ability to scale -up and scale-in as per demand , give robust business continuity and disaster recovery capabilities and improve Global footprint . The Cloud Economics is sum up of Total Cost Of Operation and the ROI benefits derived from Cloud. In other words, the faster an industry needs to change, the more value cloud brings. We see that a company's cloud financial maturity on their cloud investment follows a consistent flow as the company matures. Companies early on in their cloud journey are focused on identifying hard costs and other clear cloud value drivers, which are easier to identify but provide a limited perspective to total ROI. Figure 4 depicts these considerations in light blue at the beginning of the spectrum. Evaluation of Value and Speed with which you transform software ecosystem to Cloud, As companies mature through their economic analysis and cloud adoption journey, their financial maturity increases as they start to understand the value of agility and other soft costs, which are depicted in dark blue .

On Going Support (MSP)	Understanding On-Prem Costs and factoring using TCO Calculator	Depreciation impacts to accounting	Platform and Environment buildout and monthly usage using TCO	Business Agility and Global Capabilities	Reputation and Brand Value
Infrastructure Costs(Compute, Network, Storage)	Identifying Applications to Retire	Migration Costs (Application and Data)	Capex Vs OpeX Impacts	Improved Availability,Redundancy and security	Automation,SRE, Agile and Artificial Intelligence to build smooth processes and Cloud economy
Right-sizing Application Footprints for Optimizations	Cost Saving Methods implementation (Sustained Usage etc)	Data Centers shutdown cost		Application Cost Allocation and tracking ROI	Developer Productivity Impact on Revenue.

Less Mature   More Mature

Fig 4: Cloud Maturity and ROI

VII.   Conclusions

As organizations mature on Cloud Journey managing Cost of operations and reaping benefits is way forward. Investment on the automation and Artificial intelligence to utilize experience, usage patterns and optimization techniques to manage their economy of scale. Build cloud economists as part of CCOE, he/she is an expert in cloud economics: principles, costs, and benefits. Cloud economists help businesses forecast their costs and savings for a new cloud solution. A TCO business case analysis from a cloud economist can serve as an invaluable decision-making resource.COI(Cloud economic Index) provided will help organizations navigate their cloud journey , to reach the maturity levels .

Refactoring Applications on Cloud Native technologies,Retraining teams andVendor-lock-in once the applications begin to leverage cloud vendor proprietary functionality will be part of journey .Once you have moved to cloud vendor and started using their proprietary functionalities it becomes very difficult to change vendors or even move workloads back on-premise, hence assessment and strategical decisions need to be continuously made. Need to start viewing abstraction layer on top of Cloud Provider platform, which will allow common tooling and software's and allow the workloads to easily move between the Cloudecosystems for better economics and customer experience .

References

[1].   "Time To Value : Harnessing Human Capital in Digital Age :Author -Dr Zeenat Alam ",http://www.iosrjournals.org/iosr-jbm/papers/Vol20-issue1/Version-2/J2001027175.pdf
[2].   "Cost Management Best Practices",https://docs.microsoft.com/en-us/azure/cost-management-billing/costs/cost-mgt-best-practices
[3].   "Nine Ways To Reduce Bills " ,.https://pages.awscloud.com/Nine-Ways-to-Reduce-Your-AWS-Bill_2020_0008-CMP_OD.html>
[4].   "Smart   Cloud :   A   Framework   for   Cloud   Native   Applications   "   -Jalal   Hasan   Ahmed   Al Kiswanihttps://www.cse.unr.edu/~fredh/papers/thesis/PHD-014-Jalal-Kiswani/dissertation.pdf